DOE/EIS-0281

SANDIA NATIONAL LABORATORIES/ NEW MEXICO

VOLUME I

CHAPTERS 1-14

SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT

OCTOBER 1999

Organization of the Site-Wide Environmental Impact Statement

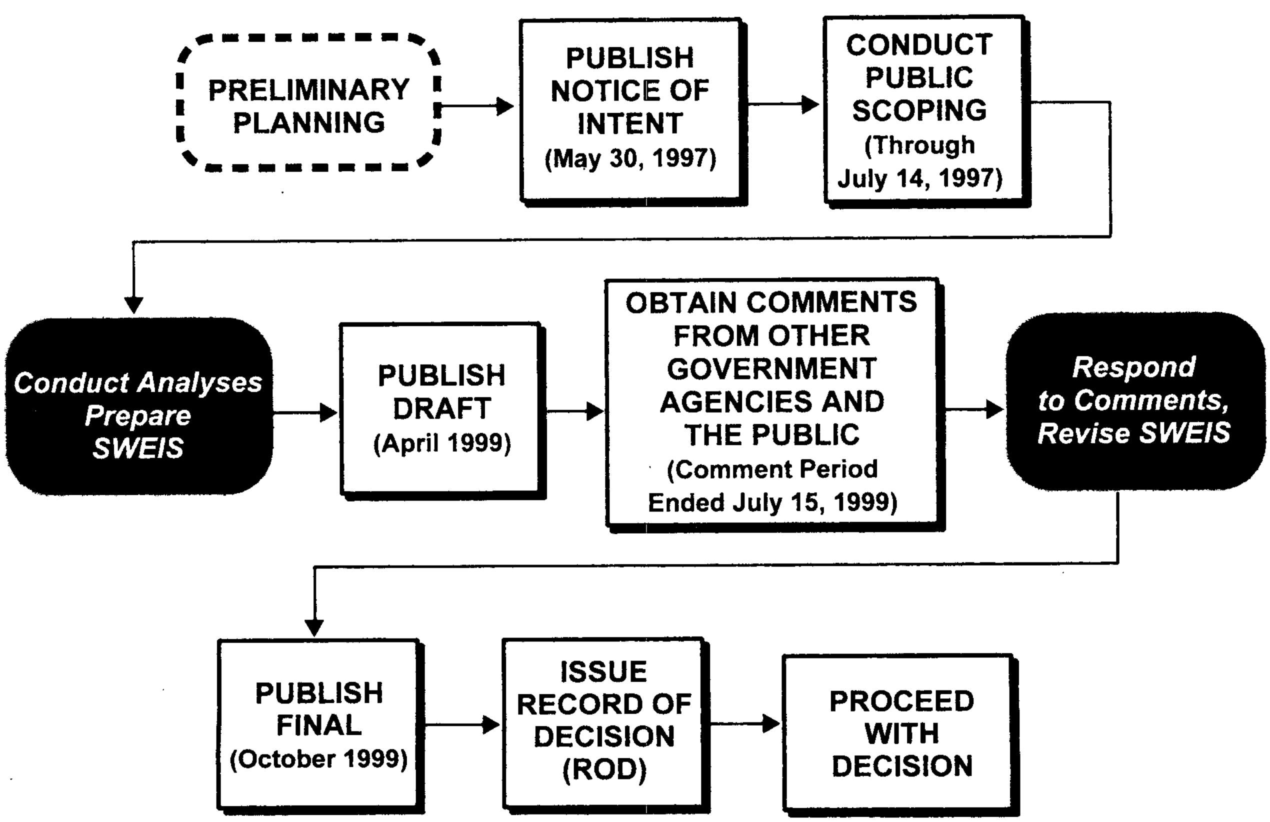
The Site-Wide Environmental Impact Statement (SWEIS) is divided into a Summary and three volumes.

The Summary provides an overview of material presented in the SWEIS, including background, purpose and need, alternatives, existing environment, and environmental impacts.

Volume I analyzes the three alternatives (including the U.S. Department of Energy's [DOE's] preferred alternative, the Expanded Operations Alternative) as they relate to the DOE missions assigned to Sandia National Laboratories/New Mexico (SNL/NM): national security, energy resources, environmental quality, science and technology. Volume I contains 15 chapters. Chapter 1 provides introductory information on background, site missions, purpose and need, decisions to be made, related *National Environmental Policy Act* analyses, and public participation. Chapter 2 describes programs and facility operations at SNL/NM (including selected facilities). Chapter 3 describes the alternatives. Chapter 4 provides a discussion of the affected environment, and Chapter 5 presents an analysis of environmental consequences of each of the proposed alternatives. Chapter 6 describes potential cumulative effects (including effects from other DOE-funded operations and other activities on Kirtland Air Force Base). Chapter 7 contains applicable laws, regulations, and other requirements. Chapters 8 through 15 include references; a list of preparers; conflict of interest statements; list of agencies, organizations, and individuals who received copies of the Final SWEIS; list of agencies and people contacted; glossary; notice of intent; and index.

Volume II contains appendixes of technical details in support of the environmental analyses presented in Volume I. These appendixes contain information on the following issues: material inventory, water quality analysis, cultural resources, air quality analysis, human health analysis, accidents analysis, transportation analysis, and waste generation.

Volume III contains a description of the public comment process, comments and responses, and a description of changes made to the Draft SWEIS. All comments received on the Draft SWEIS were identified and categorized by issue (for example, Socioeconomics) and assigned unique identifiers.



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COVER SHEET

RESPONSIBLE AGENCY: U.S. DEPARTMENT OF ENERGY (DOE)

COOPERATING AGENCY: U.S. AIR FORCE

TITLE: Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281)

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Abstract: The DOE proposes to continue operating the Sandia National Laboratories/New Mexico (SNL/NM) located in central New Mexico. The DOE has identified and assessed three alternatives for the operation of SNL/NM: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. The Expanded Operations Alternative is the DOE's preferred alternative (exclusive of the Microsystems and Engineering Sciences Applications Complex configuration). Under the No Action Alternative, the DOE would continue the historical mission support activities SNL/NM has conducted at planned operational levels. Under the Expanded Operations Alternative, the DOE would operate SNL/NM at the highest reasonable levels of activity currently foreseeable. Under the Reduced Operations Alternative, the DOE would operate SNL/NM at the minimum levels of activity necessary to maintain the capabilities to support the DOE mission in the near term. Under all of the alternatives, the affected environment is primarily within 50 miles (80 kilometers) of SNL/NM. Analyses indicate little difference in the environmental impacts among alternatives.

Public Comments: The Draft SWEIS was released to the public for review and comment on April 16, 1999. The comment period ended on June 15, 1999, although late comments were accepted to the extent practicable. All comments were considered in preparation of the Final SWEIS[1]. The DOE will use the analysis in this Final SWEIS and prepare a Record of Decision on the level of continued operation of SNL/NM. This decision will be made no sooner than 30 days after the Notice of Availability of the Final SWEIS appears in the *Federal Register.*

[1] Changes made to this SWEIS since publication of the Draft SWEIS are marked with a vertical bar to the right or left of the text.

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Acronyms

58th SOW	58th Special Operations Wing
A/BC AQCB	Albuquerque/Bernalillo County Air Quality Control Board
ACGIH	American Conference of Governmental Industrial Hygienists
ACPR	Annular Core Pulsed Reactor
ACRR	Annular Core Research Reactor
ACE	Atomic Energy Commission
ACS	American Cancer Society
AEA	*Atomic Energy Act*
AEHD	Albuquerque Environmental Health Department
AEI	average exposed individual
AFRL	Air Force Research Laboratory
AFSC	Air Force Safety Center
AHF	Advanced Hydrotest Facility
AL	Albuquerque Operations Office
ALARA	as low as reasonably achievable
ALOHA	*Areal Locations of Hazardous Atmospheres*
AMPL	Advanced Manufacturing Processes Laboratory
ANSI	American National Standards Institute
APPRM	Advanced Pulsed Power Research Module
AQCR	Air Quality Control Region
AQD	Air Quality Division
ARF	airborne release fraction
AT&T	American Telephone and Telegraph
BEA	Bureau of Economic Analysis
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
C&D	construction and demolition
CAA	*Clean Air Act*
CAB	Citizens Advisory Board
CAIRS	*Computerized Accident/Incident Reporting System*

Note: Italics are used to denote formal names or titles of acts, published documents, or computer models.

CAMP	Capital Assets Management Process
CAMU	Corrective Action Management Unit
CAP88-PC	*Clean Air Assessment Package*
CAS	Chemical Abstract Service
CDG	Campus Design Guideline
CDI	chronic daily intake
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CHEST	Conventional High Explosives and Simulation Test
CIS	Chemical Information System
COC	chemical of concern
CPMS	Criteria Pollutant Monitoring Station
CRMP	Cultural Resource Management Plan
CSF	cancer slope factor
CSRL	Compound Semiconductor Research Laboratory
CTA	Central Training Academy
CTBT	Comprehensive Test Ban Treaty
CTTF	Containment Technology Test Facility
CWA	*Clean Water Act*
CWL	Chemical Waste Landfill
CY	calendar year
D&D	decontamination and decommissioning
DARHT	dual-axis radiographic hydrotest
DDT	dichloro-diphenyl-trichloroethane
DEAR	Department of Energy Acquisitions Regulations
DF	decontamination factor, dispersion factor
DFG	Deutsche Forschungemeinschaft
DNL	day-night average noise level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation

DP	Defense Programs
DR	damage ratio
DU	depleted uranium
EA	environmental assessment
EAL	Explosives Applications Laboratory
ECF	Explosive Components Facility
EDE	effective dose equivalent
EF	emission factor
EID	environmental information document
EIS	environmental impact statement
ELCR	excess lifetime cancer risk
EM	Office of Environmental Management
EMP	electromagnetic pulse
EO	*Executive Order*
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
EPCRA	*Emergency Planning and Community Right-to-Know Act*
ER	Environmental Restoration (Project)
ERA	*Energy Reorganization Act*
ERPG	emergency response planning guideline
ES&H	Environment, Safety, and Health
ETC	Energy Training Center
FAA	Federal Aviation Administration
FCDSWA	Field Command, Defense Special Weapons Agency
FFCA	*Federal Facilities Compliance Act*
FM&T/NM	Federal Manufacturing & Technology/New Mexico
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FSID	*Facilities and Safety Information Document*
FTE	full-time equivalent
FWE	*Fish and Wildlife Plan*
FY	fiscal year
GHA	ground hazard area
GIF	Gamma Irradiation Facility

GIS	geographic information system
GRABS	Giant Reusable Air Blast Simulator
GWPMPP	*Groundwater Protection Management Program Plan*
HA	hazards assessment
HAP	hazardous air pollutant
HBWSF	High Bay Waste Storage Facility
HCF	Hot Cell Facility
HCPI	Hazardous Chemicals Purchased Inventory
HEAST	Health Effects Assessment Summary Tables
HEPA	high efficiency particulate arrestance
HERMES	High-Energy Radiation Megavolt Electron Source
HERTF	High-Energy Research Test Facility
HI	hazard index
HLW	high-level radioactive waste
HPML	High Power Microwave Laboratory
HQ	headquarters
HR	hydrogeologic region
HSWA	*Hazardous and Solid Waste Amendments*
HVAR	high velocity aircraft rocket
HWMF	Hazardous Waste Management Facility
IBMRL	Ion Beam Materials Research Laboratories
ICF	inertial confinement fusion
ICRP	International Commission on Radiological Protection
IDLH	immediately dangerous to life and health
IH	industrial hygiene
IHE	insensitive high explosives
IHIL	Industrial Hygiene Instrumentation Laboratory
IHIR	Industrial Hygiene Investigation Report
IMRL	Integrated Materials Research Laboratory
INEEL	Idaho National Engineering and Environmental Laboratory
INRMP	*Integrated Natural Resources Management Plan*
IPDP	Isotopes Production and Distribution Program
IPS	Integrated Procurement System
IRIS	Integrated Risk Information System

IRP	Installation Restoration Program
ISC	industrial source complex
ISCST3	*Industrial Source Complex Short-Term Model, Version 3*
ISS	interim storage site
JIT	just-in-time
JP	jet propulsion
KAFB	Kirtland Air Force Base
KAO	Kirtland Area Office
KUMMSC	Kirtland Underground Munitions and Maintenance Storage Complex
L90	the A-weighted background sound pressure level that is exceeded 90 percent of the time, based on a maximum of a 1-hour period
LADD	lifetime average daily dose
LANL	Los Alamos National Laboratory
LANMAS	*Local Area Network Nuclear Material Accountability System*
LBERI	Lovelace Biomedical and Environmental Research Institute, Inc.
LCF	latent cancer fatality
LLMW	low-level mixed waste
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LPF	leak path factor
LSA	low specific activity
LSF	Lightning Simulation Facility
LWDS	Liquid Waste Disposal System
LX	press-moldable explosives
M&O	management and operations
MAC	maximum allowable concentration
MACCS2	*MELCOR Accident Consequence Code System, Version 2*
MAR	material-at-risk
MBTA	*Migratory Bird Treaty Act*
MCL	maximum contaminant level
MDL	Microelectronics Development Laboratory
MEI	maximally exposed individual
MEMF	Mobile Electronic Maintenance Facility
MEPAS	*Multimedia Environmental Pollutant Assessment System*

MESA	Microsystems and Engineering Sciences Applications
MIPP	Medical Isotopes Production Project
MOBILE 5a	*Mobile Source Emission Factor (model)*
MOU	Memorandum of Understanding
MSDS	material safety data sheet
MTRU	mixed transuranic waste
M.W.	molecular weight (in grams)
MWL	Mixed Waste Landfill
NA	not available/not applicable
NAAQS	*National Ambient Air Quality Standards*
NAGPRA	*Native American Graves Protection and Repatriation Act*
NASA	National Aeronautics and Space Administration
NCA	*Noise Control Act*
NCEA	National Center for Environment Assessment
NCRP	National Council on Radiation Protection and Measurements
ND	not detected
NEPA	*National Environmental Policy Act*
NESHAP	*National Emissions Standards for Hazardous Air Pollutants*
NEW	net explosive weight
NF	not found
NFA	no further action
NFPA	National Fire Protection Association
NGF	Neutron Generator Facility
NGIF	New Gamma Irradiation Facility
NG/ST	Neutron Generator/Switch Tube
NHPA	*National Historic Preservation Act*
NIOSH	National Institute of Occupational Safety and Health
NMAAQS	*New Mexico Ambient Air Quality Standards*
NMAC	*New Mexico Administrative Code*
NMED	New Mexico Environment Department
NMEIA	New Mexico Environmental Improvement Agency
NMEIB	New Mexico Environmental Improvement Board
NMFRCD	New Mexico Forestry and Resource Conservation Division

NMGFD	New Mexico Game and Fish Department
NMSA	*New Mexico Statutes Annotated*
NMSLO	New Mexico State Land Office
NMSU	New Mexico State University
NMWQCC	New Mexico Water Quality Control Commission
NNSI	Nonproliferation and National Security Institute
NOI	Notice of Intent
NOVA	North Vault
NPDES	National Pollutant Discharge Elimination System
NPR	Nuclear Posture Review
NPS	National Park Service
NPT	Nuclear Nonproliferation Treaty
NR	not reported
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NWSM	Nuclear Weapons Stockpile Memorandum
OBODM	*Open Burn/Open Detonation Model*
OEL	occupational exposure limit
OLM	ozone limiting method
ORPD	Occupational Radiation Protection Division
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration/Occupational Safety and Health Act
PBCA	Particle Bed Critical Assembly
PBFA	Particle Beam Fusion Accelerator
PBX	plastic-bonded explosive
PCB	polychlorinated biphenyl
PDD	Presidential Decision Directive
PDFL	Photovoltiac Device Fabrication Laboratory
PDL	Power Development Laboratory
PEIS	Programmatic Environmental Impact Statement
PEL	permissible exposure limit
PETL	Processing and Environmental Technology Laboratory

PHS	primary hazards screening
PL	*Public Law*
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
PM_{10}	particulate matter smaller than 10 microns in diameter
PNM	Public Service Company of New Mexico
PPE	personal protective equipment
PSD	prevention of significant deterioration
PSL	Production Primary Standards Laboratory
PT	product tester
R&D	research & development
RAD	radiological
RCRA	*Resource Conservation and Recovery Act*
REL	recommended exposure limit
REMS	Radiation Exposure Monitoring System
RESRAD	*Residual Radioactivity* (model)
RF	respirable fraction
RHEPP	Repetitive High Energy Pulsed Power
RHI	risk hazard index
RITS	Radiographic Integrated Test Stand
RME	reasonable maximum exposure
RMMA	Radioactive Materials Management Area
RMP	Risk Management Plan
RMSEL	Robotic Manufacturing Science Engineering Laboratory
RMWMF	Radioactive and Mixed Waste Management Facility
ROD	Record of Decision
ROI	region of influence
RV	reentry vehicle
SA	safety assessment
SABRE	Sandia Accelerator & Beam Research Experiment
SANDOS	Sandia Dosimetry System
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
SDWA	*Safe Drinking Water Act*
SECOM	Secure Communication Center

SHPO	State Historic Preservation Officer (NM)
SIP	State Implementation Plan
SLEP	Stockpile Life Extension Program
SMERF	Smoke Emission Reduction Facility
SMS	Scenery Management System
SNAP	Systems for Nuclear Auxiliary Power
SNL/CA	Sandia National Laboratories/California
SNL/HI	Sandia National Laboratories/Hawaii
SNL/NM	Sandia National Laboratories/New Mexico
SNL/NV	Sandia National Laboratories/Nevada
SNM	special nuclear material
SPA	sawdust-propellant-acetone
SPHINX	Short-Pulse High Intensity Nanosecond X-Radiator
SPR	Sandia Pulsed Reactor
SSM	stockpile stewardship and management
SST	safe, secure transport
START	Strategic Arms Reduction Treaty
STEL	short-term exposure limit
STL	Simulation Technology Laboratory
STP	standard temperature and pressure
SVOC	semivolatile organic compound
SWEIS	Site-Wide Environmental Impact Statement
SWISH	Small Wind Shielded Facility
SWMU	solid waste management unit
SWTF	Solid Waste Transfer Facility
TA	technical area
TAP	toxic air pollutant
TBF	Terminal Ballistics Facility
TCE	trichloroethene
TCP	traditional cultural property
TEDE	total effective dose equivalent
TESLA	Tera-Electron Volt Semiconducting Linear Accelerator
TEV	threshold emission value

TLV	threshold limit value
TNT	trinitrotoluene
TREAT	Transient Reactor Test Facility
TRU	transuranic
TSCA	*Toxic Substances Control Act*
TSD	Transportation Safety Division
TSP	total suspended particulates
TTF	Thermal Treatment Facility
TWA	time-weighted average
UBC	Uniform Building Code
UNM	University of New Mexico
UPS	United Parcel Service
USAF	U.S. Air Force
U.S.	United States
U.S.C.	*United States Code*
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tan
VDL	vacuum diode load
VHI	vapor hazard index
VHR	vapor hazard ratio
VMF	vehicle maintenance facility
VOC	volatile organic compound
WARE	*Worksite Accident Reduction Expert*
WFO	work for others
WIPP	Waste Isolation Pilot Plant
WM	Waste Management

UNIT OF MEASURE	ABBREVIATION
acre	ac
billion gallons per year	BGY
centimeters	cm
cubic feet	ft^3
cubic feet per second	ft^3/s
cubic meters	m^3
cubic yards	yd^3
Curie	Ci
decibel	dB
degrees Celsius	°C
degrees Fahrenheit	°F
feet	ft
gallon	gal
gallons per day	gpd
gram	g
grams per second	g/sec
gravity	*g*
hectare	ha
Hertz	Hz
hour	hr
kelvin	K
kilogram	kg
kilojoule	kJ
kilometer	km
kilometer per hour	km/hr
kilovolt	kV
kilovoltampere	kVA
kilowatt	kW
kilowatt hour	kWh
liter	L
megajoule	MJ
megavolt-ampere	MVA

UNIT OF MEASURE	ABBREVIATION
megawatt	MW
megawatt hour	MWh
megawatt-electric	MWe
megawatt-thermal	MWt
meter	m
meters per second	m/sec
microcurie	μCi
microcuries per gram	μCi/g
microgram	μg
micrograms per cubic meter	$\mu g/m^3$
micrograms per kilogram	μg/kg
micrograms per liter	μg/L
micron or micrometer	μm
microohms per centimeter	μohms/cm
micropascal	mPa
mile	mi
miles per hour	mph
millicurie	mCi
millicurie per gram	mCi/g
millicurie per millimeter	mCi/ml
milligram	mg
milligram per liter	mg/L
milliliter	ml
millimeters of mercury	mmHg
million	M
million electron volts	MeV
million gallons per day	MGD
million gallons per year	MGY
millirem	mrem
millirem per year	mrem/yr
nanocurie	nCi
nanocuries per gram	nCi/g

UNIT OF MEASURE	ABBREVIATION
part per billion	ppb
part per billion by volume	ppbv
part per million	ppm
particulate matter of aerodynamic diameter less than 10 micrometers	PM_{10}
particulate matter of aerodynamic diameter less than 25 micrometers	PM_{25}
pascal	Pa
picocurie	pCi
picocuries per gram	pCi/g
picocuries per liter	pCi/L
pound	lb
pounds mass	lbm
pounds per square inch	psi
pounds per year	lb/yr
quart	qt
Roentgen equivalent, man	rem[a]
second	sec
square feet	ft^2
square kilometers	km^2
square meters	m^2

[a] Although not used in the SWEIS, the sievert is a common unit of measure for dose and equivalent to 100 rems.

Metric Conversion Chart

TO CONVERT FROM U.S. CUSTOMARY INTO METRIC			TO CONVERT FROM METRIC INTO U.S. CUSTOMARY		
If you know	**Multiply by**	**To get**	**If you know**	**Multiply by**	**To get**
Length					
inches	2.540	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.03281	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.6214	miles
Area					
square inches	6.452	square centimeters	square centimeters	0.1550	square inches
square feet	0.09290	square meters	square meters	10.76	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.4047	hectares	hectares	2.471	acres
square miles	2.590	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.57	milliliters	milliliters	0.03381	fluid ounces
gallons	3.785	liters	liters	0.2642	gallons
cubic feet	0.02832	cubic meters	cubic meters	35.31	cubic feet
cubic yards	0.7646	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.35	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.205	pounds
short tons	0.9072	metric tons	metric tons	1.102	short tons
Temperature					
Fahrenheit (°F)	subtract 32, then multiply by 5/9	Celsius (°C)	Celsius (°C)	multiply by 9/5, then add 32	Fahrenheit (°F)
kelvin (°k)	subtract 273.15	Celsius (°C)	kelvin (°k)	Multiply by 9/5, then add 306.15	Fahrenheit (°F)
Note: 1 sievert = 100 rems					

Metric Prefixes

PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS	PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS
atto-	10^{-18} = 0. 000,000,000,000,000,001	dekta-	10^{1} = 10
femto-	10^{-15} = 0. 000,000,000,000,001	hecto-	10^{2} = 100
pico	10^{-12} = 0. 000,000,000,001	kilo-	10^{3} = 1,000
nano-	10^{-9} = 0. 000,000,001	mega-	10^{6} = 1,000,000
micro-	10^{-6} = 0.000,001	giga-	10^{9} = 1,000,000,000
milli	10^{-3} = 0.001	tetra-	10^{12} = 1,000,000,000,000
centi	10^{-2} = 0.01	peta-	10^{15} = 1,000,000,000,000,000
deci-	10^{-1} = 0.1	exa-	10^{18} = 1,000,000,000,000,000,000

Note: 10^{0} = 1

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CHAPTER 1

Introduction and Purpose and Need for Agency Action

This chapter introduces Sandia National Laboratories' (SNL's) role in supporting the U.S. Department of Energy's (DOE's) statutory missions and operations, a statement of the purpose and need for the Department's action, a description of DOE missions for SNL, an overview of the alternatives to be considered, and a review of the decisions that the DOE will make based in part on the findings in this Site-Wide Environmental Impact Statement (SWEIS) in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] Section 4321). In addition, it discusses the public participation process, related NEPA documents, and the organization and contents of the remaining chapters in the SWEIS.

1.1 INTRODUCTION

SNL is one of several national laboratories that support the DOE's statutory responsibilities for nuclear weapons research and design, development of other energy technologies, and basic scientific research. SNL is one of the largest laboratories in the world, with an annual budget of approximately $1.4 billion and a workforce of approximately 7,500 (DOE 1998j). SNL is composed of four geographically separated facilities: Albuquerque, New Mexico (SNL/NM); Tonopah, Nevada; Kauai, Hawaii; and Livermore, California (SNL/CA). This SWEIS focuses on SNL/NM. (A SWEIS was completed in 1992 for SNL/CA and Lawrence Livermore National Laboratory (DOE/EIS-0157) (DOE 1992f).)

SNL/NM comprises approximately 8,800 ac of Federal land (owned by the DOE, U.S. Department of Defense [DoD], and U.S. Forest Service [USFS]) on Kirtland Air Force Base (KAFB) southeast of the city of Albuquerque (Figure 1.1–1) (SNL/NM 1997a). SNL/NM shares KAFB with other Federal agencies, primarily the U.S. Air Force (USAF) and the USFS. The USAF is a cooperating agency in the preparation of the SWEIS.

The DOE has prepared the SWEIS to examine the environmental impacts associated with three alternatives for SNL/NM's continued operation (see Section 1.3 and Chapter 3 for additional information regarding the alternatives). In the SWEIS, the DOE describes the consequences, both onsite and offsite, of ongoing and proposed SNL/NM operations and compares the potential consequences to three alternative levels of future operations.

DOE activities at the national laboratories and production facilities are known as mission lines. In the DOE *Strategic Plan*, mission lines are also known as business lines. Descriptions of DOE mission/business lines follow (DOE 1997c):

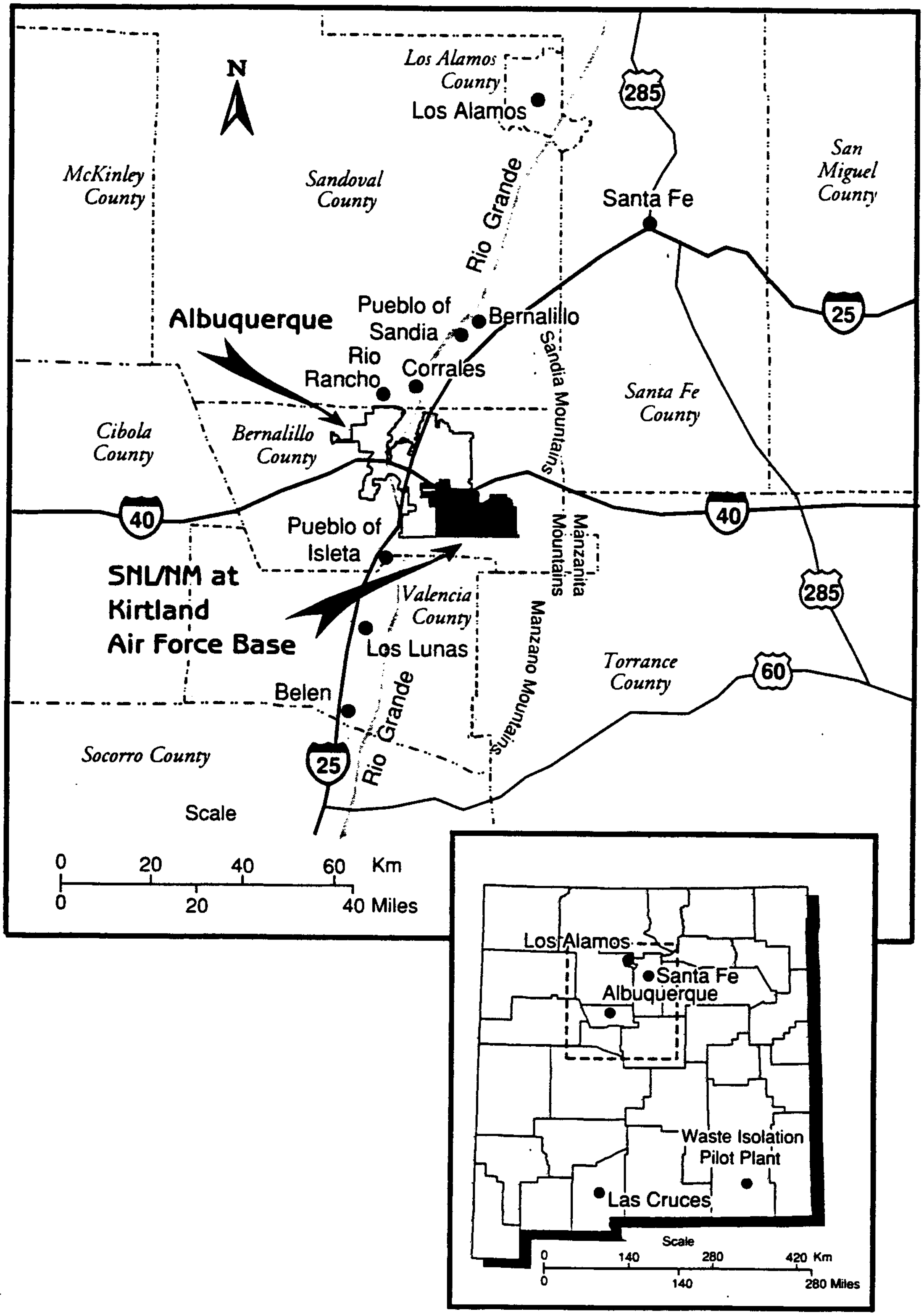
The Importance of SNL's National Security Role

The continuing need for SNL to support the DOE's national security mission line was confirmed by President Clinton, who stated, ***"...to meet the challenge of ensuring confidence in the safety and reliability of our stockpile, I have concluded that the continued vitality of all three DOE nuclear weapons laboratories will be essential."*** Statement by the President: Future of Major Federal Laboratories (The White House 1995).

- *National Security*—effectively support and maintain a safe, secure, and reliable enduring stockpile of nuclear weapons without nuclear testing; safely dismantle and dispose of excess nuclear weapons; and provide technical leadership for national and global nonproliferation and nuclear safety activities.
- *Energy Resources*—ensure adequate supplies of clean energy; reduce U.S. vulnerability to supply disruptions; encourage efficiency and advance alternative and renewable energy technologies; and increase energy choices for all consumers.

The DOE Mission Statement

To foster a secure and reliable energy system that is environmentally and economically sustainable, to be a responsible steward of the nation's nuclear weapons, to clean up our own facilities, and to support continued United States leadership in science and technology.
(DOE 1996e)



Source: SNL/NM 1997j

Figure 1.1–1. SNL/NM, KAFB, and Surrounding Region

SNL/NM is located within the boundaries of KAFB, southeast of Albuquerque in Bernalillo county.

- *Environmental Quality*—reduce the environment, safety, and health risks and threats from DOE facilities and materials; safely and permanently dispose of civilian spent nuclear fuel and defense-related radioactive waste; and develop the technologies and institutions required for solving domestic and international environmental problems.
- *Science and Technology*—combine the unique resources of the Department's laboratories and the nation's universities to maintain leadership in basic research and to advance scientific knowledge; focus applied research and technology development in support of the Department's mission lines; contribute to the nation's science and mathematics education; and deliver relevant scientific and technical information.

1.2 PURPOSE AND NEED FOR AGENCY ACTION

The DOE needs to continue to meet its responsibilities for national security, energy resources, environmental quality, and science and technology at SNL/NM. The DOE needs to continue to fulfill its responsibilities as mandated by statute, Presidential Decision Directive (PDD), and congressional authorization and appropriation, while meeting this need in a manner that protects human health and the environment.

DOE missions for SNL have evolved over time in response to national needs. When assigning missions to SNL, the DOE considers many factors, including PDDs; the *National Defense Authorization Act of 1994* (Public Law 103-160); the DoD Nuclear Posture Review; and treaties, both implemented and proposed, including the Nuclear Nonproliferation Treaty, Strategic Arms Reduction Treaty (START) I, proposed START II, and the proposed Comprehensive Test Ban Treaty. Following are specialized capabilities SNL/NM provides in support of the Department's mission lines:

- science-based performance and reliability testing and computer-based modeling of nuclear components;
- production of nonnuclear components;
- production of neutron generators;
- materials science, including studying behavior of materials under high temperature and pressure;
- engineering and high-energy physics;

SWEIS Terminology

Mission The DOE's mission is to foster a secure and reliable energy system that is environmentally and economically sustainable, to be a responsible steward of the nation's nuclear weapons, to clean up its facilities, and to support continued United States leadership in science and technology.

Mission Lines The DOE accomplishes its major responsibilities by assigning groups or types of activities (National Security, Energy Resources, Environmental Quality, Science and Technology) to its system of national laboratories and production facilities.

Programs The DOE is organized into Program Offices. Each has a primary responsibility within one of the four DOE mission lines. The Program Offices provide funding and direction for activities at DOE facilities. Similar, coordinated sets of activities that meet Program Office responsibilities are referred to as programs. Programs are usually long-term efforts with broad goals or requirements.

Capabilities The DOE's capabilities include the combination of equipment, facilities, infrastructure, and expertise required to implement mission assignments.

- high explosives research and development (R&D) and testing;
- microelectronics and photonics research;
- medical isotopes production; and
- radiation effects experimentation and accelerator operations.

For additional discussion of SNL/NM's support of DOE mission lines, see Section 2.1.

1.3 PROPOSED ACTION AND ALTERNATIVES

The DOE proposes to continue operating SNL/NM and managing its resources in a manner that meets evolving DOE mission lines and that responds to the concerns of affected and interested individuals and agencies.

The DOE identified three alternatives—No Action, Expanded Operations (the DOE's Preferred Alternative), and Reduced Operations—that would meet its purpose and need for agency action and support existing and potential future program-related activities at SNL/NM.

1.3.1 No Action Alternative

Under the No Action Alternative, ongoing DOE and interagency programs and activities at SNL/NM would continue the status quo, that is, operating at planned levels as reflected in current DOE management plans. In some cases, these planned levels include increases over today's operating levels. This would also include any recent activities that have already been approved by the DOE and have existing NEPA documentation.

1.3.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, DOE and interagency programs and activities at SNL/NM would increase to the highest reasonable activity levels, as set forth in this SWEIS, that could be supported by current facilities and their potential expansion and construction of new facilities for future actions specifically identified in the SWEIS. In this Final SWEIS the Expanded Operations Alternative has two potential configurations for the Microelectronics Development Laboratory (MDL) facility. In the first configuration, the SWEIS analyzed the expansion of operations in the existing MDL (analyzed in the Draft SWEIS). In the second configuration, the SWEIS presents the available information on the developing proposal for the Microsystems and Engineering Sciences Applications (MESA) Complex, including impacts from the construction and operation of the facility (see Sections 3.3 and 5.4) adjacent to the existing MDL. The DOE has included in the second configuration of the Expanded Operations Alternative all available programmatic and environmental information on the MESA Complex based on its approved *Microsystems and Engineering Sciences Applications Complex Conceptual Design Plan* (SNL/NM 1999b).

The conceptual design for the MESA Complex will be finalized in the December 1999 timeframe with the issuance of the Conceptual Design Report currently under preparation. Thus, because the information on the MESA Complex in this SWEIS is preliminary and incomplete (based on the Conceptual Design Plan), and was added after issuance of the Draft SWEIS for public review and comment, the DOE has determined that an additional NEPA review will be conducted for the construction and operation of the proposed MESA Complex after the conceptual design is finalized. Based on the current configuration for the proposed MESA Complex, the DOE will prepare an environmental assessment (EA) to determine whether an environmental impact statement (EIS) is required and will include the opportunity for public participation. The decision whether or not to construct and operate the MESA Complex will be made following the additional NEPA review. The DOE did not include the MESA Complex as a "Projects Under Consideration" in the Draft SWEIS because the DOE had not then decided to proceed with conceptual design for the project. Once the DOE decided to go forward with conceptual design, however, it elected to present the information it had gathered thus far from the ongoing conceptual design. Nothing in the Final SNL/NM SWEIS is intended to influence the findings of any subsequent NEPA review of the MESA Complex. Similarly, the Record of Decision (ROD) based on the Final SWEIS will not affect the DOE's eventual decision with respect to the MESA Complex. Any decision to construct and operate the MESA Complex will be based solely on a NEPA review specific to the MESA Complex.

While the DOE will not make a decision on MESA based on this SWEIS, construction and operation of the MESA Complex is nonetheless presented in the SWEIS. The DOE has elected to share with the public such information as it has assembled in the course of its ongoing conceptual design of the MESA Complex to give the public an idea of the additional consequences that could potentially occur at SNL/NM should the project go forward (see Section 5.4, Expanded Operations Alternative). Because conceptual design is ongoing, environmental impact information is also incomplete and preliminary and may differ from what will be presented in the subsequent EA.

1.3.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, DOE and interagency programs and activities at SNL/NM would be reduced to the minimum level of operations needed to maintain SNL/NM facilities and equipment in an operational readiness mode.

The Notice of Intent (NOI) (62 *Federal Register* [FR] 29332) proposed that the No Action and Expanded Operations Alternatives be considered in the SWEIS (see Chapter 14); however, a third alternative, the Reduced Operations Alternative, was added to show a broader range of alternatives and respond to comments received from the public during the scoping process (Section 1.7.1).

The SWEIS analyzes the environmental impacts of activities at SNL/NM associated with these three alternatives, as well as activities common to all alternatives including maintenance support and material management. The alternatives are more fully described in Chapter 3.

1.3.4 Preferred Alternative

The DOE did not present a Preferred Alternative in the Draft SNL/NM SWEIS. The DOE has now selected the Expanded Operations Alternative (exclusive of the MESA Complex) as its Preferred Alternative. Under the Expanded Operations Alternative, the DOE would expand operations at SNL/NM as the need arose (until 2008), subject to the availability of congressional appropriations, to increase the level of existing operations to the highest reasonable foreseeable activity levels that are analyzed in the SWEIS. The Preferred Alternative would only implement expansion at the existing MDL, without addition of the MESA Complex.

1.4 OBJECTIVE OF THE SWEIS

In the SWEIS, the DOE is examining the environmental impacts of the three alternatives for the continued operation of the laboratory. The objective of the SWEIS is to provide the DOE, other agencies, and the public with the following:

- descriptions of the affected environment, current operation, and potential impacts associated with the continued operation of SNL/NM;
- sufficient information to facilitate routine decisions by the DOE regarding verification of operational status;
- a document that can be used for tiering (linking) NEPA analyses for future proposed actions, to eliminate repetitive discussions of similar issues and focus on the actual issues ready for decisions at each level of environmental review; and
- an understanding of SNL/NM's contribution to cumulative environmental impacts created by SNL/NM, KAFB, other onsite DOE facilities and activities in the Albuquerque area.

The last site-wide NEPA document for SNL/NM was prepared in 1977 (ERDA 1977). Since that time, site programs and activity levels have changed. Recently, the DOE has made decisions on the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996a), the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997i), the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), and the *Nonnuclear Consolidation Environmental Assessment* (DOE/EA-0792) (DOE 1993c). Based on these changes and decisions, the DOE decided that a thorough environmental analysis was needed to describe impacts of ongoing and proposed SNL/NM operations.

1.5 DECISIONS TO BE SUPPORTED BY THE SWEIS

The SWEIS will be used to support DOE decisions on the levels of operations at SNL/NM, as well as serving as a basis for tiering future NEPA analyses and decisions regarding specific activities, as needed.

No sooner than 30 days after the Final SWEIS is issued, the DOE will consider preparing a ROD. The ROD will contain the DOE's decisions on future operating levels for SNL/NM. In the ROD, the DOE will explain all factors, including environmental impacts, that the Department considered in reaching its decision and identify the environmentally preferable alternative or alternatives. The DOE may select one of the three alternatives or a combination of the alternatives analyzed in the SWEIS.

Where the DOE has analyzed the environmental impacts at selected facilities for the three levels of operations that comprise the three alternatives, the DOE may choose different activity levels for each of the selected facilities and facility groups in its ROD. The NEPA process is satisfied as long as the department has bounded the environmental impacts for the selected level of operations of each facility. Here, all of the selected activity levels are analyzed in the SWEIS, and any combination of activities between the Reduced and Expanded Operations Alternatives will similarly be bounded by the SWEIS. If mitigation measures, monitoring, or other conditions are adopted as part of the DOE decision, these, too, will be summarized in the ROD.

1.6 PROJECTS UNDER CONSIDERATION

The following six projects are under consideration, but have not been included in this NEPA process (with one exception) because they are not ripe for decision-making. The MESA Complex configuration for the Expanded Operations Alternative has been included in the analysis and presented in the SWEIS for the purpose of full disclosure and integration. Separate NEPA review of each would be conducted before implementation of these projects.

- *X-1 Advanced Radiation Source*—an accelerator envisioned to generate X-ray outputs far greater than those that can be generated on the SNL/NM Z-machine or the ZX machine. The X-1 would enable a comprehensive range of weapon research activities, made possible by achievement of high yield fusion burn. Four potential alternative locations for this facility, including SNL/NM, were outlined in the Final Programmatic Environmental Impact Statement (PEIS) for Stockpile Stewardship and Management (SSM). However, pre-conceptual design on this project is stopped at this time, and the DOE will make the decision to proceed at a later date.
- *ZX*—a concept for a ZX experimental facility is under discussion that would provide a new X-ray source for high-energy density R&D and weapon effects testing. This facility would entail modifications to facilities in Technical Area (TA)-IV. The ZX would provide an increase in SNL/NM capabilities for stockpile stewardship studies. In concept, this facility would use existing facilities and infrastructure in TA-IV, but would require an additional building to house the pulsed-power accelerator and experimental area. The ZX would produce a significant increase in soft X-ray energy output (up to 7 MJ) per shot compared to the existing Z-machine. Target materials would be similar to those used or planned for the Z facility. At this time, the DOE has decided that SNL/NM will not build a new $200 M facility, rather the work will be carried out in the existing facility.
- *Annular Core Pulse Reactor-II*—a proposed reactor that would use the same fundamental design as the existing Annular Core Research Reactor (ACRR) facility. This reactor could be used for defense program-related testing using the uranium oxide-beryllium oxide fuel from the existing ACRR. This facility could be constructed in TA-V. A potential scenario for operation of such a reactor is analyzed under the Expanded Operations Alternative, but would require separate NEPA review if the DOE proposes pursuing the project.
- *ACRR-medical isotopes production privatization*— The DOE could decide to privatize its medical isotopes production in the future.
- *DOE-owned portion of a local research park*— eighty-six ac of undeveloped DOE land adjacent to the Sandia Science and Technology Park may be developed in the future. The entire research park comprises approximately 200 ac, and various public and private entities are involved in the development activities. This project has not been analyzed in this SWEIS, but is described in Section 6.4.1.
- *MESA*—a developing proposal comprised of technical and engineering activities required to implement microsystems technology into the nuclear weapons stockpile. The program could provide capabilities that support the DOE's stockpile stewardship and management, the Stockpile Life Extension Program (SLEP), and The Enhanced Surety Campaign. Current plans call for the MESA Complex to be built adjacent to the existing MDL. The project could require retooling of equipment in the existing MDL and construction of a replacement building for the antiquated Compound Semiconductor Research Laboratory (CSRL). Once the replacement laboratory was completed, the DOE would combine the MDL and the existing CSRL into one integrated design, prototype, and fabrication facility that would be a part of the MESA Complex. Other support buildings and structures (light laboratories, offices, gas storage) would be built nearby. If MESA becomes operational the DOE will demolish the existing CSRL.

  As discussed in Section 1.3.4, Preferred Alternative, the DOE has determined that an EA will be conducted for the construction and operation of the MESA Complex (a developing proposal) after the conceptual design is finalized and before this project can be implemented.

1.7 PUBLIC PARTICIPATION

Public participation is integral to the preparation of the SWEIS. This section summarizes the issues and concerns that were identified during the public scoping process.

1.7.1 Scoping Process

Scoping is a process for determining the range of issues to be addressed in an EIS and for identifying significant issues associated with the alternatives (40 Code of Federal Regulations [CFR] §1501.7). The objectives of the scoping process are to notify interested persons, agencies, and other groups about the proposed action and the alternatives being considered; solicit comments about environmental issues, alternatives for the proposed action, and other items of interest; and consider those comments in the preparation of the SWEIS.

Scoping for the SWEIS consisted of both internal DOE scoping and external public scoping processes. The internal DOE scoping process began with working groups comprised of DOE managers and SNL/NM laboratory managers. The external scoping process period began after the publication of the NOI (62 FR 29332) on May 30, 1997, and continued until July 14, 1997. The NOI was published to notify the public that the DOE was intending to prepare a SWEIS on SNL/NM operations and to invite other Federal agencies, Native American tribes, state and local governments, and the general public to participate in the scoping process. The NOI also presented background information on SNL/NM and preliminary alternatives and issues identified through the internal scoping process.

Two scoping meetings for the SWEIS were held for the general public on June 23, 1997, at the University of New Mexico Continuing Education Center in Albuquerque, New Mexico. At these meetings, the DOE presented information on its proposal to prepare the SWEIS and the alternatives that were to be analyzed. The public was invited to present oral and/or written comments at the scoping meetings or by telephone by way of a toll-free number. Written comments could also be submitted by mail, facsimile, or electronic mail.

1.7.2 Summary of Scoping Issues and Concerns

During the public scoping process, a total of 29 individuals and organizations either submitted requests for information or made oral or written comments. These comments, summarized in Table 1.7–1, were sorted based on the organization of the SWEIS. All of these comments have been reviewed and considered at various stages during the preparation of the SWEIS. Many are explicitly addressed in the pertinent sections of the first seven chapters of the SWEIS.

1.7.3 Public Comment Process

The DOE released the Draft SWEIS in April 1999 for review and comment by the state of New Mexico, Native American tribes, local governments, other Federal agencies, and the general public. The formal public comment period lasted 60 days, ending on June 15, 1999.

The DOE considered all comments, including those it received after the end of the comment period, to evaluate the accuracy and adequacy of the Draft SWEIS and to determine whether it needed to correct, clarify, or otherwise revise the SWEIS text. The DOE gave equal weight to spoken and written comments, all of which were reviewed for content and relevance to the environmental analysis in the SWEIS.

Commenters raised several topics that the DOE has addressed in the following *Summary of Comments and Responses* section.

1.7.4 Summary of Comments and Responses

This section contains an overview of comments and responses on the Draft SWEIS. Typically, the following subsections discuss resource areas for which the DOE received multiple comments, often from several commenters. These subsections do not capture all specific comments, but provide the reader with the essence of public concerns on the Draft SWEIS.

In addition to the comments summarized below, the DOE also received comments on other topics. A breakdown of all comments received, by issue category, is presented in Table 1.3–1 of the Comment Response Document, Volume III of this Final SWEIS.

1.7.4.1 Alternatives

Some commenters took issue with the alternatives evaluated, maintaining that there were not enough differences among alternatives or that the Reduced Operations Alternative should have gone further toward scaling back SNL/NM activities. For example, one commenter stated that the "SWEIS does not clearly distinguish between the alternatives." Another stated that in "the majority of instances, on a project-by-project basis, there are far more similarities…than there are differences" in operations at facilities among the different alternatives. A commenter also noted that "the Draft SWEIS admits that for some facilities, 'reduced operations' would actually be increased operations

Table 1.7–1. Summary Public Scoping Comments

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
General	Discuss the effects of Sandia National Laboratories/New Mexico (SNL/NM) on the environment.
	Examine current and future energy requirements and conservation potential.
	What are your proposed activities now and 10 years from now?
Alternatives	Return all or part of the withdrawn U.S. Forest Service lands to public use.
	Consider zero production.
	Evaluate neutron generator production if manufactured at a higher level than indicated in the Nonnuclear Consolidation Environmental Assessment (EA).
	Consider reduced operations.
	Consider relocating and/or outsourcing of some current activities.
	Consider closure of SNL/NM.
	Continue some operations and increase/decrease others.
	Concern was expressed about the DOE's objectivity in defining "minimum" operations.
	Expand renewable energy, energy efficiency, and waste management research facilities.
	Dedicate vast unused lands owned by SNL as an Environmental Research Park.
	Expand some activities by making them available to other Federal agencies and move other activities that are underutilized to some other location.
	Broaden scope to anticipate research and development of new technologies to ensure leading-edge competency at SNL.
Land Use	Give full consideration of the use and impacts to U.S. Forest Service land.
	Consider impacts from testing/operations on land use, including tribal lands.
Geology	The potential for seismic activity along earthquake faults in the Manzanos makes the Manzano facility unsuited for nuclear storage.
Water Resources	Discuss water use, conservation, and cleanup.
	Consider the effects of testing on water in the East Mountain area.
	SNL should expand its research on wastewater treatment and water reuse technologies.
	Studies must include effects of an accident on groundwater quality.
	What impact will waste discharges to groundwater have on Isleta, and what impact will current and future surface water discharge have on the Rio Grande?
	Determine the extent of groundwater contamination.
	Is there a groundwater monitoring program in place?

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Water Resources (continued)	What is the current and future water use, and what is its impact on the Albuquerque Basin?
	How many acre feet of water rights do you currently have? Do you anticipate purchasing more in the future?
	Provide data on the present number of wells, including depth, water quantity, and water quality. Will more wells be needed?
	Is surface water currently used, including water from the Rio Grande? Will it be used in the future?
	Is there any surface water contamination?
	Is there a surface water monitoring program in place?
	Consider implication of traffic associated with Sandia and Kirtland Air Force Base (KAFB) on water resources.
Biological Resources	Consider impacts on migratory birds such as the burrowing owl and gray vireo.
	Evaluate any research involving the capture and rendering of animals on KAFB for chemical or other analysis.
	What are the types of wildlife on your lands and how will they be impacted by future activities? If they migrate, where would they go?
	Have there been any tissue studies performed on any of the wildlife to determine if they have chemical concentrations that might be harmful to humans?
Cultural and Religious	Consider impacts to Native American archaeological sites and artifacts.
	Evaluate how impacts to cultural resources and properties, which may be historically significant, will be minimized.
	Full consideration must be given to Native American cultural and religious sites.
	Address cumulative impacts to traditional cultural properties.
	Consideration should be given to loss of access for Pueblo of Isleta to traditional cultural properties.
	A full ethnographic survey of impacted lands should be conducted.
Air Quality	Air quality must be addressed openly, otherwise public suspicion is fostered.
	Impacts of the open burn facility on the adjacent public use areas and the East Mountain area, including black smoke and forest fires, must be considered.
	Air conformity issues related to onsite transportation must be considered.
	Air conformity issues related to offsite transportation must be considered.
	Consider the cumulative impacts to Pueblo of Isleta due to discharges of hazardous air pollutants, including radionuclides.

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Air Quality (continued)	How many air pollutants are currently emitted and how will they be increased if activities are expanded?
Health and Safety	Could there be an increased incidence of thyroid cancer in the nearby community due to operation on KAFB?
	Have SNL/NM operations increased the incidence of child deformities?
	What is the current physical condition of the laboratories?
	How does the current condition of these laboratories compare with industry standards?
	What kind of environmental risk is posed by operating laboratories in their current physical condition?
	Are there criteria to ensure that a lab operation is appropriate to the condition of the lab?
	Is there a real option for a researcher or lab manager to stop work in a lab because it is unsafe?
	How has the maintenance or replacement budget for the individual labs fared and what is its future?
	The integrity of radioactive waste storage areas has to be examined to prevent environmental health hazards.
	Risks to surrounding neighborhoods in the case of an accident need to be studied.
	Cleanup standards for U.S. Forest Service land must consider ecological risks, not just the industrial human health cleanup standard.
	What types and quantities of nuclear materials and chemicals are used at SNL/NM?
	Does SNL/NM have an emergency response plan in place in the event of an emergency, and is the lab prepared for an evacuation if necessary?
	Are employees trained to handle a nuclear and/or chemical emergency?
	What are the potential public and worker exposures to radiological and/or hazardous materials?
Transportation	How can SNL/NM assist in developing more efficient, less intrusive transportation corridors?
	In what ways can SNL/NM assist in implementing a Southeast Corridor bypass?
	Discuss the effects of onsite transportation of radioactive and hazardous materials and wastes on the site workforce and the general public.
	Discuss impacts related to offsite transportation of radioactive and hazardous materials and wastes.
	Address the impact of SNL operations in relation to city and county policies regarding transportation planning.
	Is it in the best interest of the community to transport mixed waste to SNL/NM for treatment?

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
General	Discuss the effects of Sandia National Laboratories/New Mexico (SNL/NM) on the environment.
	Examine current and future energy requirements and conservation potential.
	What are your proposed activities now and 10 years from now?
Alternatives	Return all or part of the withdrawn U.S. Forest Service lands to public use.
	Consider zero production.
	Evaluate neutron generator production if manufactured at a higher level than indicated in the Nonnuclear Consolidation Environmental Assessment (EA).
	Consider reduced operations.
	Consider relocating and/or outsourcing of some current activities.
	Consider closure of SNL/NM.
	Continue some operations and increase/decrease others.
	Concern was expressed about the DOE's objectivity in defining "minimum" operations.
	Expand renewable energy, energy efficiency, and waste management research facilities.
	Dedicate vast unused lands owned by SNL as an Environmental Research Park.
	Expand some activities by making them available to other Federal agencies and move other activities that are underutilized to some other location.
	Broaden scope to anticipate research and development of new technologies to ensure leading-edge competency at SNL.
Land Use	Give full consideration of the use and impacts to U.S. Forest Service land.
	Consider impacts from testing/operations on land use, including tribal lands.
Geology	The potential for seismic activity along earthquake faults in the Manzanos makes the Manzano facility unsuited for nuclear storage.
Water Resources	Discuss water use, conservation, and cleanup.
	Consider the effects of testing on water in the East Mountain area.
	SNL should expand its research on wastewater treatment and water reuse technologies.
	Studies must include effects of an accident on groundwater quality.
	What impact will waste discharges to groundwater have on Isleta, and what impact will current and future surface water discharge have on the Rio Grande?
	Determine the extent of groundwater contamination.
	Is there a groundwater monitoring program in place?

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Environmental Restoration/Waste and Waste Management (continued)	The DOE needs to include thorough studies of potential cleanup sites and develop implementation strategies for cleanup of waste storage facilities.
	Studies must include effects of contamination on soils.
	If Mesa del Sol is contaminated from any SNL/NM sources, SNL/NM has a duty to clean it up.
	When considering returning U.S. Forest Service land to public access, the necessary decontamination and decommissioning must be carried out.
	Concerns relating to the Medical Isotope Production project need to be addressed including the life of the project, where and how spent fuel rods will be stored, how many spent fuel rods will be generated, has the disposal cost been considered, and which DOE program would pay for it.
	Consider impacts to Isleta property from soil contamination due to waste discharges.
	Consider heavy metal and depleted uranium contamination from overshot and explosives debris.
	What are current waste management practices, and are hazardous materials currently stored or disposed of onsite?
Regulatory Compliance	Consider SNL/NM's and KAFB's compliance with environmental laws, including the *Clean Air Act* and *Clean Water Act*.
	A study of Native American traditional cultural properties on KAFB and the U.S. Forest Service withdrawn land must consider not only the *National Historic Preservation Act*, but also the relevant aspects of the *American Indian Religious Freedoms Act*.
Public Involvement	Make technical data more available, including by computer access.
	Public involvement and input must be considered.
	There should be total public disclosure of activities.
	Information should be disseminated to the local Hispanic community and be available in Spanish.
	Copies of *National Environmental Policy Act* (NEPA) documents and supporting analyses should be available to the public for independent review.
	All comments, DOE responses, and other documents should be available on the Internet.
	Will there be public participation meetings?
	A work plan or some other similar document should be made available for public comment by the Fall of 1997 that would identify schedules, alternatives, facilities to be analyzed, contractors preparing the SWEIS, roles of other Federal agencies, and other NEPA documents the DOE intends to prepare during preparation of the SWEIS.
	The DOE should actively cooperate with and involve the Pueblo of Isleta in the preparation of the draft SWEIS.

Table 1.7–1. Summary Public Scoping Comments (concluded)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Public Involvement (continued)	The DOE should provide for ongoing public input during the SWEIS process and keep the public informed on SWEIS progress.
	The "Open House" format of the June 23, 1997, public meeting permitted good communication and should be continued.
	The DOE should demonstrate during the NEPA process a respectful, continuing government-to-government relationship with the Pueblo of Isleta.
Mission, Policy and Management	Technology transfer between SNL/NM and Bernalillo county and local governments should continue to be encouraged.
	SNL/NM should stop open burn tests and any and all reclamation of plutonium pits from warheads.
	The DOE should set time limits for each constituent part of the SWEIS with the total time not to exceed 15 months.
	SNL/NM is a good place to work.
	Concern was expressed over ethics of experiments such as human radiation experiments on people living around SNL/NM.
	The DOE should reassign SNL/NM's mission statement and make it concentrate on energy and material efficiency, renewable resource research, waste management and recycling, and development of biodegradable and reusable materials.
	SNL/NM should make a commitment to engage in an arms control program, work on weapons disarmament, and seek improvements to the recent test-ban agreement.
	The SWEIS should be extended to cover business incubator activities.
	In the event of a war, would SNL/NM be a target?
Document Preparation	It should be explained in the SWEIS how the DOE will ensure that all proposed actions will receive the appropriate level of NEPA review after the document is completed.
	A description of how the DOE intends to condition funding for mitigation, if proposed, and a progress report on mitigation should be included in the SWEIS or a mitigation action plan.
	The many other project-specific NEPA documents that SNL/NM has prepared, other than the two called out in the Notice of Intent, should be considered.
	Any relationship between SNL/NM and contractors selected to prepare the SWEIS should be described in the disclosure statement.
	A classified appendix is not warranted.

Source: HNUS 1997

compared with the base period activities," and that the DOE should have considered an alternative of "returning all or part of the withdrawn Forest Service lands to public use." Commenters also noted that the No Action Alternative is described as possibly involving increased activity, which contradicts the concept of no action.

The three alternatives represent the same mission assignments carried out at different levels. Other than the proposed expansion of the MDL to include the MESA Complex (a developing proposal that is still undergoing conceptual design but is presented under one of two configurations in the Expanded Operations Alternative, as discussed in Section 3.3.1.2 of the Final SWEIS), there would be very little construction of new facilities; and, even in those cases, construction would occur largely in previously disturbed areas. Renovations to existing buildings could also occur.

In general, implementation of any of the alternatives would use the existing physical plant. In many cases, the actual changes in levels of activities represent a very small change in relation to current levels, so the change in impacts would be relatively small. The DOE believes the Reduced Operations Alternative accurately reflects the minimal level of operation possible at SNL/NM to maintain the capabilities identified in the Stockpile Stewardship and Management PEIS. Some facilities in the Withdrawn Area are unique to the DOE nuclear weapons complex, such as the Lurance Canyon Burn Site and the Aerial Cable Facility. Because of the uniqueness and necessity of the facilities located in the Withdrawn Area, the DOE does not anticipate moving these facilities or suspending activities at them within the time frame analyzed in the SWEIS. For this reason, the DOE does not believe it is reasonable to return all or part of the Withdrawn Area to the public and, therefore, did not analyze it in the SWEIS. The rationale for not considering return of withdrawn lands to public use has been added to the Final SWEIS as Section 3.5.3.

The No Action Alternative in the SWEIS considers SNL/NM activities at currently planned levels of operations. This includes some activities or projects that have been planned and approved, but are not yet operational. This is intended to present a realistic picture of the continuing activity at the current congressionally approved level. If these planned operations are implemented in the future, they could result in increased activity above present levels.

1.7.4.2 Water Use

A number of comments dealt with reducing the quantity of water used by SNL/NM. One commenter focused on water conservation, stating "I hope that [SNL/NM]... actually implements this 30 percent conservation reduction that is mentioned more than once in the document," and that SNL/NM "should join the rest of us in significant [water] conservation efforts over the next few years." Another commenter asked "can SNL/NM justify expending critical water resources for programs such as those conducted at the Microelectronics Development Laboratory?"

Based on 1996 usage, SNL/NM's goal is to reduce annual water use from 440 M gal to 308 M gal by 2004. This goal will be achieved through a variety of conservation efforts, especially at higher water use facilities such as the MDL. The MDL provides custom and radiation-hardened microelectronics—a critical capability to the nuclear weapons stockpile maintenance program. In part due to SNL/NM's signing of the water conservation memorandum of understanding with the city of Albuquerque and KAFB, the MDL began to implement a series of steps to reduce water use. In 1996, work began on improving the MDL's reverse osmosis water treatment system. The MDL is currently researching a water-recycling project to further reduce water consumption by 70 percent to 80 percent. This project uses sophisticated sensors to monitor the quality of water before it enters the recycling loop, preventing the introduction of contaminants into the recycled water system. Another project originally designed in 1996 would take some of the process wastewater at the MDL and pump it for reuse in an adjacent cooling tower, resulting in savings of approximately 12 M gal per year.

1.7.4.3 Groundwater

A number of comments addressed the issue of groundwater quality at SNL/NM, particularly groundwater contamination at the Chemical Waste Landfill (CWL) and other locations around KAFB. Several commenters took issue with the SWEIS characterization of areas of groundwater contamination, which indicated the CWL was the only location of groundwater contamination definitely attributable to SNL/NM activities. For example, one commenter stated that he "believes that sufficient data have been developed to support the attribution to known SNL/NM activities [in] other tech areas in addition to [TA]-III as sources of ground water contamination." Another commenter inquired about concentrations of potassium-40 that have "recently been over the DOE guideline in four wells."

The SWEIS presents data from four other locations of known or suspected groundwater contamination, in addition to the CWL, where SNL/NM activities were the possible cause of contamination. Based on groundwater monitoring data published in 1999, the SWEIS has been revised to state that nitrate contamination at TA-V and petroleum hydrocarbon component contamination at the Lurance Canyon Burn Site are the result of SNL/NM activities. The source of trichloroethene (TCE) contamination at "Sandia North" is still unknown. Concentrations of metals and radioisotopes exceeding groundwater standards, such as potassium-40, have been noted at other locations around KAFB; however, these are naturally occurring elements that appear to be unrelated to human activities.

1.7.4.4 Surface Water

Several comments focused on the adequacy of surface water sampling and analyses that SNL/NM has performed, the methodology used in the surface water impacts analysis, and exceedance of permit limits in runoff from TAs-I, -II, and -IV. One commenter questioned the conclusions of the analysis, stating that "[t]he two important areas, III and V, have no routine surface water monitoring or surface water monitoring stations," and that "[t]aking occasional surface water samples at the CWL does not provide the same level of assurance as provided by continuous monitoring." Another commenter stated "[i]t is...unclear whether relevant analyses were conducted on surface waters (priority pollutants, organic compounds, tritium, gross alpha) in order to determine if water quality concentrations exceeded those known to be toxic or that are protective." One commenter criticized the comparison of surface water sample analyses to New Mexico Water Quality Control Commission standards, stating the "analysis of impacts to surface water quality was unnecessarily restricted to regulatory limits." Several commenters took issue with the SWEIS statement that there was no evidence of contamination of runoff from SNL/NM activities. One commenter asserted that this "statement is directly contradicted by SNL/NM own report...The analytical results...show that iron and zinc exceeded permit limits...by a large margin."

The DOE believes that the sampling program discussed in the SWEIS provides the best available data and methods for determining the contribution of contaminants from SNL/NM facilities. The surface water quality analysis was not restricted to regulatory limits. In addition to regulated constituents, surface water sampling data used in the analysis included 12 metals, 7 anions, 11 explosives, and 7 radionuclides for which there are no regulatory limits. These data provide no evidence of contamination from SNL/NM facilities. As to exceedance of permit limits in runoff from TAs-I, -II, and -IV, low flow at these monitoring stations requires placement of the sample intake tube on the bottom of the drainage channel. This has caused the introduction of a greater amount of suspended solids than is representative of the runoff. During the laboratory analysis of these samples, minerals naturally occurring in the suspended solids, such as zinc and iron, can appear at higher concentrations as well. There are no known SNL/NM activities or discharges to surface water in the areas monitored by these stations that would cause permit exceedances of zinc and iron.

1.7.4.5 Biology

A number of commenters requested that the SWEIS include more quantitative information about biological resources onsite and the potential impact to these resources and further support of statements made in the SWEIS about beneficial biological impacts of SNL/NM activities. One commenter stated, "[t]he amount of improvement in grassland quality, vegetative productivity, and beneficial changes to the grassland community was not quantified or is without citation." Another commenter asked "[i]s the quality of grasslands, the reintroduction of the gramma grass cactus, the siting of a raptor, and the absence of contaminant loads of radionuclides in rodents ample enough evidence to apply such a broad sweeping statement to the 60-odd species of plants and animals mentioned in the study?"

Studies and reports used in arriving at the conclusion that "beneficial impacts to biological and ecological resources would occur under all alternatives" were prepared by several entities, including the DOE, SNL/NM, the USAF, and the USFS. These studies and reports are cited in the SWEIS.

1.7.4.6 Socioeconomics

Socioeconomic comments centered primarily on the definition of the region of influence (ROI). One commenter stated, "[d]efining the SNL/NM socioeconomic [ROI] as Bernalillo, Sandoval, Torrance and Valencia counties overstates, in my view, the socioeconomic impact of SNL/NM in central New Mexico. For example, the northwestern portion of Sandoval county includes the eastern extent of Navajo Indian trust lands and the southernmost part of the Jicarilla Apache Indian Reservation. The socioeconomics of this area are not impacted in the least by SNL/NM's operations, as would also be the case for most of Torrance county more than a few miles south of the I-40 corridor." Further, he stated, "by not including the southernmost part of Santa Fe county along I-40 in the ROI, the SWEIS excludes from consideration the burgeoning community of Edgewood, which certainly is home to many SNL/NM employees."

The current four-county ROI is a reasonable basis for assessing SNL/NM-related socioeconomic impacts because 97.5 percent of SNL/NM employees reside in the four-county area. The analysis performed in the SWEIS mirrors annual studies prepared by New Mexico State University, which are publicly available (*The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico: Fiscal Year 1996* [DOE 1997b]; *The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico: Fiscal Year 1997* [DOE 1998j]). These studies provide an excellent basis for comparing economic activity, income, and employment changes resulting from the three alternatives within the four-county area. In addition, refining the analysis to add or subtract parts of other counties would not visibly change the results of the four-county analysis nor the conclusions of this analysis.

1.7.4.7 Environmental Justice

Comments on environmental justice criticized two aspects of the methodology: the use of a high threshold in defining a minority area, and the logic of stating that there can be no significant environmental justice issues within a particular resource analysis because no significant environmental impacts were identified. One commenter stated "[a] 25 percent minority population threshold was utilized in the [environmental justice] analyses of both the Pantex and Los Alamos National Laboratory SWEIS', so why is this more sensitive standard not used in the SNL/NM SWEIS? The treatment of Environmental Justice in the Draft SWEIS is nothing more than a whitewash, literally and figuratively, in my opinion." This commenter further states "[w]ith only a few exceptions mainly in the northeast part of Albuquerque, nearly every 1990 Census tract within the 50-mile radius circle has a population which is at least 25 percent minority, thus warranting scrutiny from an Environmental Justice perspective." Questioning the logic of the environmental justice analysis, the commenter states "[t]he flow of the arguments is as follows: there are no adverse impacts in the ROI as a whole (for each resource area), so therefore, there can be no disproportionate and adverse impacts for any minority or low income subarea of the ROI...Not true, as minimal knowledge of the history of the Environmental Justice movement would reveal in case after case historically, a large area around, say, an oil refinery appeared environmentally sound, but in neighborhoods immediately adjacent to the refinery, a low income minority population was devastated by contaminants from the facility."

In determining the threshold for identifying minority populations, the analysis considered the guidance contained in *The Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997). This document suggests identifying areas where "...the minority population of the affected area exceeds 50 percent." *Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (EPA 1998d) also recommends identifying areas where minority populations exceed 50 percent. The DOE recognizes there are different approaches for analyzing environmental justice impacts. However, because the 1990 Census reported New Mexico's minority population at 49 percent, it was determined that 49 percent should be the threshold. All resources were analyzed on an individual basis for environmental justice impacts and, in addition, five were evaluated in detail (water resources, cultural resources, air quality, human health, and transportation). Only one resource area, water resources, was determined to have adverse impacts, and the impacts affect all communities equally. No disproportionately high and adverse impacts were identified for any of the alternatives.

1.7.4.8 Cumulative Effects

Many of the comments on cumulative effects centered on questions about accidents. One commenter asked if there was even a remote possibility, "that an airplane crash into [TA-V] could trigger nuclear reactions" at a nearby KAFB munitions storage facility. The commenter further asks "could a severe earthquake in the area result in a similar sequence of events?" Another commenter wanted more specific information on accidents involving large military aircraft at KAFB, particularly accounting for fuel load and cargo capacity, to better understand the potential risks.

A USAF-prepared EA (USAF 1986) for the munitions storage facility states that the innovative physical design of the facility "all but eliminates" the possibility of a falling aircraft penetrating such a below-ground structure. The aircraft accident analysis did not have to include the impact of aircraft fuel or cargo, because it assumed that the impact of any aircraft, regardless of fuel load or cargo, would create worst-case conditions that would affect all of a building's hazardous material at risk.

1.7.5 Changes to the Draft SWEIS

The DOE revised the Draft SWEIS in response to the comments received from other Federal agencies; tribal, state, and local governments; nongovernmental organizations; the general public; and internal reviews. The text was changed to provide additional environmental baseline information, correct inaccuracies, make editorial corrections, and provide additional discussions of technical considerations to respond to comments and clarify text. In addition, the DOE updated information due to events or decisions made in other documents since the publication of the Draft SWEIS for public comment in April 1999.

Where appropriate, the DOE corrected the Final SWEIS in response to comments.

1.7.5.1 Preferred Alternative

The DOE did not present a Preferred Alternative in the Draft SNL/NM SWEIS. The DOE has now selected the Expanded Operations Alternative, exclusive of the MESA Complex, as its Preferred Alternative. Under the Expanded Operations Alternative, the DOE would expand operations at SNL/NM as the need arose (until 2008), subject to the availability of congressional appropriations, to increase the level of existing operations to the highest reasonable foreseeable activity levels that are analyzed in the SWEIS. The Preferred Alternative would only implement expansion at the existing MDL facility, without addition of the MESA Complex.

1.7.5.2 The Microsystems and Engineering Sciences Applications (MESA) Complex of the Microelectronics Development Laboratory

In the Draft SWEIS, the MDL was identified as operating as a research, development, and fabrication facility. A single configuration with no new construction was presented and MDL operations were described as focusing on the fabrication of approximately 7,500 silicon-based wafers. In the Final SWEIS, the Expanded Operations Alternative has two configurations: 1) to support R&D and production of silicon-based microelectronic devices; or 2) to support R&D and production of silicon-based microelectronic devices along with producing war reserve microsystems-based components with specialty alloys (such as gallium arsenide and indium arsenide).

Under the first configuration, there would be no construction of new facilities for the expanded wafer production and the CSRL (Building 893) would remain in operation at its present location.

The second configuration (a developing proposal) would result in the construction of a new laboratory and other buildings comprising the MESA Complex.

The MESA Complex configuration (including R&D) would produce a mix of 7,500 silicon/specialty alloy wafers per year. The DOE has identified a need related to the surety improvements in weapon systems incorporating microelectronics, microoptics, and microelectromechanical systems in these silicon/specialty alloy wafers. The estimated $300 million project would integrate and leverage the scientific and technological capabilities existing separately at the MDL and CSRL in a new laboratory, replacing the outdated CSRL, collocated adjacent to the current MDL. The project would include retooling existing operations. Related infrastructure needs would include laboratories, offices, and gas storage. If the developing proposal for the MESA Complex configuration were to become operational (about 2003), the DOE would phase out and eventually decommission and decontaminate the existing CSRL.

For more information regarding the DOE's NEPA strategy, see the *Proposed Action and Alternatives Section* of the Summary and Section 1.3 of the Final SNL/NM SWEIS.

1.7.5.3 Microsystems and Engineering Sciences Applications (MESA) Complex Impacts

The Expanded Operations Alternative analysis presents impacts of constructing and operating the MESA Complex project, primarily water usage and accident scenarios, based on preliminary information from the ongoing conceptual design work.

Water use would increase from 495 million gallons per year to 499 million gallons per year if the MESA Complex became operational; however, the DOE and SNL/NM are committed to reducing SNL/NM-wide water use by 30 percent based on 1996 usage. Accident scenarios are discussed below.

The impacts of chemical accident and site-wide earthquake scenarios have changed, primarily due to changes in Emergency Response Planning Guideline Level 2 (ERPG-2) and the addition of the MESA Complex into one of the configurations under the Expanded Operations Alternative. The ERPG-2 guidelines for some chemicals, including arsine and phosphine, became more restrictive after the Draft

SWEIS was published. The stricter guidelines affected which chemical accident scenarios would have the greatest impacts and increased the impacts of the site-wide earthquake chemical releases under all alternatives.

Further, the addition of the proposed MESA Complex into one configuration under the Expanded Operations Alternative, which would include the relocation of CSRL as part of the MESA Complex, affected the dominant chemical accident scenarios.

1.7.6 Next Steps

The SWEIS ROD, which the DOE will publish no sooner than 30 days after the EPA issues the Notice of Availability of the Final SWEIS, will explain all factors, including environmental impacts, that the DOE considered in reaching its decision. In addition, the ROD will identify the environmentally preferred alternative or alternatives.

1.8 RELATED NEPA DOCUMENTS

The following NEPA documents analyzed ongoing programs and activities at SNL/NM:

- Final *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS 0236-F) (DOE 1996a).
- Final *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE/EIS-0200-F) (DOE 1997i).
- *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE/EIS-0249-F) (DOE 1996b).
- *Nonnuclear Consolidation Environmental Assessment* (DOE/EA-0792) (DOE 1993c).
- *Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* (DOE/EA-1140) (DOE 1996c).
- Final *Rapid Reactivation Project Environmental Assessment* (DOE/EA-1264) (DOE 1999a).
- *Environmental Assessment of the Radioactive and Mixed Waste Management Facility* (DOE/EA-0466) (DOE 1993a).
- *Environmental Assessment for Operations, Upgrades, and Modifications in SNL/NM Technical Area-IV* (DOE/EA-1153) (DOE 1996g).
- *Environmental Assessment for the Processing and Environmental Technology Laboratory (PETL)* (DOE/EA-0945) (DOE 1995d).
- *Neutron Generator/Switch Tube Prototyping Relocation Environmental Assessment* (DOE/EA-0879) (DOE 1994a).

1.8.1 Stockpile Stewardship and Management Programmatic Environmental Impact Statement (DOE/EIS-0236-F)

The DOE prepared the SSM PEIS and evaluated stockpile stewardship activities required to maintain a high level of confidence in the safety, reliability, and performance of nuclear weapons in the absence of underground testing and to be prepared to resume underground testing of nuclear weapons if directed by the President (DOE 1996a). Stockpile management activities include maintenance, evaluation, repair, or replacement of weapons in existing stockpiles.

The SSM PEIS examined the existing basic capabilities of the DOE laboratory and industrial complex, including those of SNL. The ROD for the PEIS determined SNL would continue as one of three weapons laboratories possessing most of the core intellectual and technical competencies of the U.S. in nuclear weapons.

1.8.2 Final *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE/EIS-0200-F)

In the Waste Management Programmatic Environmental Impact Statement (WM PEIS), the DOE evaluated the environmental impacts of alternatives for managing five types of radioactive and/or hazardous waste generated by defense and research activities at a variety of DOE sites around the U.S. SNL/NM manages four of the five waste types: low-level waste (LLW), low-level mixed waste (LLMW), transuranic (TRU) waste, and hazardous waste. The DOE decided on January 23, 1998, that SNL/NM TRU waste would be sent to Los Alamos National Laboratory for storage pending disposal (63 FR 3629), and on August 5, 1998, that SNL/NM would continue to ship its hazardous waste offsite for treatment (DOE 1998m). The DOE has not yet decided on a national strategy for treatment and disposal of LLW and LLMW; but under the preferred alternatives for both waste types, SNL/NM would treat its own waste onsite, then ship it offsite for disposal.

1.8.3 *Medical Isotopes Production Project Environmental Impact Statement* (DOE/EIS-0249-F)

The DOE prepared the Medical Isotopes Production Project (MIPP) EIS and evaluated the domestic production of molybdenum-99 and related medical isotopes (DOE 1996b). The MIPP EIS's five alternatives regarding the production of a reliable domestic supply of molybdenum-99 included a baseline production level of 10 to 30 percent of the current U.S. demand and the capability to increase production to supply 100 percent of the U.S. demand.

The MIPP EIS evaluated the ACRR capabilities, target fabrication, target processing at the Hot Cell Facility (HCF), and waste management capabilities at SNL/NM. The ROD for the MIPP EIS determined SNL/NM would become a domestic producer and supplier of molybdenum-99 (61 FR 48921).

1.8.4 *Nonnuclear Consolidation Environmental Assessment* (DOE/EA-0792)

The DOE prepared the *Nonnuclear Consolidation Environmental Assessment* and evaluated the consolidation of nonnuclear component manufacturing, storage, and surveillance functions (DOE 1993c). The EA discussed six categories of capabilities: electrical/mechanical; tritium handling; detonation; beryllium technology and pit support; neutron generators, cap assemblies, and batteries; and special products.

The Finding of No Significant Impact (FONSI) for the EA determined the significance of impacts for the continuation of SNL/NM's existing research, development, testing, and prototyping capability, which would be augmented to provide the necessary fabrication capability for future neutron generators, cap assemblies, and other nonnuclear components (DOE 1993c).

1.8.5 *Environmental Assessment of the Environmental Restoration Project at SNL/NM* (DOE/EA-1140)

The DOE prepared the Environmental Restoration (ER) Project EA and FONSI. The EA evaluated the environmental impacts of site restoration characterization and waste cleanup activities (corrective actions) at SNL/NM (DOE 1996c). The corrective actions included a range of waste treatment options at a currently estimated 182 ER Project sites. The corrective measures implement treatment technologies that are reasonable, feasible, and capable of being implemented to achieve regulatory compliance.

1.8.6 *Rapid Reactivation Project Environmental Assessment* (DOE/EA-1264)

The Rapid Reactivation Project EA analyzed alternatives for continued neutron generator production. The DOE's FONSI covers the proposed alternative that increases the annual neutron generator production capacity from its current level of 600 to 2,000. Existing buildings and infrastructure would be used to the maximum extent possible to meet the additional production needs. The addition of approximately 26,290 gross square feet of facility space and other facility modifications would be necessary to achieve the proposed production capacity.

1.8.7 *Environmental Assessment of the Radioactive and Mixed Waste Management Facility* (DOE/EA-0466)

The DOE prepared the Radioactive and Mixed Waste Management Facility (RMWMF) EA and FONSI for the proposed completion of construction and subsequent operation of the RMWMF in TA-III. The RMWMF was designed to receive, store, characterize, conduct limited bench-scale treatment of, repackage, and certify LLW and LLMW for shipment to an offsite disposal or treatment facility.

1.8.8 *Environmental Assessment for Operations, Upgrades, and Modifications in SNL/NM Technical Area-IV* (DOE/EA-1153)

The EA for Operations, Upgrades, and Modifications in SNL/NM Technical Area-IV and the FONSI were prepared by the DOE for continuing existing operations, modifying an existing accelerator (Particle Beam Fusion Accelerator II) to support defense-related Z-pinch experiments, and constructing two transformer oil storage tanks to support the expansion of the Advanced Pulsed Power Research Module.

1.8.9 *Environmental Assessment for the Processing and Environmental Technology Laboratory (PETL)* (DOE/EA-0945)

In the EA for the PETL at SNL/NM, the DOE analyzed alternatives for the building and operation of the PETL. The DOE proposed constructing the PETL on KAFB and relocating operations from existing facilities to the new building in TA-I. The DOE issued a FONSI associated with the proposed alternative.

1.8.10 *Neutron Generator/Switch Tube Prototyping Relocation Environmental Assessment* (DOE/EA-0879)

The Neutron Generator/Switch Tube Prototyping Relocation EA analyzed two alternatives for expanded prototyping of neutron tubes, neutron generators, and switch tubes. The DOE's proposed action would relocate neutron tube, neutron generator, and switch tube prototyping operations from Buildings 891 and 878 to a Building 870 annex. A prototyping capability for electronic neutron generators would be established in Building 878. The DOE prepared a FONSI for this action.

1.9 COOPERATING AGENCIES

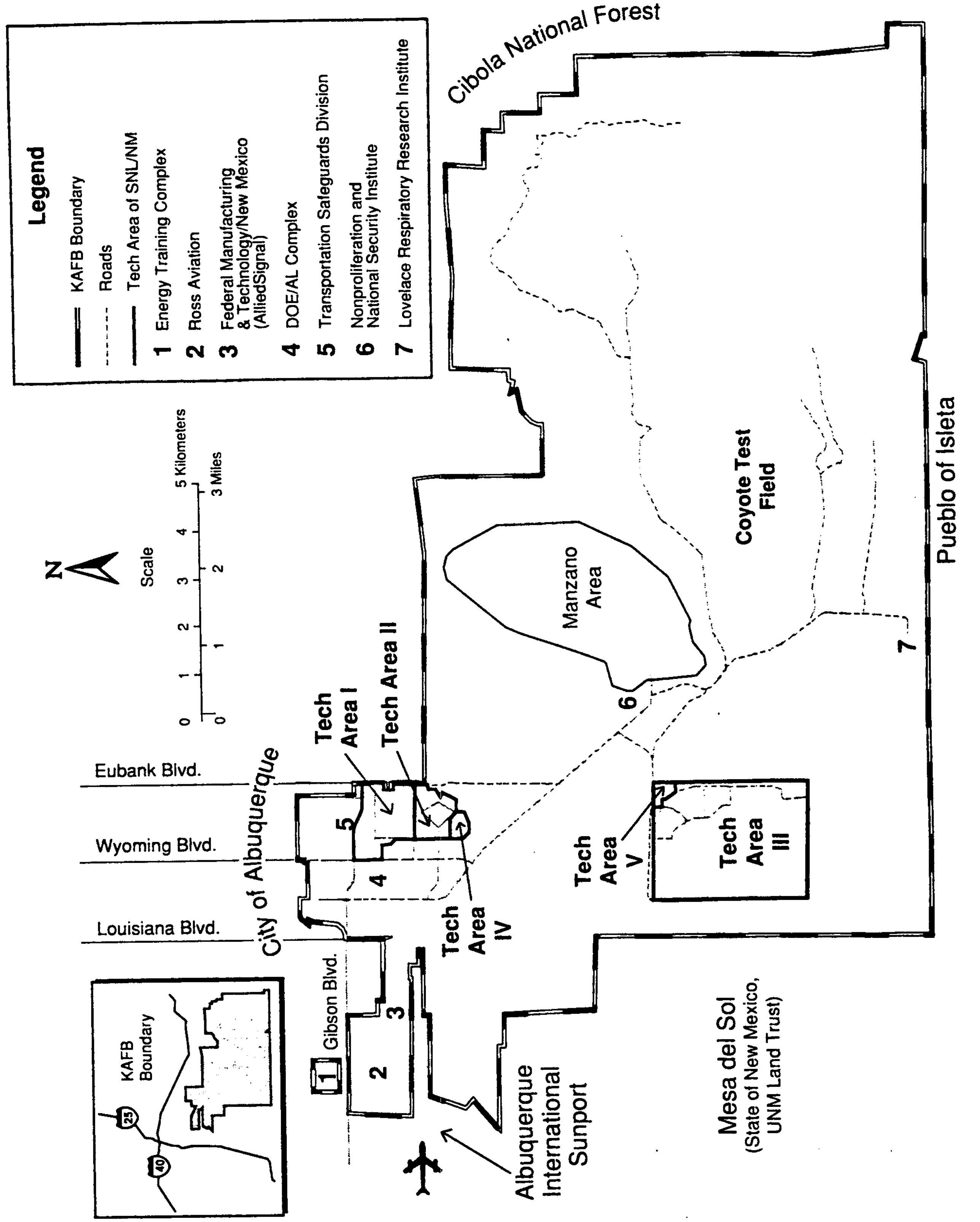
On May 30, 1997, the NOI announced the USAF as a cooperating agency because of the interdependence of KAFB and the DOE planning for SNL/NM. The USAF has participated in planning meetings, developing analytical methodologies and data projections, and reviewing analyses for and predecisional drafts of the SWEIS.

1.10 OTHER DOE OPERATIONS AT KAFB

In addition to SNL/NM, the following DOE-funded facilities are located on KAFB. The impacts from these facilities are not analyzed in Chapter 5 because they are not under the management of SNL. They are analyzed as part of cumulative effects in Chapter 6.

- The Lovelace Respiratory Research Institute, formerly the Inhalation Toxicology Research Institute, is a private business that leases space from the DOE. The Institute began operations in the 1960s as a research facility or determining the long-term health impacts of inhaling radioactive particles. It has since become a recognized center for inhalation toxicology and related fields.
- The Nonproliferation and National Security Institute ensures the efficient and effective training of Safeguards and Security Division personnel from throughout the DOE complex who are, or might become, involved in the protection of materials and facilities vital to the nation's defense.
- The Transportation Safeguards Division (TSD) coordinates, implements, and operates the DOE Safeguards Program that oversees the transport of special nuclear materials (SNM). The TSD coordinates and plans weapons distribution with the DoD and coordinates SNM shipments for all DOE field offices.
- Federal Manufacturing & Technology/ New Mexico, a division of AlliedSignal, is an applied science and engineering organization engaged in research, analysis, testing, and field operations. A major portion of this work is in the design, fabrication, and testing of electro-optic and recording systems for capturing fast transient signals.
- Ross Aviation is the DOE's support contractor providing air cargo and passenger service. Ross transports cargo between production plants, national laboratories, test sites, and military facilities and provides special passenger and cargo flights on request.
- The DOE's Albuquerque Operations Office complex houses DOE and contractor staff.
- The Energy Training Complex consists of classrooms for DOE training.

Figure 1.10–1 shows the approximate locations of these facilities. The above operations, along with KAFB activities, are discussed in more detail in Chapter 6.



Source: SNL/NM 1997j

Figure 1.10–1. Seven Additional DOE Facilities at KAFB

Other DOE-funded operations not related to SNL/NM are located within the boundaries of KAFB.

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CHAPTER 2

Sandia National Laboratories/New Mexico Operations

Chapter 2 provides an overview of Sandia National Laboratories/New Mexico (SNL/NM) operations, programs, and facilities. It begins with a description of the history of the laboratory and site-wide operations, followed by a discussion of SNL/NM support for U.S. Department of Energy (DOE) mission lines, programs, and projects. Descriptions of selected facilities and their operations are located at the end of the chapter.

During World War II, nuclear weapons were designed, developed, and tested entirely at Los Alamos Laboratory. In late 1945, Los Alamos Laboratory began transferring its field-testing and engineering organization, known as Z-Division, to Sandia Base, near Albuquerque. This organization was the nucleus of what became Sandia Laboratory in 1949. The initial focus of the newly formed Sandia Laboratory was on nuclear weapons engineering and production coordination, with a growing emphasis on research and development (R&D) to improve weapons design.

By 1952, Sandia Laboratory focused on weapons development. The laboratory undertook extensive field testing of components, supported the atmospheric tests conducted by its partner laboratories, and established an advanced development group to anticipate future nuclear weapons proliferation, weapons development, and treaty monitoring technological projects.

In the 1960s and early 1970s, the growing emphasis on strengthening engineering applications resulted in new missions lines and programs. These new areas, energy research and safeguards and security, addressed international concerns such as the energy crisis and international terrorism. They remain as current programs in the areas of nuclear, fossil, and renewable energy.

As international arms control efforts increased in the late 1970s and throughout the 1980s, the U.S. emphasized treaty monitoring, safety, security, and control of the national nuclear weapons stockpile. With the end of the Cold War in the late 1980s, the role of SNL/NM (formerly known as Sandia Laboratory), to act as stockpile steward ensuring nonproliferation and continued safety, security, and reliability, took on greater importance.

The DOE uses management and operating (M&O) contractors to manage its facilities, including SNL/NM. SNL/NM was managed and operated by American Telephone and Telegraph (AT&T) from 1949 to 1993. In 1993, the M&O contract was awarded to Sandia Corporation, a subsidiary of Martin Marietta Corporation, now known as Lockheed Martin Corporation.

2.1 SNL/NM SUPPORT FOR DOE MISSION LINES

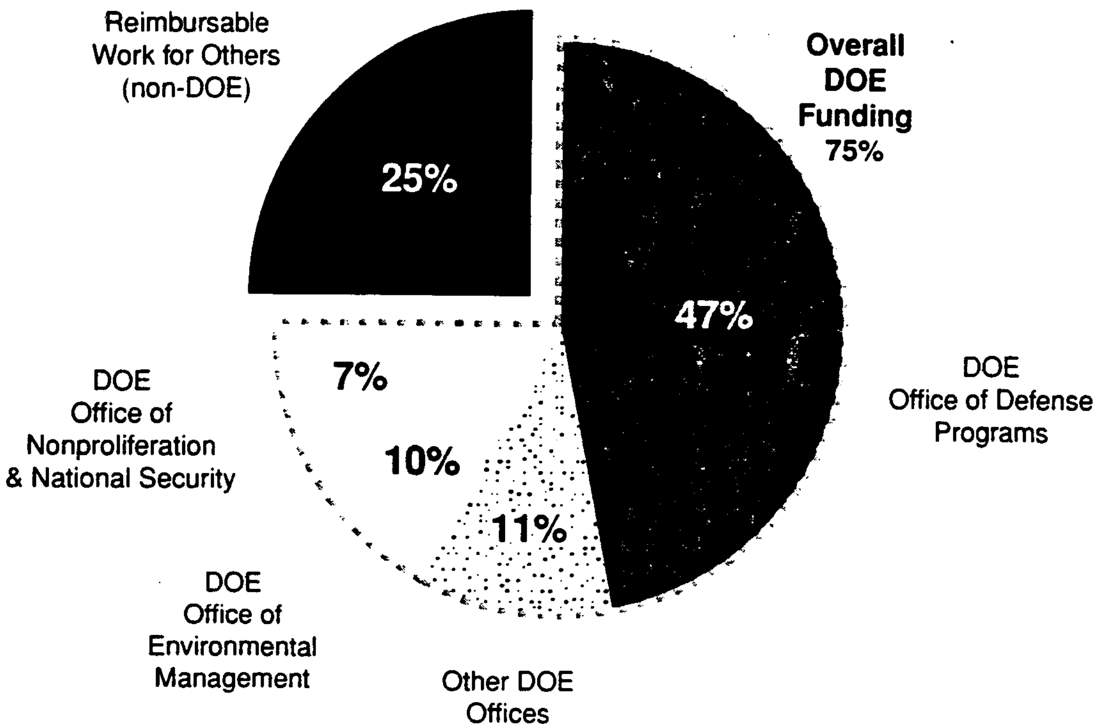
As discussed in Chapter 1, the DOE is responsible for ensuring the safety, reliability, and effectiveness of the nation's nuclear deterrent; fostering a secure and reliable energy system that is environmentally and economically sustainable; reducing the environment, safety, and health risks and impacts from DOE facilities and materials; maintaining leadership in basic research; and advancing scientific knowledge.

SNL/NM has unique capabilities that support the DOE Office of the Assistant Secretary of Defense Programs (DP) and other programs. DP provides approximately 47 percent of SNL/NM's budget (Figure 2.1–1).

SNL/NM conducts R&D activities involving over 90 percent of the individual nonnuclear parts of a typical nuclear weapon.

SNL/NM's primary capabilities, as listed in Chapter 1, are as follows:

- Supporting stockpile surveillance activities of hardened weapons systems and components to ensure these systems function properly when exposed to radiation from hostile sources, whether encountered by satellites and reentry vehicles in space or by the conditions created by nuclear detonations. SNL/NM integrates experimentation and computational simulation in support of radiation effects testing, radiation transport, diagnostics, and analyses to certify that electrical, mechanical, energetic, and other nonnuclear components will operate as designed in such hostile radiation environments.



Source: SNL/NM 1997i

Figure 2.1–1. SNL Funding Sources by Major Program

SNL funding is provided by a variety of major programs.

- Developing specific, limited "piece parts" required to repair deterioration or defects in existing weapons components or to make modifications essential to maintaining deterrent credibility as the existing stockpile continues to shrink and age.
- Characterizing and demonstrating the utility of pulsed-power-generated soft X-ray sources for weapons physics and inertial confinement fusion experiments. SNL/NM combines diagnostics, modeling, and simulation codes in designing, developing, and applying pulsed-power accelerators.
- Developing fundamental capabilities required to take advantage of computational engines ranging from clusters of components to massively parallel units to large state-of-the-art platforms. Expertise ranges from fundamental, broadly applicable efforts to those of a developmental nature, all of which support both high-end computing and specific stockpile systems simulations.
- Conducting computer science research that addresses computational methods and technologies such as numerical methods for designing and processing new stockpile materials, new massively parallel numerical algorithms, and new strategies for code reusability, portability, and debugging. SNL/NM develops codes for simulating shock, high-velocity impact, penetration, or blast, and develops computational techniques that can represent fundamental circumstances and processes with the capability to provide predictive solutions.
- Developing radiation transport models that address three-dimensional radiation deposition for heat-based structure response and heat-based mechanical shock of systems in hostile environments.
- Manufacturing neutron generators, switches, and tubes. SNL/NM provides technical analysis, engineering design, and manufacturing support for nonnuclear components, as well as nonnuclear component dismantlement support.
- Providing sensor development, technical analysis, and export license support for the control and prevention of nuclear and nonnuclear (chemical, biological, explosive, and missiles) proliferation. Detection technology capabilities include airborne, satellite, seismic, and chemical-based monitoring systems.

- Producing a number of medical radioisotopes including iodine-131 and molybdenum-99, the primary isotope used in nuclear medicine in the U.S. SNL/NM supports the development of optimized production and processing, cooperation with private industry, and technology transfer.
- Conducting fundamental energy research in a wide variety of energy resources including electrical energy, energy storage, hydrogen storage (fuel cells), fossil fuels, geothermal technology (wireless telemetry), solar energy technology, photovoltaics (silicon cell), applied wind power technology, and light-water reactor technology.
- Conducting numerous projects that contribute to DOE's science and technology mission. These include activities in scientific computing, basic energy conducting sciences, and magnetic fusion energy; developing methods using computational science research for solving scientific and engineering problems and a software infrastructure for parallel computing; using the performance and cost advantages of massive parallelism to meet critical DOE mission requirements in advanced computing; conducting scientific research, development, and applied engineering on materials and systems in areas of chemistry, physics, material science, biology, and environmental sciences; and designing components for fusion plasma environments.
- Managing, storing, and treating a variety of wastes. SNL/NM also develops technology to improve waste processing and reduce impacts to the environment, including technology applied at long-term waste disposal facilities such as Waste Isolation Pilot Plant (WIPP).
- Restoring, monitoring, and treating a variety of environmental cleanup sites. SNL/NM develops technology (including remote robotics) to improve environmental restoration processes to reduce impacts to the environment.

The DOE directs SNL/NM activities in support of its programs and missions. In turn, SNL/NM's facilities and operations are designed to meet the requirements of the programs, projects, and activities assigned to the laboratory. Figure 2.1–2 illustrates the DOE's funding, by mission, to SNL/NM facilities. Table 2.1–1 lists DOE mission lines by DOE mission and office. Following are brief descriptions of DOE mission assignments to SNL/NM.

2.1.1 SNL/NM Support for DOE's National Security Mission Line

SNL/NM's principal DOE assignments under the National Security mission line focus on the nuclear stockpile and reducing the vulnerability of a reduced stockpile; managing nonnuclear components of nearly every weapon in the U.S. nuclear weapons stockpile; and reducing the vulnerability of the U.S. to threats of proliferation and the use of weapons of mass destruction, to nuclear incidents, and to environmental damage. Following are the major DOE programs under this mission line:

- *Stockpile Stewardship*—Tasks involve stockpile upgrades, material and component tests involving hostile environmental exposures, computer-simulated testing, performance assessments, systems component engineering, chemistry and material science activities, stockpile computations, pulsed-power-driven inertial confinement research, and new technology development.
- *Stockpile Management*—SNL/NM provides capabilities in onsite and offsite manufacturing; design of nonnuclear components, systems, and materials; production support; quality assurance; stockpile surveillance; component dismantlement; and accident response support. SNL/NM supplies, certifies, and tests shipping containers including nuclear component and tritium containers.
- *Nonproliferation*—Material control includes support in the following areas: verification R&D; nuclear safeguards and security; arms control; material protection, control, and accounting; proliferation prevention; and intelligence.

In 1997, SNL/NM undertook 218 R&D projects using DOE-focused technologies and unique SNL/NM science and engineering capabilities (SNL 1998a). Nearly 46 percent of the projects had applications that were national security-related.

2.1.2 SNL/NM Support for DOE's Energy Resources Mission Line

SNL/NM supports DOE assignments under the Energy Resources mission line to enhance the safety, security, and reliability of energy supplies. This work focuses on implications for our nation's security related to the increasing interdependencies among domestic elements and global resources. SNL/NM helps develop strategies to protect the supply of the nation's energy resources. SNL/NM applies science and technology capabilities to develop various

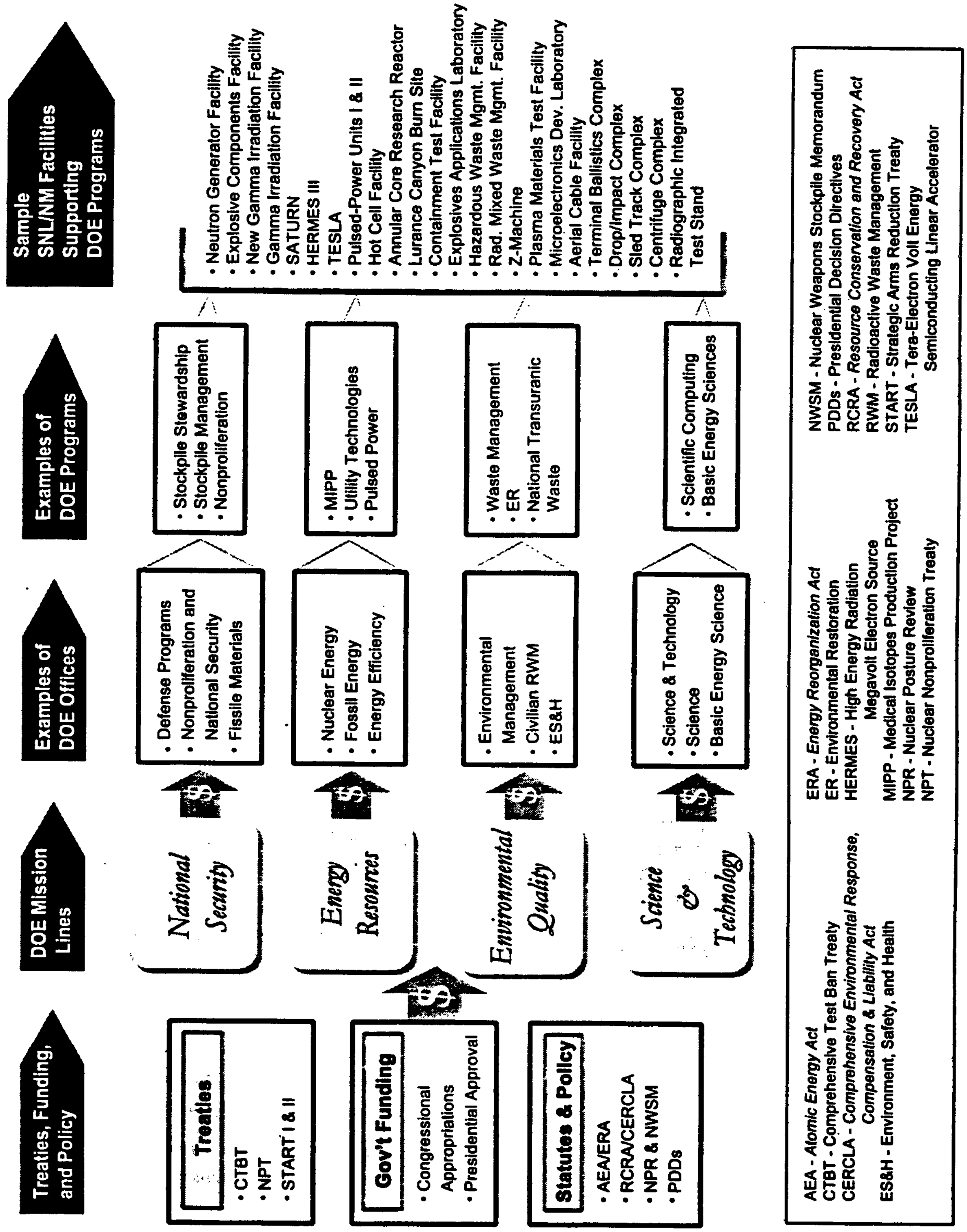


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Figure 2.1–2. Flow of DOE Funding by Mission Line to SNL/NM

The DOE's funding flows through various DOE offices to SNL/NM.

Table 2.1–1. DOE Mission Lines and DOE Office Mission Statements

DOE MISSION LINE	DOE OFFICE	MISSION STATEMENT
National Security	Defense Programs	To ensure the safety, reliability, and performance of nuclear weapons without underground testing
	Nonproliferation & National Security	To support DOE activities related to nonproliferation, nuclear safeguards and security, classification and declassification, and emergency management
	Fissile Materials Disposition	To reduce the global nuclear danger associated with inventories of surplus weapons usable fissile materials
Energy Resources	Nuclear Energy	To support the successful decontamination and decommissioning of nuclear reactor sites; certify next-generation nuclear power plants; ensure the availability of industrial and medical isotopes and radioisotope power systems for space exploration
	Fossil Energy	To enhance U.S. economic and energy security
	Energy Efficiency	To lead the nation to a stronger economy, a cleaner environment, and more secure future through development and deployment of sustainable energy technologies
Environmental Quality	Environmental Management	To develop a clear national cleanup strategy with a strong commitment to results that will gain the trust and confidence of Congress, the states, Native American tribes, and the public
	Civilian Radioactive Waste Management	To develop, construct, and operate a system for spent nuclear fuel and high-level radioactive waste disposal, including a permanent geologic repository, interim storage capability, and transportation system
	Environment, Safety, & Health	To protect the environment and the health and safety of workers at DOE facilities and the public
Science & Technology	Science & Technology	To manage and direct targeted basic research and focused, solution-oriented technology development
	Science	To improve and advance the science and technology foundations and effective use and management of DOE laboratories
	Basic Energy Science	To advance the scientific and technical knowledge and skills needed to develop and use new and existing energy resources in an economically viable and environmentally sound manner

Source: DOE 1997c

technologies. Following are the major DOE programs under this mission line:

- *Medical Isotopes Production*—Tasks include developing a U.S. source for the molybdenum-99 isotope and other isotopes that have widespread medical applications. The project uses the Annular Core Research Reactor (ACRR) and the Hot Cell Facility (HCF). Detailed information is provided in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b).
- *Utility Technologies*—Utility technologies support includes developing clean, renewable, and more economical sources of electricity. SNL/NM supports aggressive R&D in photovoltaic, solar thermal, wind, geothermal, hydropower, and biomass power technologies and systems.
- *Pulsed-Power*—Pulsed-power tasks include developing fusion capabilities and experimenting with X-ray sources for understanding harsh electromagnetic, shock, and debris environments. SNL/NM supports R&D in radiography and accelerator technology.

Of the 218 R&D projects undertaken by the DOE in 1997, about 16 percent had applications that were energy resource-related.

2.1.3 SNL/NM Support for DOE's Environmental Quality Mission Line

SNL/NM supports DOE assignments under the Environmental Quality mission line with onsite waste operations and developing technology, (for example, transuranic [TRU] waste containers) for national environmental problems. Activities include some treatment, temporary storage, and offsite disposal of hazardous waste, low-level waste (LLW), low-level mixed waste (LLMW), TRU, mixed transuranic (MTRU) waste, and solid wastes generated by ongoing mission-related activities. Environmental restoration activities are ongoing at SNL/NM, with most remedial actions scheduled for completion by the end of 2004. Following are the major DOE programs under this mission line:

- *Waste Management*—Tasks include some treatment, storage, and offsite disposal of wastes in a manner that is safe to humans and the environment. The Hazardous Waste Management Facility (HWMF) and Radioactive and Mixed Waste Management Facility (RMWMF) manage a variety of wastes in accordance with applicable laws, permits, and regulations.
- *Environmental Restoration*—Environmental restoration activities include the assessing and cleaning up of inactive sites contaminated from previous defense and nondefense-related programs. SNL/NM activities are conducted in accordance with applicable Federal, state, and local laws and regulations.
- *National TRU Waste Program*—Activities include site assessments, performance assessments, regulatory compliance support, and science research in support of the WIPP.

Of the 218 R&D projects undertaken by the DOE in 1997, about 24 percent had applications that were environmental quality-related.

2.1.4 SNL/NM Support for DOE's Science and Technology Mission Line

SNL/NM's facilities and expertise are used in support of the Science and Technology mission line through R&D in modeling and simulation testing, physical sciences, and advanced chemical and materials sciences. SNL/NM activities include developing radiation-hardened microelectronic components; computer-based testing, modeling, and simulation; and pulsed-power technology. Following are the major DOE programs under this mission line:

- *Scientific Computing*—Advanced mathematical modeling, computational R&D, communication sciences, and information technologies.
- *Basic Energy Sciences*—R&D in material sciences, chemical sciences, energy biosciences, and engineering.

Of the 218 R&D projects undertaken by the DOE in 1997, about 15 percent had applications that were science and technology-related.

2.2 REIMBURSABLE WORK FOR OTHERS

SNL/NM performs reimbursable work for other Federal agencies and sponsors, including the private sector. This work, also known as work for others (WFO), must be compatible with the DOE mission work conducted at SNL/NM and must be work that cannot reasonably be performed by the public sector. Approximately 25 percent of SNL's funding comes from reimbursable work for agencies and organizations other than the DOE (Figure 2.1–1). SNL/NM activities support other Federal departments and agencies. The major agencies include the U.S. Department of Defense, U.S. Nuclear Regulatory Commission, U.S. Department of Transportation (DOT), National Aeronautics and Space Administration, Department of State, and U.S. Environmental Protection Agency (EPA). Details regarding WFO support activities and projects are provided in SNL/NM's *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b), and the *SNL Institutional Plan FY 1998-2003* (SNL 1997b).

Universities and approved researchers can use SNL/NM facilities to conduct research. SNL/NM collaborates with the University of New Mexico in the materials science area.

2.3 SNL/NM FACILITIES: A FRAMEWORK FOR IMPACTS ANALYSIS

As discussed above, SNL/NM provides a diverse set of capabilities that support DOE's mission lines through various programs. The major consideration in deciding to analyze impacts by facility rather than by program was the complexity of the analysis. Any given program may use operations in more than one facility, and many facilities serve multiple programs. An analysis of environmental impacts requires knowledge of particular activities in a particular place over a known span of time in order to project the effect those activities will have on the surrounding environment. A presentation of impacts by program would require that impacts from operations at each facility be subdivided into the contribution from each program using the facility. The resulting impacts would then have to be reassembled by program. The complexity of analysis would greatly increase, and the clarity of the presentation would suffer. Therefore, the DOE chose to group the operations to be analyzed by facility.

To accomplish this objective, the DOE used the results of a detailed survey distributed throughout SNL/NM to develop a database containing pertinent information about the approximately 670 buildings in the 5 technical areas (TAs) and the structures in the Coyote Test Field. An initial screen of these facilities, along with the details of how the screen was performed, is described and the facilities are listed in the FSID (SNL/NM 1997b).

This list was then further assessed and refined by qualitatively evaluating the types of operations performed, identifying those with the highest potential for environmental impacts or concerns, and then grouping them according to function and location. Key qualitative criteria used in the final screen identified facilities or facility groups with operations that have generated important public concern in the past or have a relatively greater impact to the environment, safety, and health. The criteria used in this final screening process are described in Section 2.3.1 and illustrated in Figure 2.3–1.

The operations within these facilities or facility groups are the basis for differentiating among the three alternatives analyzed in the SWEIS and any associated environmental impacts. Taken together, these facilities and facility groups represent the majority of exposure risks associated with continuing operations at SNL/NM. They represent

- over 99 percent of all radiation doses to SNL/NM personnel.
- over 99 percent of all radiation doses to the public.
- from 81 to 99 percent of stationary source criteria pollutants (nitrogen dioxide, carbon monoxide, particulate matter less than 10 microns in diameter [PM_{10}], and sulfur dioxide), depending on the alternative. This does not include hazardous air pollutants or toxic air pollutants, which instead are analyzed on a site-wide basis in the SWEIS. The remaining stationary source criteria pollutants would be associated with backup generators.
- all waste volumes, including radioactive wastes, Environmental Restoration (ER) Project wastes, and hazardous wastes, which are accounted for in analyses of infrastructure, radiological air quality, transportation, and waste generation.

2.3.1 Facility Screening Process

To be selected for detailed analysis, a facility or facility group had to meet one or more of the following criteria:

- be known to have generated an important public concern;
- conduct operations that have the potential to affect the environment, safety, and health;
- be a critical element of one of SNL/NM's principal missions; and/or
- be anticipated to expand over the next 10 years, likely resulting in the need for additional *National Environmental Policy Act* (NEPA) documentation.

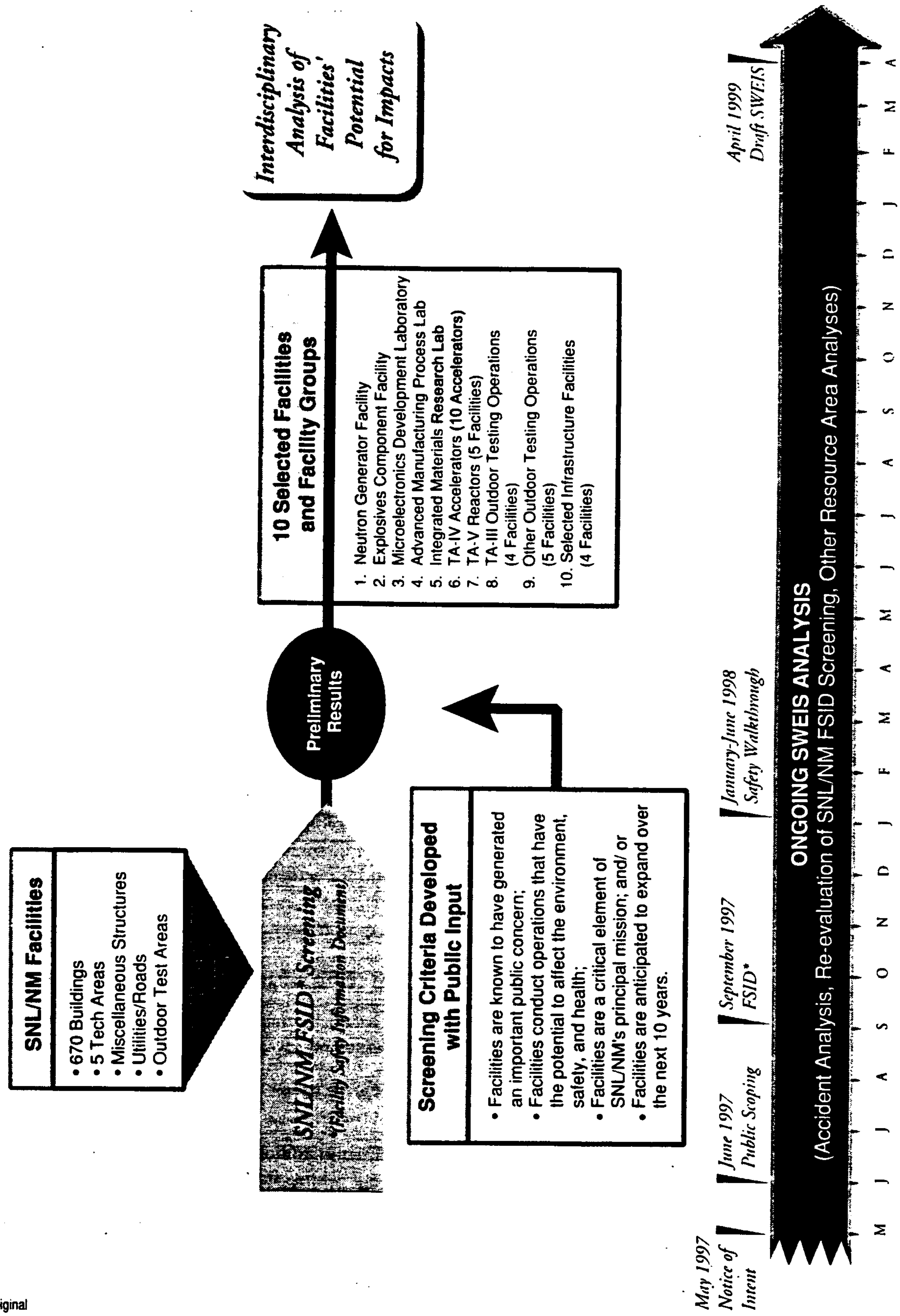

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Figure 2.3–1. SWEIS Analysis of SNL/NM Facilities

An SNL/NM facility screening process was used during SWEIS analysis of potential impacts.

2.3.2 Framework for Analysis

The SWEIS evaluates SNL/NM facilities and operations and their effects on environmental conditions under the three alternatives. Because of their importance, potential environmental impacts from the selected facilities are described and evaluated in greater detail than other SNL/NM facilities. This in-depth look at selected facilities provides the framework for analyzing impacts.

For completeness of analysis, the DOE also gathered information on the balance of operations at SNL/NM. Information regarding other facilities, site support services, water and utility use, waste generation, hazardous chemicals purchased for use, process wastewater, and radioactive dose data were incorporated into the analysis. The DOE examined all nuclear/radiological facilities and hazardous nonradiological facilities and associated DOE-approved safety documents (for example, safety analysis reports, safety assessments, and hazard assessments) for SNL/NM facilities. In addition, facility walk-throughs and interviews were performed to ensure that all hazards and safety concerns were properly captured in the accident analysis. This information is included in the current environmental consequences (Chapter 5) and Appendix F. In addition, some aspects of the impact analysis considered individual facility operations, regardless of whether the entirety of the facility met the criteria for detailed analysis. These aspects included evaluating chemical air emissions and radiological air emissions. This type of specific information, as well the contribution to impacts in all resource areas from the balance of operations at SNL/NM, including ongoing R&D activities, is included in the analysis of each alternative.

The following sections provide an overview of the TAs at SNL/NM and describe the facilities the DOE identified for detailed analysis.

2.3.3 Technical Areas

DOE mission lines are executed at SNL/NM through program funding at multiple facilities. Facility operations are conducted within five TAs and many additional outdoor test areas, including an area of test facilities known as the Coyote Test Field. These TAs comprise the basic geographic configuration of SNL/NM. Figure 2.3–2 shows the locations of the five TAs. TA-I is the main administration and site support area and contains several laboratories. TA-II consists primarily of support service facilities along with the new Explosive Components Facility (ECF), several active and inactive waste management facilities, and vacated facilities replaced by the ECF. TA-III is devoted primarily to physical testing, TA-IV contains primarily accelerator operations, and TA-V contains primarily reactor facilities. The Coyote Test Field and the Withdrawn Area are used primarily for outdoor testing. A complete listing of all the facilities in each TA is presented in the FSID (SNL/NM 1997b).

2.3.4 Selected SWEIS Facilities

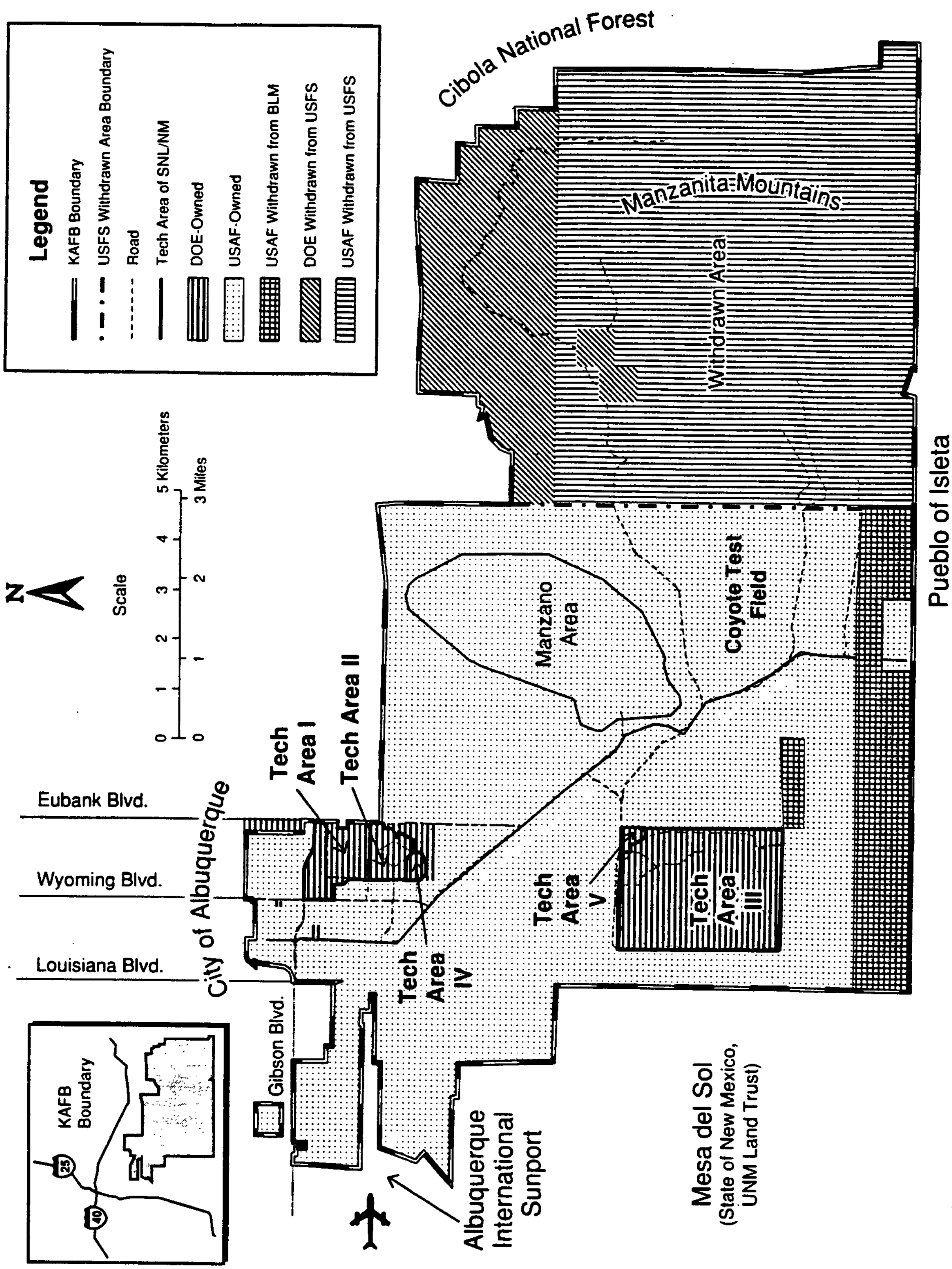
Table 2.3–1 identifies the 10 facilities or facility groups selected for in-depth analysis. Taken together, these facilities represent the main activities at SNL/NM that have the potential to affect the environment, have generated public concern, are critical to SNL/NM's missions, or are anticipated to expand over the next 10 years. TA-I and TA-II contain five selected facilities that fall into the categories of manufacturing, R&D laboratories, and testing described in Section 2.3.4.1, below. The five other selected facility groups include the following:

- physical testing and simulation facilities (TA-III) (Section 2.3.4.2),

Table 2.3–1. Facilities/Facility Groups Selected for Analyzing SNL/NM Operations

SELECTED FACILITIES/FACILITY GROUPS	LOCATION
1. *Neutron Generator Facility*	TA-I
2. *Microelectronics Development Laboratory*[a]	TA-I
3. *Advanced Manufacturing Processes Laboratory*	TA-I
4. *Integrated Materials Research Laboratory*	TA-I
5. *Explosive Components Facility*	TA-II
6. *Physical Testing and Simulation Facilities*	TA-III
7. *Accelerator Facilities*	TA-IV
8. *Reactor Facilities*	TA-V
9. *Outdoor Test Facilities*	Coyote Test Field and Withdrawn Area
10. *Selected Infrastructure*	TA-I and TA-III

Source: SNL/NM 1997b
TA: technical area
[a] Under the Expanded Operations Alternative, the Microelectronics Development Laboratory could become part of the Microsystems and Engineering Sciences Applications Complex.



Source: SNL/NM 1997j

Figure 2.3–2. Locations of Technical Areas and Outdoor Test Facilities on Kirtland Air Force Base

SNL/NM conducts operations within five technical areas and several outdoor test areas, including the Coyote Test Field.

- accelerator facilities (TA-IV) (Section 2.3.4.3),
- reactor facilities (TA-V) (Section 2.3.4.4),
- outdoor test facilities (including Coyote Test Field and the Withdrawn Area) (Section 2.3.4.5), and
- selected infrastructure facilities (Section 2.3.4.6).

2.3.4.1 Manufacturing, R&D Laboratories, and Testing Facilities

The five selected facilities located in TA-I and TA-II are described below (SNL/NM 1997b).

- *Neutron Generator Facility (NGF)*—Manufactures neutron generators, which provide a controlled source of neutrons.
- *Microelectronics Development Laboratory (MDL)*—Performs R&D and fabricates custom and radiation-hardened microelectronics. Under the Microsystems and Engineering Sciences Applications (MESA) Complex configuration for the Expanded Operations Alternative, the MESA Complex, a proposed state-of-the-art facility, could provide a unique capability in research and development of microsystems-based components in limited quantities as needed to support planned weapon refurbishments. The MESA Complex (a developing proposal) would enhance current MDL capabilities in the areas of micromachines, microsensors, photonics, and microelectronics, including silicon and compound semiconductors (such as alloys of gallium arsenide and indium arsenide). See Facility Descriptions at the end of Chapter 2 for additional information on the MESA Complex.
- *Advanced Manufacturing Processes Laboratory (AMPL)*—Performs R&D of technologies, practices, and unique equipment and fabricates prototype hardware for advanced manufacturing processes.
- *Integrated Materials Research Laboratory (IMRL)*—Performs R&D of semiconducting and other specialized materials, including silicon processing and equipment development and materials synthesis, growth, processing, and diagnostics.
- *Explosive Components Facility (ECF)*—Performs R&D and testing of explosives components, neutron generators, batteries, and explosives.

2.3.4.2 Physical Testing and Simulation Facilities

TA-III is composed of numerous principal buildings and structures devoted to the physical testing and simulation of a variety of natural and induced environments. The facilities include extensive environmental test facilities, such as sled tracks, centrifuges, and a radiant heat facility. Other facilities include an inactive paper incinerator; a large melt facility; and the formerly used Chemical Waste, LLW, and LLMW landfills. Major outdoor operations located in TA-III include the following (SNL/NM 1997b):

- *Terminal Ballistics Complex*—Provides a test environment for ballistics studies and terminal effects.
- *Drop/Impact Complex*—Provides a controlled environment for high velocity impact testing on hard surfaces, water impact testing, and underwater testing.
- *Sled Track Complex*—Simulates high speed impacts of weapons shapes, substructures, and components to verify design integrity, performance, and fuzing functions; tests parachute systems to aerodynamic loads.
- *Centrifuge Complex*—Simulates the forces of acceleration produced by missiles and aircraft for test packages that include satellite systems, re-entry vehicles, rocket propellants, sensing devices of weapons, and weapons system components.

2.3.4.3 Accelerator Facilities

TA-IV contains several inertial-confinement fusion research and pulsed-power research facilities. Facilities include a large "Z-pinch" accelerator known as the Z-Machine, and the Simulation Technology Laboratory (STL), which houses seven pulsed-power accelerators that simulate the effects of nuclear detonations on nonnuclear components and subsystems. The accelerators are also used to conduct research on inertial-confinement fusion and particle-beam weapons. Another accelerator facility, SATURN, and a research facility are also located in TA-IV. Accelerator operations located in TA-IV are described below (SNL/NM 1997b).

- *SATURN Accelerator*—Simulates X-ray radiation effects of nuclear weapons on electronic and material components.
- *High-Energy Radiation Megavolt Electron Source III (HERMES III) Accelerator*—Provides gamma-ray effects testing for component and weapon systems development, which helps ensure operational reliability of weapon systems in radiation environments caused by nuclear explosions.

Accelerators

Accelerators are devices that accelerate (speed up) the movement of atomic-sized particles such as electrons, protons, and ions. These devices range in size from huge cyclotrons to television sets. The accelerators in TA-IV use pulsed-power technology and are called pulsed-power accelerators. Accelerators can produce radiation by accelerating atoms or their subatomic particles, which strike other target atoms, thereby producing prompt radiation such as X-rays or, in the case of accelerated protons, radioisotopes.

Pulsed-power accelerators are single-shot devices that accelerate large numbers of particles (energy) in a very short period. These accelerators are considered high power. The HERMES III accelerator, for example, can generate a 350-kJ pulse of electrons in 20 nsec, or 17 TW (17×10^{12} W) of power. However, because of the low shot rate of these machines (sometimes only one per day), the average power generated is typically very low. One of the areas of research being conducted in TA-IV is to increase the shot rate, or repetition rate, of these accelerators for applications that require high average power.

The TA-IV pulsed-power accelerators are designed to compress (in time) the electrical pulse. This generates high power by transferring a high percentage of the energy while shortening the pulse.

The desire to create controlled fusion for commercial power generation initially motivated the development of pulsed-power technology. Later, it was determined that the same technology could be used to generate X-rays and gamma rays for weapons testing. New uses for pulsed-power technology are continually being explored. Usually, a particular application will require some modification to existing devices, which adds knowledge to the pulsed-power technology base. Many applications, such as materials hardening and sterilization, have resulted in the development of high-power, high-repetition-rate accelerators.

- *Sandia Accelerator & Beam Research Experiment (SABRE)*—Supports the inertial confinement fusion program for advanced extraction ion diode research and for target and focusing studies.
- *Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) Accelerator*—Measures X-ray-induced photocurrents from short pulses in integrated circuits and thermostructural response in materials.
- *Repetitive High Energy Pulsed-Power Unit I (RHEPP I) Accelerator*—Supports the development of technology for continuous operation of pulsed-power systems.
- *Repetitive High Energy Pulsed-Power Unit II (RHEPP II) Accelerator*—Supports the development of technology for continuous operation of pulsed-power systems for very high power outputs.
- *Z-Machine Accelerator (formerly the Particle Beam Fusion Accelerator)*—Generates high intensity light-ion beams for the inertial confinement fusion program and the high energy/density weapons physics program for stockpile stewardship.
- *Tera-Electron Volt Energy Superconductor Linear Accelerator (TESLA)*—Tests plasma opening switches for pulsed-power drivers.
- *Advanced Pulsed-Power Research Module (APPRM) Accelerator*—Tests the performance and reliability of components for use in a much larger accelerator still in the conceptual stage.
- *Radiographic Integrated Test Stand (RITS) Accelerator*—Simulates nuclear weapons effects on nonnuclear components and subsystems.

2.3.4.4 Reactor Facilities

TA-V is a highly secure, remote research area housing experimental and engineering nuclear reactors. Certain facilities in this area are being converted to production facilities for medical radioactive isotopes. Reactor operations located in TA-V are discussed below (SNL/NM 1997b).

- *New Gamma Irradiation Facility (NGIF)*—Produces a gamma radiation field, simulating weapons effects on nuclear weapons components.
- *Gamma Irradiation Facility (GIF)*—Provides high intensity gamma radiation for radiation environment testing of materials, components, and systems.
- *Sandia Pulsed Reactor (SPR)*—Simulates nuclear weapons effects on nuclear weapons components. The SPR houses two fast-burst reactors, SPR II and SPR III.
- *ACRR*—Formerly used for pulsed-power research; under conversion for the production of molybdenum-99 for use in nuclear medicine.

Reactors

Typically, reactors are devices that provide neutron and sustained gamma-pulsed environments. Normally, the SNL/NM reactors operate at steady-state power. These reactors are considered low power.

The reactors in TA-V conduct a variety of experiments, including those for DP system component electronics testing and reactor safety research.

The primary purpose for the ACRR is the production of medical isotopes.

TA-V reactors are designed as research reactors, small low-power reactors providing specialized near-fission ranges of radiation environments. SPR reactors, SPR II and SPR III, are small air-cooled reactors less than 8 ft tall. The ACRR would operate approximately 1,000 hours per year at a maximum power level of 4 MW (approximately 4,000 MWh per year). Commercial reactors operate at 1,000 MW of power (approximately 5,000,000 MWh per year).

The desire to produce medical isotopes can include expanding the range of isotopes to cover the broad field of medical isotopes and various research isotopes. The long-term, steady-state operation of the reactor for isotope production would allow experiments in areas of neutron irradiation, radiography, and other activities related to isotope production.

- *HCF*—Formerly used to support pulsed-power research; under conversion for processing irradiated targets from the ACRR and the production of molybdenum-99.

2.3.4.5 Outdoor Test Facilities

Selected outdoor test facilities are located in the Coyote Test Field and the Lurance Canyon Burn Site. The Coyote Test Field is a remote area containing physics testing facilities. Lurance Canyon was used for explosives testing. Although no explosives tests are currently being conducted at Lurance Canyon, burn tests are currently conducted there. Outdoor operations in the Coyote Test Field and several canyons are discussed below (SNL/NM 1997b).

- *Containment Technology Test Facility - West*—Provides nuclear power reactor containment model testing.
- *Explosives Applications Laboratory (EAL)*—Supports the design, assembly, and testing of explosive experiments in support of site-wide programs.
- *Aerial Cable Facility*—Provides a controlled environment for high velocity impact testing on hard surfaces and precision testing of full-scale, ground-to-air missile operations; air-to-ground ordnance testing; and nuclear material shipping container testing for certification.
- *Lurance Canyon Burn Site*—Provides safety testing of various hazardous material shipping containers, weapons components, and weapons mockups exposed to aviation fuel fires, propellant fires, and wood fires.
- *Thunder Range Complex*—Provides inspection facility capabilities and assembly and disassembly of special explosive-containing items. In the past, the facility was used for environmental, safety, and survivability testing for nuclear weapons applications.

2.3.4.6 Selected Infrastructure Facilities

All SNL/NM structures were evaluated to identify representative infrastructure facilities. Most SNL/NM infrastructure facilities are used for office space, storage, or support. Other infrastructure support related to roads and utilities is described in Section 4.4. Following are the major infrastructure facilities at SNL/NM that have environmental permits and that have been selected for evaluation:

- *Steam Plant in TA-I*—Provides heat and hot and chilled water to buildings in TA-I and the eastern portion of Kirtland Air Force Base (KAFB).
- *HWMF in TA-I*—Provides temporary storage for hazardous SNL/NM wastes prior to offsite treatment and/or disposal.
- *RMWMF in TA-III*—Processes LLW and LLMW generated at SNL/NM to meet waste acceptance criteria at designated DOE disposal sites.
- *Thermal Treatment Facility (TTF) in TA-III*—Thermally treats (burns) small quantities of waste explosive substances, waste liquids, and items contaminated with explosive substances.

2.3.5 Activities Common to All Alternatives

Some activities at SNL/NM are not expected to change significantly, regardless of which alternative the DOE selects for continued operations. In general, these balance of operations activities involve little or no toxic materials, are of low hazard, and are usually categories of actions excluded from analysis by DOE's NEPA regulations (see 10 Code of Federal Regulations [CFR] Part 1021). Balance of operations analyses were included for each resource area. These analyses are evaluated along with the more detailed analyses of the selected facilities for each alternative to provide the total impacts from SNL/NM operations. The balance of operations activities include many R&D activities and routine operations; infrastructure, administrative, and central services for SNL/NM; traffic flow adjustments to existing onsite roads in predisturbed areas, including road realignment and widening; facility maintenance and refurbishment activities; and environmental, ecological, and natural resource management activities. Some routine refurbishment, renovation, and small-scale removal of specific surplus facilities and closures will also continue at SNL/NM. Examples include office buildings, trailers, storage facilities, and infrastructure. A detailed description of these routine activities is available in the FSID (SNL/NM 1997b).

2.3.5.1 Research & Development Activities

R&D activities at SNL/NM are focused in the following areas: materials and process science, computational and information sciences, microelectronics and photonics sciences, engineering sciences, and pulsed-power sciences. Many aspects of the programs described in Section 2.1 fall into the area of R&D and are not analyzed in detail.

SNL/NM's research expertise in materials and process science develops the scientific basis for current and future mission needs. New and replacement materials are created for refurbished weapons components, enhanced safety subsystems, and advanced energy storage devices.

SNL/NM's research expertise in computational and information sciences develops technology to transition from model- and simulation-based life-cycle engineering. Increases in supercomputing capabilities are needed to analyze complicated accident scenarios, to design weapons components and systems, and to predict the aging of key stockpile materials.

SNL/NM's research expertise in microelectronics and photonics provides the science and technology to ensure implementation of its electronics systems. This research foundation conducts activities ranging from fundamental solid-state physics to design and fabrication of radiation-hardened integrated circuits.

SNL/NM's research expertise in engineering sciences focuses on model- and simulation-based, life-cycle engineering. Life-cycle engineering at SNL/NM occurs within a comprehensive validated modeling and simulation environment required for validation and verification of simulations.

SNL/NM's research expertise in fast pulsed-power technology applies pulsed-power technological advances in conjunction with other DOE laboratories, U.S. industry, and universities. SNL/NM supports science-based stockpile stewardship by providing radiation experiments to certify the survivability of strategic systems in the stockpile and to support DOE initiatives such as the Stockpile Life Extension Program. The large-volume, high-temperature, high-energy-density environments uniquely generated with pulsed power have produced a unique opportunity to collaborate with Lawrence Livermore National Laboratory and Los Alamos National Laboratory (LANL) in weapons physics and experimentation. These capabilities are especially critical in the absence of underground nuclear testing for certification of weapons survivability and performance (SNL/NM 1997b).

2.3.5.2 Maintenance Support Activities

These activities comprise frequently and routinely requested maintenance services for operational support of SNL/NM facilities and associated DOE properties. Activities range from ongoing custodial services to corrective, preventive, predictive, and training actions required to maintain and preserve buildings, structures, roadways (including widening in disturbed areas), and equipment in a condition suitable for fulfilling their designated purposes. While these activities are intended to maintain current operations, they would not substantially extend the life of a facility or allow for substantial upgrades or improvements.

2.3.5.3 Material Management and Operations

Routine operations at SNL/NM require the management of hazardous, industrial, commercial, and recyclable materials. Appendix A contains information regarding the responsible organizations, regulatory requirements, and

Hazardous Material

A material, including a hazardous substance, as defined by 49 CFR §171.8, that poses an unreasonable risk to health, safety, and property when transported or handled.

types and quantities of material at SNL/NM. SNL/NM standards, which were developed in accordance with DOE, DOT, and U.S. Air Force policies, determine if a material constitutes an onsite hazard.

Four types of hazardous material regulated by the DOT are tracked by SNL/NM. These include radioactive materials, chemicals, explosive materials, and fuels.

2.3.5.4 Chemical Materials Management and Control

The primary goal for managing and controlling chemicals at SNL/NM is to protect the health and safety of workers, the public, and the environment.

Chemical Materials

SNL/NM handles more than 25,000 chemical containers annually. Chemicals are designated as hazardous if they present either a physical or a health hazard as defined by the DOT and listed in 49 CFR §172.101. Chemicals are managed using administrative and physical controls that are designed to minimize exposure to an identified hazard. Facilities that use and store chemicals are evaluated using SNL/NM's Integrated Safety, Environmental, and Emergency Management System for determining appropriate approaches to managing and controlling hazards.

Historic Chemical Materials Use

SNL/NM previously maintained inventories of hazardous chemicals at levels sufficient to meet immediate needs that could arise at any time. This approach involved economical bulk chemical purchases; however, this approach also led to the shelf life of some containers expiring before they could be used. These chemical procurement practices created legacy chemicals that had to be disposed of properly. Now, SNL/NM orders needed chemicals on a "just-in-time" basis.

Baseline Hazardous Chemical Materials Use

From 1990 through 1996, SNL/NM primarily tracked chemical inventories using the CheMaster System. This system was designed primarily to enable SNL/NM to meet the requirements of the *Emergency Planning Community Right-to-Know Act* (EPCRA), also known as *Superfund Amendments and Reauthorization Act, Title III* (SARA) (42 United States Code [U.S.C.] §11001). EPCRA requires that a facility generate an annual list documenting the presence of certain hazardous chemicals in quantities exceeding federally prescribed safety thresholds and provide the list to emergency planning officials in the state and local community.

SNL/NM is currently changing to a new chemical inventory tracking system known as the *Chemical Information System* (CIS). This system, a commercial program developed by AT&T, provides features not available with the former system that allow the tracking of individual containers and access to online chemical inventory data at any time. This system also interfaces more readily with other environment, safety, and health programs, including those for industrial hygiene, hazardous waste management, radioactive and mixed waste management, waste minimization, emergency preparedness, fire protection, and NEPA. For NEPA, the CIS provides essential information on the chemical inventory and is a necessary element for calculating potential health effects.

2.3.5.5 Explosive Material Management and Control

SNL/NM manages explosive material through the *Explosive Inventory System*, a comprehensive database that tracks explosives and explosive-containing devices and assemblies from acquisition through use, storage, reapplication, and transfer or disposal. It provides information on material composition, characteristics, shipping requirements, life-cycle cost, plan of use, and duration of ownership. This system includes an inventory of explosive material owned or controlled by SNL/NM line organizations.

2.3.5.6 Radioactive Material Management and Control

SNL/NM uses a twofold approach to radioactive material management: reduce surplus legacy radioactive material inventories and manage current nuclear material inventories at mission-essential levels. Nuclear material is a subclass of radioactive material as defined by the *Atomic Energy Act of 1954* (AEA) (42 U.S.C. §2011). SNL/NM manages the three types of accountable nuclear material—special nuclear material, source material, and other nuclear material—through an inventory database known as the *Local Area Network Nuclear Material Accountability System (LANMAS).*

2.3.5.7 Waste Management and Operations

Waste Operations

This section generally describes waste operations that are not analyzed in detail, as noted in Section 2.3.5.

SNL/NM manages all wastes in accordance with applicable Federal, state, and local laws and regulations and DOE Orders. These wastes are primarily regulated by the EPA, the DOE, and the New Mexico Environment Department (NMED). All current waste operations are being implemented following SNL/NM policies established to ensure worker and public safety and compliant management of regulated waste. These policies clearly define waste acceptance and disposal criteria, limit the number of workers who handle wastes, provide appropriate waste-specific training, and centralize waste handling areas.

Hazardous Waste

Hazardous wastes managed at the HWMF include wastes regulated under *Resource Conservation and Recovery Act* (RCRA) (42 U.S.C. §6901) and wastes regulated under the *Toxic Substances Control Act* (TSCA) (15 U.S.C. §2601); other wastes managed at the HWMF including wastes not regulated by RCRA or TSCA, but still hazardous; certain other solid wastes; and some other wastes not accepted by the Solid Waste Transfer Facility (SWTF). The hazardous waste generated at SNL/NM is predominantly from experiments, testing, other R&D activities, and infrastructure fabrication and maintenance. Environmental restoration and decontamination and decommissioning (D&D) also generate hazardous waste. Hazardous waste generated at each facility is usually coordinated by that facility's waste management department, with the exception of waste from large projects focused on asbestos abatement, which is managed separately through subcontracts.

SNL/NM also manages small amounts of waste from other SNL or DOE operations, such as SNL's Advanced Materials Laboratory on the University of New Mexico campus in Albuquerque or the DOE's Albuquerque Operations Office.

Radioactive Waste

The RMWMF staff manages LLW, LLMW, TRU waste, and MTRU waste for SNL/NM. In general, LLW and LLMW are generated during laboratory experiments and component tests. TRU and MTRU wastes are generated from the use of small quantities of plutonium and other TRU isotopes in R&D or from experiments involving nuclear reactor operations, including cleanup of residuals during reactor tests. Additional small quantities of LLW can be received periodically from remote test facilities including Kauai, Hawaii; White Sands Missile Range, New Mexico; and Tonopah Test Range, Nevada. LLMW generated at Sandia National Laboratories/California has also been shipped to SNL/NM for management in accordance with an NMED compliance order issued under the *Federal Facility Compliance Act* (42 U.S.C. §6961). SNL/NM has also received TRU waste from the Lovelace Respiratory Research Institute, which is DOE-funded and located on KAFB (Section 6.2.6).

Other Waste Categories

Hazardous Waste—Any solid waste (definition includes semisolid, liquid, or gaseous material) having one or more characteristics of ignitability, corrosivity, toxicity, or reactivity or any other waste specifically regulated as a hazardous waste, by the *Resource Conservation and Recovery Act* (RCRA).

Nonhazardous Waste—Chemical waste not defined as a RCRA hazardous waste. The term nonhazardous waste does not necessarily imply the level of protection needed to properly manage the waste.

2.3.5.8 Environmental Restoration

The ER Project is a phased project designed to identify, assess, and remediate contaminated DOE-owned or -operated sites that have contamination from waste disposal, releases, or spills of hazardous substances. The initial remedial assessment of SNL/NM sites was conducted under the Comprehensive Environmental Assessment and Response Program beginning in 1984 and ending in 1987. The assessment identified 117 potential release sites. By 1993, the number had increased to 219 potential release sites (including offsite locations).

Radioactive Waste Categories

Low-Level Waste (LLW)—Waste that contains radioactivity and is not classified as high-level waste, TRU waste, spent nuclear fuel, or byproduct tailings containing uranium or thorium from processed ore (as defined in Section 11[e][2] of the AEA [42 U.S.C. §2011]). Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, provided that the concentration of TRU is less than 100 nCi/g.

Low-Level Mixed Waste (LLMW)—Waste that contains both hazardous waste under the RCRA (42 U.S.C. §6901) and source, special nuclear, or byproduct material subject to the AEA (42 U.S.C. §2011).

Transuranic Waste (TRU)—Waste that contains more than 100 nCi of alpha-emitting TRU isotopes per gram of waste, with a half-life greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary has determined, with concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or (c) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Mixed Transuranic Waste (MTRU)—TRU waste that contains hazardous waste, as defined and regulated under the RCRA (42 U.S.C. §6901).

Hazardous and Solid Waste Amendments (HSWA)

The HSWA were proposed in 1984 by the EPA as amendments to the RCRA (42 U.S.C. §6901). A very important aspect of HSWA requires that release of hazardous wastes or hazardous constituents from any solid waste management unit that is located on the site of a RCRA-permitted facility be cleaned up. The cleanup is required regardless of when the waste was placed in the unit or whether the unit was originally intended as a waste disposal unit. SNL/NM's HSWA module to the RCRA Part B permit includes provisions for corrective actions for all releases. It also contains a compliance schedule that governs the corrective action process.

A Hazardous and Solid Waste Amendments (HSWA) module of the RCRA permit was issued in August 1993. As co-permittees, both SNL/NM and the DOE are responsible for compliance under the terms of the HSWA permit. The EPA Region 6 (Dallas, Texas) was the authorized permitting agency at the time of issuance, but beginning in January 1996, authority was transferred to the NMED. The terms, conditions, and schedule contained in the original HSWA Part B permit are, and continue to be, the primary legal drivers for the ER Project.

The remediation field activities under the ER Project are scheduled for completion in Fiscal Year (FY) 2002, with permit modification by FY 2004 to remove remediated sites from further action. Subsequent monitoring activities are scheduled for an additional 30 years. As of August 1998, 60 sites remained on the list for restoration or additional assessment. SNL/NM has proposed no further action for 122 of the 182 sites to the appropriate regulatory authority.

The ER Project is currently the largest generator of regulated waste at SNL/NM. The project can potentially generate wastes of varying types due to the many kinds of material that have historically been handled at SNL/NM. For example, these wastes may consist of contaminated soils, debris, wastewater, and used personal protective equipment. The waste categories include LLW, LLMW, RCRA hazardous waste, TSCA waste, biohazardous waste (such as septic tank sludge), and nonhazardous waste.

ER Project generated waste is processed through the HWMF, the RMWMF, or the SWTF. Once accumulated, sampled, and fully characterized, ER Project-generated waste is transferred to the appropriate SNL/NM waste management department for treatment, storage, and offsite disposal. The time frame for disposal of waste, once removed from a release site, can be months or years, depending on the time required for characterization and for scheduling shipment to disposal facilities.

In June 1996, SNL/NM submitted a request for a permit modification for a Corrective Action Management Unit (CAMU) designed to be a storage, treatment, and containment unit dedicated to ER Project-generated hazardous waste (SNL/NM 1997a). This unit will be located near the former Chemical Waste Landfill (a site scheduled for remediation and closure under a RCRA

Low-hazard Nonnuclear

"Low-hazard nonnuclear" are facilities or project activities that have the potential for minor onsite impacts (within the boundaries of SNL/NM-controlled areas) and negligible offsite impacts (outside the boundaries of SNL/NM-controlled areas) to people or the environment. SNL/NM uses primary hazards screening (PHS) to identify hazards, hazard classifications, training requirements, and required safety documents. A "low-hazard nonnuclear" facility does not require additional safety documentation. Accelerators and reactors do not meet this definition and require additional safety documentation including safety assessments and safety analysis reports.

Closure Plan). SNL/NM security personnel will provide controlled access. The SNL/NM waste management departments will continue to manage waste generated by the ER Project, excluding hazardous waste designated for containment in the CAMU. The CAMU was approved in September 1997 by EPA Region 6. An environmental assessment was prepared for the ER Project at SNL/NM. It analyzes potential environmental effects of the characterization and waste cleanup or corrective action of environmental restoration sites (DOE 1996c). The impacts of the ER Project are incorporated into the analysis of the SWEIS.

2.3.5.9 Pollution Prevention and Waste Minimization

SNL/NM has implemented a Pollution Prevention Program to comply with DOE requirements. SNL/NM's Pollution Prevention Program applies to all pollutants generated by routine and nonroutine operations. It consists of activities that encourage pollution prevention or waste source reduction, recycling, resource and energy conservation, and procurement of EPA-designated recycled products.

2.3.5.10 Recycling

SNL/NM currently has recycling processes for plain paper, cardboard, used oil, scrap metal, batteries, fluorescent light bulbs, solvents, mercury, landscaping waste, aluminum cans, tires, and used toner cartridges. At present, all paper and corrugated paper recycled at SNL/NM are processed through the SWTF. In 1996, SNL/NM initiated a joint effort with LANL to collect, process, and market LANL-generated recyclable paper. After creating the process, the program was expanded to include the DOE/Kirtland Area Office. Over the next few years, efforts will continue to expand cooperation with other Federal and state facilities.

2.3.6 Selected Facilities

Following Chapter 2 are a series of facility descriptions that provide additional detail for all of the facilities that are named in Sections 2.3.4.1 through 2.3.4.6. They consist of a brief description of the location, hazard class (low-hazard nonnuclear), primary purpose, and the major types of activities performed at the facility. Also identified are the basic processes performed at the facility, the programs and activities currently being supported, the major categories of radioactive and hazardous materials used by the processes, and the types or radioactive and hazardous emissions or wastes generated by activities at the facility. For all of the facilities described here and for each of the three alternatives described in Chapter 3, the FSID (SNL/NM 1997b) contains more detail including the estimated quantities for the specific radioactive and hazardous chemicals used and emissions or waste generated by a facility's operations. All of these details were considered in completing the consequence analysis in Chapter 5.

FACILITY DESCRIPTIONS
TABLE OF CONTENTS – BY FACILITY TYPE

MANUFACTURING, R&D LABORATORIES, AND TESTING FACILITIES

PHYSICAL TESTING AND SIMULATION FACILITIES

ACCELERATOR FACILITIES

REACTOR FACILITIES

OUTDOOR TEST FACILITIES

SELECTED INFRASTRUCTURE FACILITIES

FACILITY DESCRIPTIONS
TABLE OF CONTENTS – ALPHABETICAL ORDER

NEUTRON GENERATOR FACILITY (NGF)

Function and Description:

The mission of the NGF, located in Technical Area-I, is to support the U.S. nuclear weapons program by fabricating neutron generators (external initiators for nuclear weapons), neutron tubes, and prototype switch tubes. This is a low-hazard, nonnuclear facility located in Building 870, a two-story structure with a basement, where most processing and assembly operations take place. The facility includes a special air handling system that captures tritium from operations that have the potential to release this material. The NGF is primarily an assembly facility that receives components, including the tritium-loaded target materials, from various sources. Final neutron generator assembly is conducted and devices are tested.

Specific Processes, Activities, and Capabilities:

A variety of techniques are used and highly specialized metal work is done to accomplish the following categories of processes:

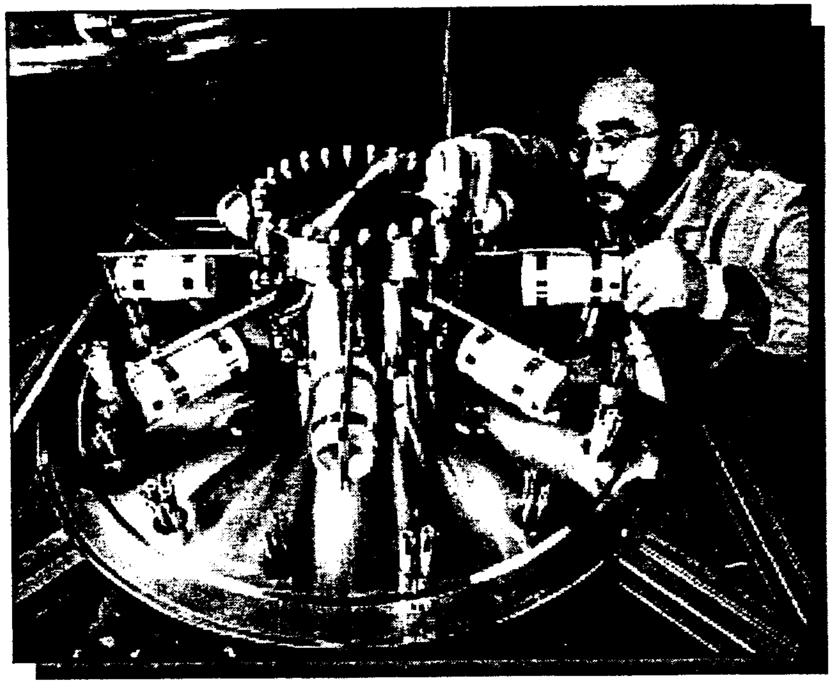
- preparing and coating the surfaces of components,
- joining and welding,
- encapsulating,
- fabricating and assembling, and
- inspecting and testing.

The NGF operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities and Weapon Programs involve development of neutron generators.
- Technology Transfer develops processes with part and process suppliers.
- Production Support and Capability Assurance activities involve production of neutron generators including components.
- Other programs, include research and development, process development, and certification testing of neutron generators and components.

The production of neutron generators involves fabricating and assembling major components, including a neutron tube, miniature accelerator, power supply, and timer.

Potential tritium emissions are associated with various aspects of equipment calibration, destructive testing, outgassing of components, prototype development, manufacturing; and material handling. A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (including hydrogen), liquid, and solid forms in relatively small quantities are used in many of these specific processes. Chemical emissions, including corrosives, alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, material processing, manufacturing, testing, and quality control. Small sealed radioactive sources, nondestructive testing (X-rays), and lasers are used in the facility.



Source: SNL/NM 1998a

Figure FD–1. Neutron Generator Facility (NGF)

The NGF is used for fabricating neutron generators and prototype switch tabs. The neutron generator consists of a neutron tube and a power supply to operate it. The generation of neutrons is accomplished by the fusion of isotopes of hydrogen (deuterium and tritium) by ion acceleration.

MICROELECTRONICS DEVELOPMENT LABORATORY (MDL)

Function and Description:

The mission of the MDL, located in Building 858 in Technical Area-I, is to provide the microelectronics research and engineering capabilities to support industry, government, and other programs of national interest. The MDL contains 30,000 ft^2 of clean room, consisting of 22 independent bays separated by 8-ft-wide utility chases. Laboratory space outside the clean room area is used for wafer test equipment, die packaging, scanning electron microscopy, device radioactive source exposure, and device inspection. The basement of the facility contains acid waste neutralization equipment used in the neutralization of process wastewater. The MDL includes the Emergency Response Center, which has the equipment necessary to respond to facility emergencies.

Under one of two configurations within the Expanded Operations Alternative, a new laboratory could be constructed to replace the existing Compound Semiconductor Research Laboratory to improve flexibility and operational efficiencies. The Microsystems and Engineering Sciences Applications (MESA) Complex would be constructed adjacent to the existing MDL. The new facility would be a state-of-the-art, three-story structure containing approximately 257,000 gross square feet; it would house offices, small laboratories, and exterior gas storage. MESA would enhance current operations at the MDL in areas of developing and manufacturing tiny electronic devices that blend the intelligence of computer chips with tiny sensors and microscopic moving machines. The MDL would also undergo renovations to support MESA activities. Additional information is provided on the next page.

Specific Processes, Activities, and Capabilities:

A variety of processes are used to produce microelectronic and micromechanical devices that may vary according to the needs of a particular project. These processes, however, can be grouped within the following four broad categories of iterative processes:

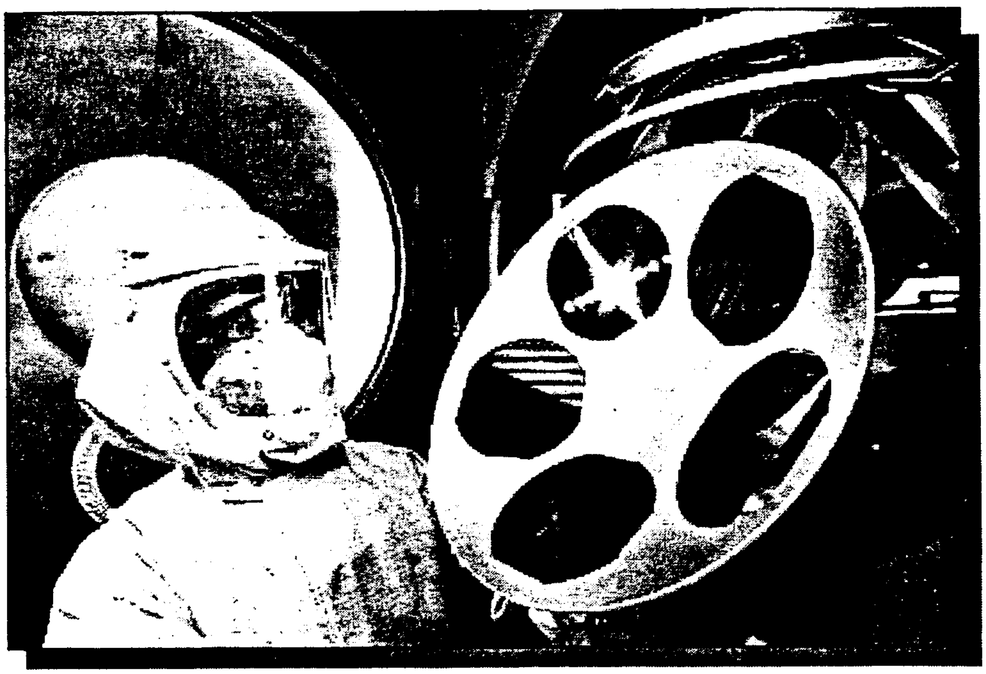
- Film deposition—processes that prepare the surface of a silicon chip with conductive and nonconductive layers and polymers.
- Photolithography—processes that transfer a larger master pattern of components onto the film layers, similar to photographic processes in concept.
- Etching—processes that carve out the image created on the films and that can expose selected portions of the surface of the silicon chip.
- Ion implantation—processes that place electrically active chemicals of various types into the exposed portions of the silicon chip surface.

MDL operations support the following types of programs and activities:

- Direct stockpile activities conduct research and development in microelectronics devices for nuclear weapon applications.
- Enhanced Surveillance Programs examine corrosion in select components.
- Technology Transfer and Education Programs develop microelectronic systems and processes.

- Advanced Manufacturing, Design and Production Technologies develop new processes and building prototypes.
- Weapons Programs activities develop microelectronic devices for weapon components.

Large quantities of acids and caustics and a wide variety of toxic and corrosive gases are used in clean rooms to clean, develop, and etch wafer surfaces and to create the films and chemical ions for implantation. While chemical quantities are less than those of a commercial manufacturing operation, the types of materials and chemicals used in these processes are generic to the semiconductor industry. Chemical air emissions occur during various points of the processes identified above, including the use or application of chemical developers and reactant liquids. Small sealed sources are also contained in equipment used in radiation hardening testing.



Source: SNL/NM 1998a

Figure FD–2. Microelectronics Development Laboratory (MDL)

The MDL was built in 1988 as a world-class facility dedicated to the advancement of microelectronic research, development, and application initiatives of strategic interest. Advanced manufacturing technologies can be tested at the MDL. Here, this worker wears a special uniform to protect microcircuits from lint and dust.

MICROSYSTEMS AND ENGINEERING SCIENCE APPLICATIONS (MESA) COMPLEX

Function and Description

The function of the MESA Complex would be to provide integration of programmatic needs in three critical disciplines: microsystems technology development, computational and engineering sciences and analysis, and weapon design system integration and certification. Specifically, MESA's unique missions would include producing war reserve microsystems-based components (parts) to support planned weapon refurbishments, reducing the number of parts per weapon, and enhancing systems required to counter current, emerging, and latent national security threats. To accomplish these missions, MESA operations would utilize researchers, scientists, and technology developers and involve a computationally based environment for the design and integration of prototypes and the fabrication and certification of microsystems into weapon components, subsystems, and systems.

The MESA Complex, a 260,000 gross-square-foot facility adjacent to MDL, would include a five- to six-story building and would cost an estimated $300 M. In addition, the DOE would replace the existing Compound Semiconductor Research Laboratory (CSRL) while providing new microoptics technology support and integration with the MDL. The CSRL would be replaced with a new clean room, small laboratories, and work space. Other support buildings and structures (light laboratories, offices, gas storage) would be built nearby. The heavy laboratory would be designed according to Universal Building Code standards and would be equipped with new tools and other capital equipment (including retooling parts of MDL). If implemented the MESA Complex would become operational around 2003, the CSRL, which is considered inadequate, would be phased out and eventually decontaminated and demolished.

Specific Processes, Activities, and Capabilities

MESA would use a variety of processes (such as gallium arsenide and inidium arsenide) used to produce silicon-based and specialty alloy-based microsystem devices similar those already in use at MDL. MESA processes would include film deposition, photolithography, etching, and ion implantation such as those at MDL and CSRL as described above. MESA specific processes would include the following:

- New technology including new ion implanters that would use subatmospheric, gas-delivery system technology thereby eliminating the need for high-pressure specialty gas cylinders including arsine and phosphine. At present, the CSRL and MDL provide the more conventional plasma processing capability.
- Upgrades to the existing MDL Reverse Osmosis Deionization Ultra Pure Water system by replacing the mixed bed ion exchangers with an electrodeionization process. This method would eliminate the current mixed bed regeneration process, resulting in a saving of approximately 2M gals of process water annually.
- Development (using existing CSRL capabilities) of low-damage plasma processing, a critical element in the fabrication of advanced photonic devices and of high-performance microelectronic devices.
- Development of proven technologies in areas of quantum-effect-based devices, reactive-ion beam etching, and electron beam lithography.
- Development (using existing CSRL capabilities) of crystalline structure growth technologies in areas of high-purity materials and ultra high electron mobile materials.

MESA operations would support programs and activities similar to those currently undertaken at MDL. MESA programs and activities would provide capabilities that support direct stockpile support, enhanced surveillance (Enhanced Surety Campaign), and technology transfer (industry partnering). MESA would provide unique capabilities to support the following types of programs and activities:

- Direct stockpile activities; conduct research and development in microelectronics, microoptics, and microelectromechanical systems, including silicon and compound semiconductors (such as alloys of gallium arsenide and indium arsenide) for improved surety in future weapons systems.
- Perform Stockpile Life Extension Program (SLEP) activities; incorporate modern surety features as part of the Enhanced Surety Campaign.

The quantities, types, uses, and air emissions of hazardous materials and chemicals (including sealed sources) would be similar to those currently used at MDL (see description above), which are generic to the semiconductor industry. As with MDL, the chemical quantities would be less than those of a commercial manufacturing operation.

ADVANCED MANUFACTURING PROCESSES LABORATORY (AMPL)

Function and Description:

The mission of the AMPL, located in Technical Area-I, is to develop and apply advanced manufacturing technology to produce products in support of Sandia National Laboratories/New Mexico's national security missions. The AMPL, comprised of 11 laboratories or divisions, can prototype and do limited manufacture of many of the specialized components of nuclear weapons. The advanced manufacturing technology development in the AMPL is focused on enhancing capabilities in four broad areas: manufacture of engineering hardware, emergency and specialized production of weapon hardware, development of robust manufacturing processes, and design and fabrication of unique production equipment.

Specific Processes, Activities, and Capabilities:

The activities conducted in the AMPL are typically laboratory and small-scale manufacturing operations involving materials and process research. The equipment used is commercial or custom-built laboratory and small-scale instrumentation. Operations range from standard wet chemistry to high-tech chemical techniques. Operations include, but are not limited to, development of processes and applications using plastics and organics, nonexplosive powders, adhesives, potting compounds, ceramics, laminates, microcircuits, lasers, machine shop equipment, electronic fabrication, multichip modules, thin-film brazing and deposition, and plating and glass technology.

AMPL operations support the following types of programs and activities:

- Direct stockpile activities program develops and applies advanced processes for nuclear weapon applications.
- System Components Science and Technology Program supports materials processing needs of Defense Programs (metals, polymers, ceramics, and glass).
- Technology Transfer and Education Programs develop advanced manufacturing processes through coordination with industrial partners.
- Production Support and Capability Assurance Program activities develop and produce active ceramic components for neutron generators.
- Advanced Manufacturing, Design, and Production Technologies develop and improve processes for weapon production.
- Work for other Federal Agencies, Private Corporations, and Institutions develop advanced manufacturing techniques and processes, electronics, materials, and systems.

These activities involve the use of a variety of chemicals (including corrosives, solvents, organics, inorganics, and gases) in relatively small amounts. All activities are performed in well-ventilated areas or fume hoods to prevent employee exposure. Most of the wastes generated in these activities are spent solvents, corrosives, and inert purge gases (such as nitrogen and helium). Neutron generators and other related components containing tritium are handled at the AMPL; however, the tritium contained in these components is completely sealed within a welded tube. No radioactive air emissions are produced at this facility.

Source: SNL/NM 1998a

Figure FD–3. Advanced Manufacturing Processes Laboratory (AMPL)

Activities at the AMPL include development of weapons hardware and design of production equipment.

INTEGRATED MATERIALS RESEARCH LABORATORY (IMRL)

Function and Description:

The mission of the IMRL, located in Technical Area-I, is to conduct materials and advanced components research. The IMRL facility is a 140,000-ft^2 multiple-story facility, which develops new and superior materials to meet the needs of government and private industry. This low-hazard, nonnuclear facility houses most of the advanced materials research and development functions at Sandia National Laboratories/New Mexico (SNL/NM). These research activities include laboratory studies in chemistry, physics, and alternative energy technologies. Experimental work is augmented by advanced computer modeling and simulation techniques, another SNL/NM area of expertise.

Specific Processes, Activities, and Capabilities:

IMRL research and development efforts are focused on meeting multiple program management objectives through manufacturing process development and integration of new and advanced products with advanced process development. In process development, IMRL concentrates on materials and processes to support long-term stockpile needs for limited-life components. In material sciences, work includes scientifically tailoring materials, studying defects, and researching impurities in materials.

Numerous techniques and highly specialized processes are developed to improve light gas membranes, improve fuel and chemical production, and develop thin films (each a few angstroms thick). These thin films include mixtures of semiconductors to enhance electronic and optical properties not exhibited in purer form. Thin-film techniques include depositing chemicals (in vapor form) to surfaces to reduce friction, corrosion, and wear and enhance performance of materials like superconductors and optical materials.

To accomplish these tasks, IMRL uses electron microscopy for analytical and high resolution imaging and an electron microprobe to analyze very small structures. Also IMRL uses X-ray diffraction, X-ray fluorescence, and vibrational spectroscopy for surface and material analysis especially for material defects along with computer-aided design, synthesis, characterization, and testing. A variety of operations are carried out involving laser, electron beam, pulsed, and inertial welding equipment designed to join different types of metals. Small-lot fabrication of foams and membranes are also made. Synthesis of novel polymers, experimental and theoretical studies on polymer degradation, and catalysis development and improved material separation to reduce impurities and defects are accomplished using numerous analytical techniques including dielectric and ferroelectric testing, electrooptic characterization, and ultra-fast optical spectroscopy.

IMRL operations support the following types of programs and activities:

- Advanced Industrial Materials Research Program conducts materials research and development.
- Catalysis and Separations Science and Engineering chemistry and materials research and development.
- Materials Processing by Design.
- Materials Sciences uses advanced characterization instrumentation for research into relationships between materials properties and structure, and development of new and favorable material properties through advanced synthesis and nanoscale structuring of materials.

- Advanced Design and Production Technologies develops and characterizes advanced materials and production processes.
- Direct Stockpile Activities conducts research and development of engineered materials for nuclear weapon applications.
- Technology Transfer and Education Activities conduct materials development and testing in conjunction with industry partners in technology development.

A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (including hydrogen), liquid, and solid forms in relatively small quantities are used in many of these specific processes. Chemical air emissions, including corrosives, alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, material processing, manufacturing, testing, and quality control. Small sealed radioactive sources, nondestructive testing (X-rays), and lasers are used in the facility.

Source: SNL/NM 1998a

Figure FD–4. Integrated Materials Research Laboratory (IMRL)

Various weapons materials are tested at the IMRL.

EXPLOSIVE COMPONENTS FACILITY (ECF)

Function and Description:

The mission of the ECF, located just outside and to the south of Technical Area (TA)-I, is to conduct research and development on a variety of energetic components. The facility comprises a main building (Building 905) and six explosives storage magazines (Buildings 905A through F). The ECF consolidates a number of activities formerly conducted in TA-II related to energetic component research, testing, and development. The ECF is a low-hazard, nonnuclear, state-of-the-art facility.

Specific Processes, Activities, and Capabilities:

The ECF is primarily a test facility performing the following activities:

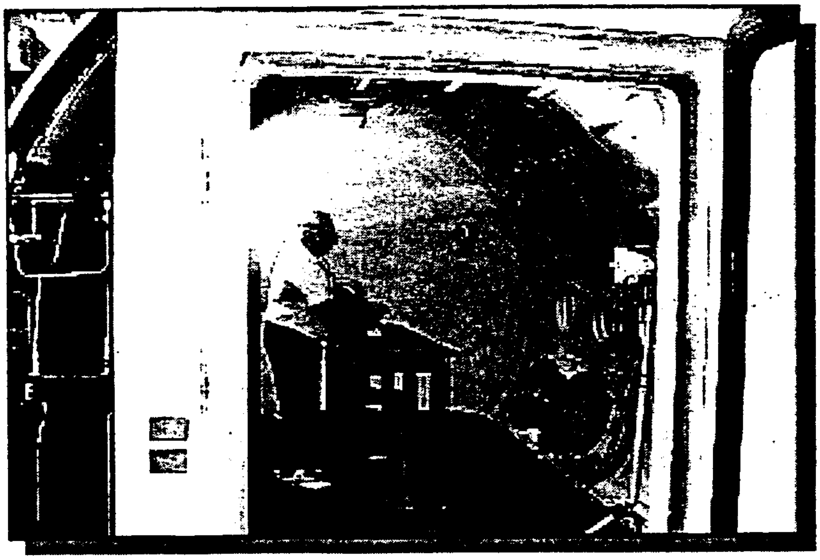
- physical and chemical testing of explosives, pyrotechnics, and propellants;
- development of advanced explosive components;
- research, development, and testing of neutron-generating devices;
- research, development, and testing of batteries; and
- stockpile surveillance of explosives, pyrotechnics, and propellants.

The ECF operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities involve research and development (R&D), energetic materials, and other components.
- Special projects, conducted with the U.S. Department of Defense, include projects for the purpose of reducing operational hazards associated with energetic materials, advanced initiation and fuse development, and material studies along with computer simulation.
- Other projects involve a wide variety of experimental testing, R&D, analyses, technology transfer, and technology development related to explosives, explosive materials, explosive components, and other materials.

A broad range of energetic-material R&D and application activities are conducted at the ECF. Advanced diagnostic equipment is used during experiments ranging from 1 kg tests to sophisticated spectroscopic studies on milligram-size samples that probe fundamental processes of detonation.

A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous, liquid, and solid forms in relatively small quantities are used in many different processes. Air emissions result from the use of corrosives, alcohols, ketones, and other solvents. Sealed radioactive sources, X-rays, and lasers are used in the facility. Low-level tritium emissions are associated with various aspects of neutron generator development and testing.



Source: SNL/NM 1998a

Figure FD–5. Explosive Components Facility (ECF)

SNL/NM's new 91,000-ft² ECF is a U.S. Department of Energy-designated user facility and makes state-of-the-art testing and evaluation capabilities available to industry.

TERMINAL BALLISTICS COMPLEX

Function and Description:

The mission of the Terminal Ballistics Complex, located in Technical Area-III, is to conduct environmental, safety, and survivability testing for nuclear weapon applications. The Terminal Ballistics Complex is a low-hazard facility that includes a main building (Building 6750), two smaller buildings (Buildings 6752 and 6753), and four explosive storage magazines. Building 6750 houses a small machine shop, office space, a control area, and an indoor firing range. Building 6753 is used for large propellant charge assembly and temperature conditioning of propellants. Building 6752 is an unoccupied storage shed for nonhazardous materials. The storage magazines are used for long-term storage of propellants and explosives.

Specific Processes, Activities, and Capabilities:

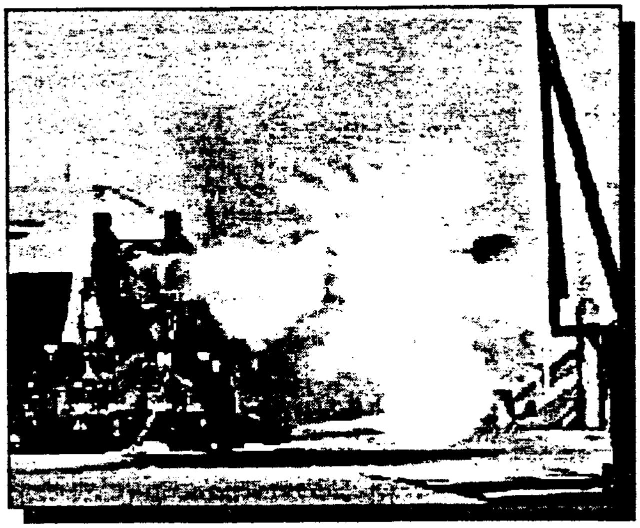
Processes at the Terminal Ballistics Complex are centered on the evaluation of test materials, primarily the physical examination, cleaning, and general quality assurance of munitions and components. In addition, the Terminal Ballistics Complex provides unique test environments and capabilities including the following:

- an outdoor, large-caliber gun range with a 155-mm "Long Tom" artillery gun permanently mounted in a revetment;
- static-fire rocket stands used to measure the thrust force of small rockets;
- test environments for ballistic studies and solid-fuel rocket motor tests; and
- secure, remote indoor and outdoor test facilities.

The Terminal Ballistics Complex operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities, include development and survivability testing of nuclear weapon subsystems and components by using firearms and projectiles to determine material effects and responses.
- Special projects reduce operational hazards associated with explosives, explosive initiators, hard target penetration, computer simulation.
- Science and Technology include material response evaluations.
- Other projects include experiments on shipping containers and storage facilities.

The Terminal Ballistics Complex maintains a small chemical inventory and no radioactive material inventory. Various aspects of the preparation and evaluation of test materials can result in emissions from a variety of solvents including alcohols and ketones. Radioactive air emissions are not produced at this facility.



Source: SNL/NM 1998a

Figure FD–6. Terminal Ballistics Complex

At the Terminal Ballistic Complex's outdoor firing range, a 155-mm "Long Tom" gun fires a projectile.

DROP/IMPACT COMPLEX

Function and Description:

The mission of the Drop/Impact Complex, located in Technical Area-III, is to conduct hard-surface impacts, water impacts, and underwater tests of weapon shapes, substructures, and components. This work is performed to verify design integrity and performance and fuzing functions performance. Such tests help ensure that the nation's nuclear weapons systems meet the highest standards of safety and reliability. This is a low-hazard, nonnuclear facility consisting of two towers: a 185-ft drop tower next to a hard surface and a 300-ft drop tower next to a water-filled pool, 120 ft wide, 188 ft long, and 50 ft deep. A 600-ft-long rocket sled track is located at the end of the pool opposite the tower for testing rocket pull-down accelerated impacts into the water pool.

Specific Processes, Activities, and Capabilities:

The Drop/Impact Complex is primarily a test facility with operations that include conducting drop tests, rocket pull-down tests, submersion tests, and underwater explosive effects tests. Testing involves the following processes and support activities:

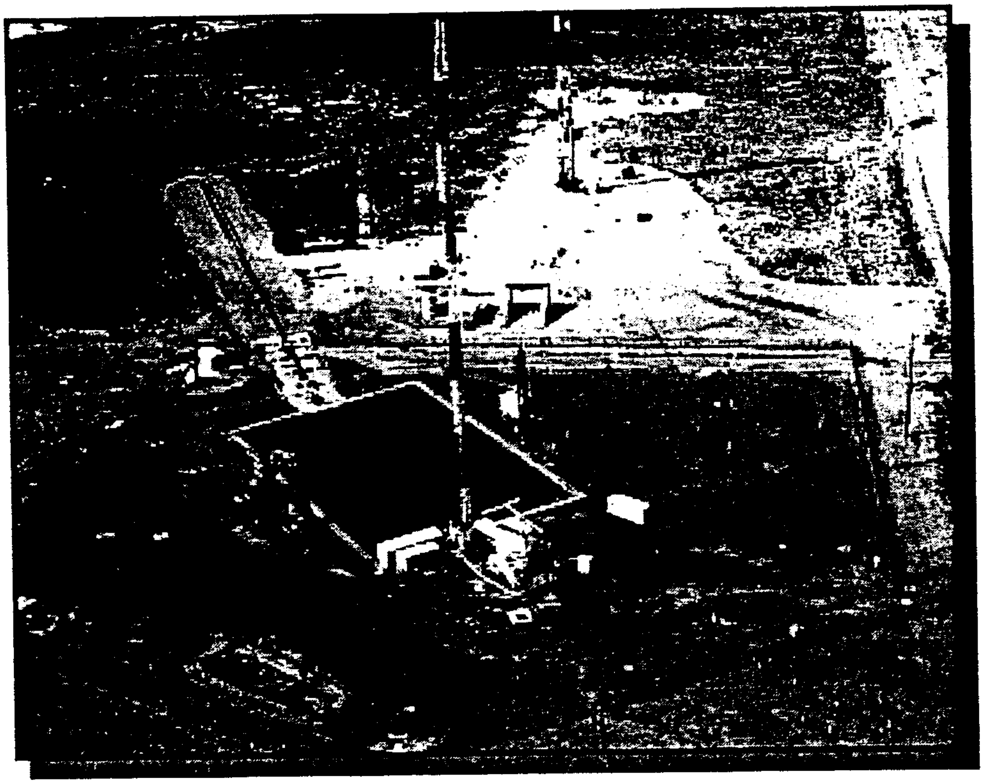
- receiving, storing, and handling explosives; pyrotechnics; propellants; nuclear radioactive, and chemical materials;
- setting up explosive tests, explosive arming and firing, explosives ordnance disposal;
- testing electronic instrumentation and data recording, photometrics, and telemetry;
- conducting hazard area control and checking fire-control system support;
- transporting test assemblies to test sites, rocket arming and launching, post-launch and firing procedures, diving operations; and
- recovering radioactive and chemical material.

The Drop/Impact Complex operations are allocated, but not limited, to the following programs and activities.

- Direct Stockpile Activities conduct environmental, safety, and survivability testing for nuclear weapon systems and components.
- Science and Technology activities involve testing of materials, components, and weapon systems.
- Model Validation efforts involve high-velocity impact testing on hard surfaces, water impact tests, and underwater tests to validate models.
- Other projects include testing prototype nuclear materials packaging, and other projects not associated with the U.S. Department of Energy.

During a drop test, a test object is dropped from the top of the tower for gravity acceleration to a hard impact surface. In a water test, objects are dropped from the top of the tower by gravity or rockets are used to boost acceleration.

The Drop/Impact Complex contains a small chemical inventory and no radioactive material inventory. Cleaners, lubricants, solvents, paints, and agents are used in small quantities. Compressed gases are used in the assembly areas, including acetylene and oxygen (for welding), argon, and helium. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Small amounts of airborne emissions, including carbon monoxide and lead, are released during explosives tests. Although the most common radioactive material used is depleted uranium, other nuclear and radioactive materials associated with test objects may include uranium alloys, thorium alloys and compounds, and tritium. Radioactive air emissions are not produced at this facility.



Source: SNL/NM 1998a

Figure FD–7. Drop/Impact Complex

The Drop/Impact Complex is used to conduct hard-surface and water impact tests.

SLED TRACK COMPLEX

Function and Description:

The Sled Track Complex, located in Technical Area-III, supports the verification of design integrity, performance, and fuzing functions of weapon systems through the simulation of high-speed impacts of weapon shapes, substructures, and components. Sandia National Laboratories/New Mexico (SNL/NM) test facilities such as the Sled Track Complex have been specifically designed for the validation of analytical modeling and the functional certification of weapons systems. The facility is also used to subject weapon parachute systems to aerodynamic loads to verify parachute design integrity and performance. In addition, SNL/NM Energy & Environment Programs use the Sled Track Complex to verify designs in transportation technology, reactor safety, and Defense Programs transportation systems.

Specific Processes, Activities, and Capabilities:

Operations at the Sled Track Complex include a variety of tests and test article preparation such as conducting rocket sled and rocket launcher tests, free-flight testing, and explosive testing. Each rocket sled test involves the acceleration of a rocket down a sled track. A test may involve impacting an object onto a target, or launching a parachute from an ejector accelerated along the track. Each explosive detonation is used to subject test articles to shock waves and propel missiles into test articles. Rocket launches are used to accelerate test objects along a beam on a carriage that is stopped at the end of the beam, releasing test objects into free flight at specific targets. In free-flight launches, test objects are launched directly into free flight from portable launch rails.

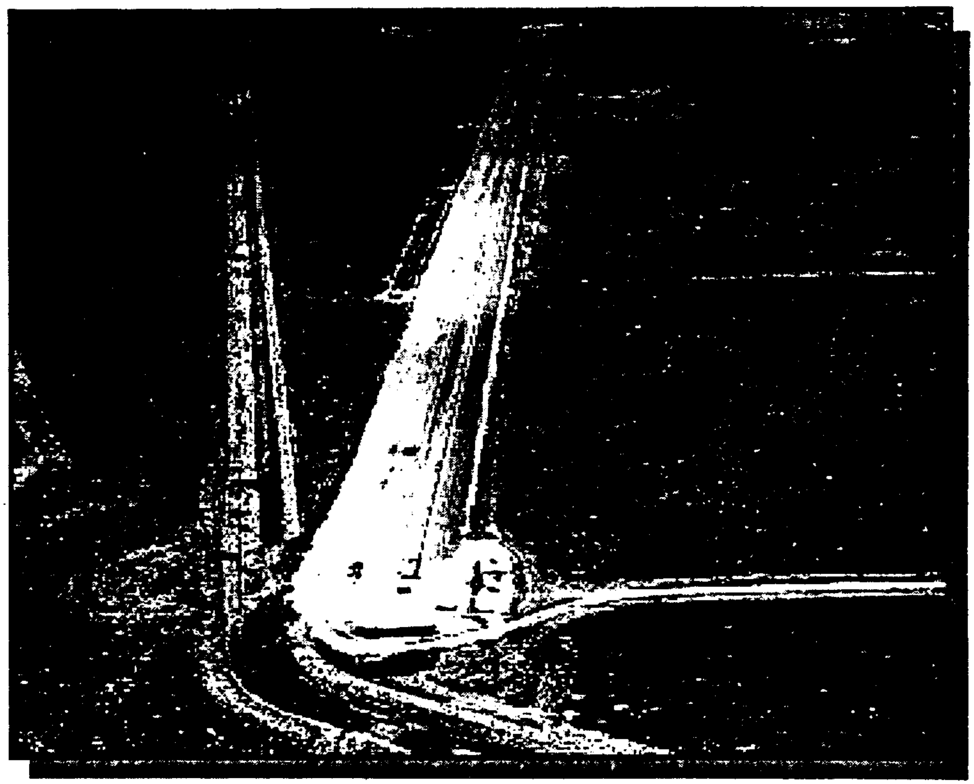
These operations also include:

- receiving, storing, and handling explosives; pyrotechnics; propellants; and nuclear, radioactive, and chemical materials;
- fabricating and assembling rocket sleds including payloads and rockets;
- setting up explosive tests, electronic instrumentation, and data recording and special equipment including lasers, tracking equipment, and X-ray;
- reducing hazards through area, systems, and personnel control;
- disposing of explosives ordnance; and
- recovering radioactive and chemical materials.

Specific programs and activities supported by the Sled Track Complex include, but are not limited to, the following:

- Direct Stockpile Activities and Performance Assessment and Technology Programs conduct environmental, safety, and survivability testing for nuclear weapon applications.
- Energy Programs certify designs in transportation technology and reactor programs.
- Work for Other Federal Agencies in impact, functional, and explosives effects testing.

Small amounts of chemicals are maintained for use in assembling rocket sleds and test payloads in Buildings 6741, 6743, and 6736. For example, various adhesives and epoxies are used to fasten transducers and similar items. Cleaners, lubricants, solvents, paints, and other such agents may also be used in small quantities. Compressed gases are used in the assembly areas, including acetylene and oxygen (for welding), argon, and helium; and dry nitrogen and carbon dioxide are used for pneumatic actuators.



Source: SNL/NM 1998a

FD–8. Sled Track Complex

One of the more unique testing sites available for use at SNL/NM is a high-speed sled track used for rocket sled and launcher testing, free-flight testing, and explosive testing.

CENTRIFUGE COMPLEX

Function and Description:

The Centrifuge Complex, located in Technical Area-III, is used to validate analytical models and to certify the functioning of large test objects under high acceleration conditions. The complex is also used to certify designs in transportation technology. The Centrifuge Complex has been classified a low-hazard, nonnuclear facility. Typical test objects in the Centrifuge Complex include weapons systems, satellite systems, reentry vehicles, geotectonic loads, rocket components, and sensing devices.

Specific Processes, Activities, and Capabilities:

Test preparation processes include machine shop welding operations, surface treatments, welding, and other means to attach parts. Test objects are attached to one end of a boom that rotates around a central shaft. Counterweights are attached to the other end of the boom to counterbalance the test objects. Hydraulic drive motors rotate the central shaft and boom to the revolutions per minute required to achieve the test acceleration. Other tests involve combining vibration and acceleration of oversized or hazardous test objects, including explosive payloads. Sometimes a centrifuge is used to accelerate small objects to high velocity with subsequent release to impact on targets. The Centrifuge Complex has two centrifuge units.

- The 29-ft indoor centrifuge, located inside Building 6526, can subject test objects weighing up to 16,000 lb to 100 times the acceleration of gravity (100 *g*). An acceleration of 300 *g* can be achieved with proportionally lighter test objects.

- The 35-ft outdoor centrifuge, located adjacent to Building 6526, can subject test objects weighing up to 10,000 lb to an acceleration of 45 *g*. An acceleration of 240 *g* can be achieved with proportionally lighter test objects.

Each centrifuge test involves subjecting a test object to a specified level of acceleration for a specified duration. In each impact test, a small object is accelerated and released from the arm of the 35-ft centrifuge on a tangential trajectory to impact targets.

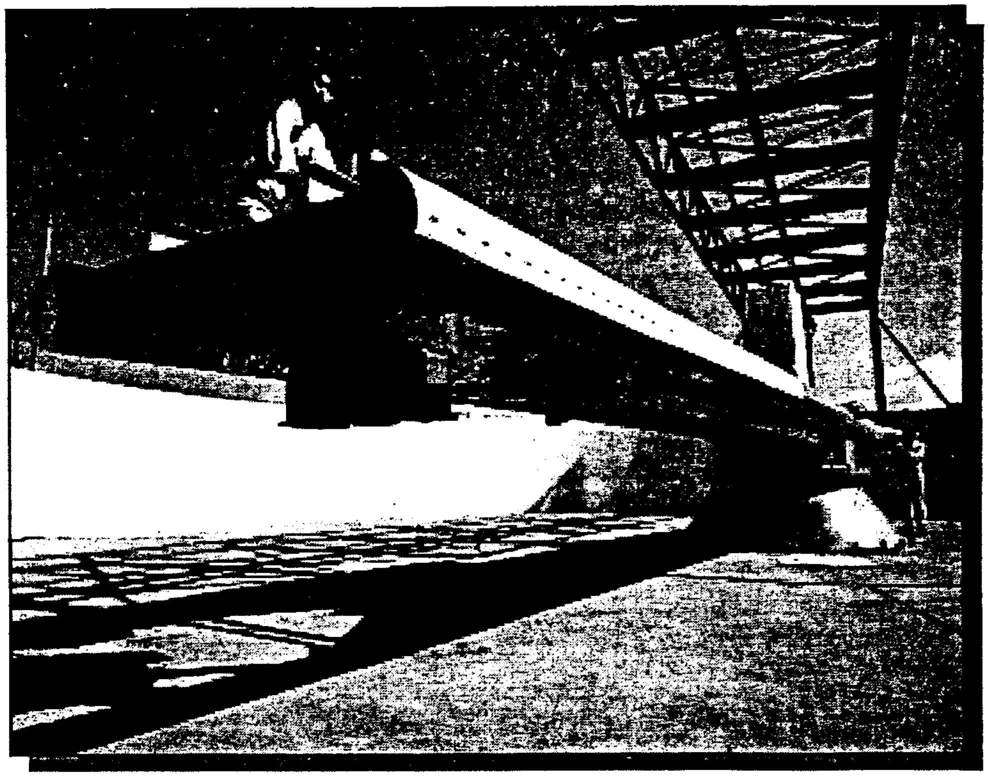
The Centrifuge Complex operation are allocated, but not limited, to the following programs and activities:

- Direct stockpile activities include survivability testing of nuclear weapon systems and components.

- Energy Programs conduct certification testing of transportation systems through impact tests.

- Other programs test satellite systems.

The Centrifuge Complex contains a small chemical inventory but no radioactive materials. Cleaners, lubricants, solvents, paints, and agents are used in small quantities. Compressed gases used in the assembly areas include acetylene and oxygen (for welding), argon, and helium. Chemical emissions, including alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Small amounts of airborne emissions, including carbon monoxide and lead, are released during explosives tests. Radioactive air emissions are not produced at this facility. Noise from centrifuge operation, collision impacts, and explosive testing does occur. Fragments resulting from centrifuge-launched explosives are recovered shortly after test events.



Source: SNL/NM 1998a

FD–9. Centrifuge Complex

This 35-ft outdoor centrifuge can test objects weighing up to 10,000 lb to an acceleration of 45 g.

SATURN ACCELERATOR

Function and Description:

The mission of the SATURN accelerator, located in Building 981 in Technical Area-IV, is to conduct development and survivability testing of nuclear weapon subsystems and components. SATURN was designed and built to provide X-ray radiation environments with enhanced simulation fidelity as well as providing improved test exposure levels and test areas. SATURN can also operate in a plasma radiation source configuration, generating ultra-high intensity soft X-ray environments. The SATURN facility consists of a laboratory building (including a high bay, office space, shop areas, light laboratories, a mechanical room, a radiation exposure cell, and a basement) and storage tanks and transfer systems for large quantities of transformer oil and deionized water.

The accelerator is a symmetric, parallel-current driver consisting of 36 identical pulse-compression and power-flow modules arranged like the spokes of a wheel. It can easily be configured to drive either annular electron beam or Z-pinch loads. The pulsed-power components are housed in an open-air tank that is 96 ft in diameter and 14 ft high. The tank is divided into energy storage, pulse compression, power flow, and power combination sections. The concrete- and earth-shielded exposure cell is located in a basement room beneath the accelerator.

Specific Processes, Activities, and Capabilities:

Activities in the SATURN involve testing the survivability of nuclear weapon systems by simulating the X-rays produced by a nuclear weapon detonation. SATURN is used to simulate the effects of nuclear countermeasures on electronic and material components, as a pulsed-power and radiation source, and as a diagnostic test bed for accelerator component development. This work would include, but not be limited to, improvements or changes to energy storage systems, pulse-forming systems, voltage conditioning networks, and other accelerator components. The SATURN accelerator is designed as a modular, high-power, variable-spectrum, X-ray simulation source that can be operated with two different X-ray controllers or any one of several plasma radiation sources.

Areas of application include the following:

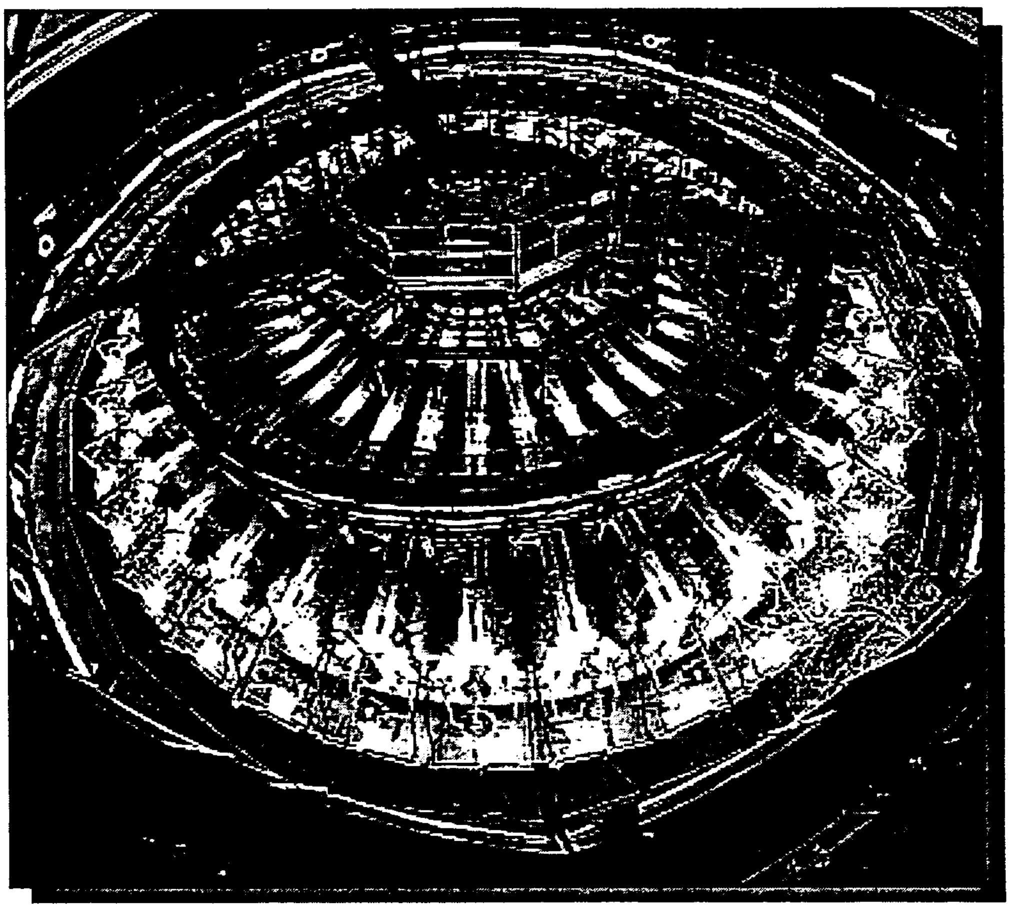
- satellite systems;
- electronic and materials devices, components, and subsystems; and
- reentry vehicle and missile subsystems.

SATURN facility operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities conduct development and survivability testing of nuclear weapons subsystems and components by simulating the X-ray radiation effects of nuclear weapons on nonnuclear components of U.S. Strategic Systems.
- Testing of satellite systems.
- Strategic Defense Initiative tests space assets, reentry vehicles, and missile subsystems.
- Inertial Confinement Fusion Programs involves Z-pinch plasma tests and weapons physics research.

The SATURN facility contains a small chemical inventory and a small radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Sulfur hexafluoride is used as the insulator gas in switching components. Sulfur hexafluoride gas is passed through switches under continuous pressure. It is hazardous in enclosed areas because it does not support respiration. Some tests involve the installation of beryllium filters or shields that can be damaged during a shot, causing release of beryllium particulates. Radioactive air emissions are not produced at this facility. Small sealed radioactive sources (calibration and monitoring), nondestructive testing (X-rays), and lasers are used in the facility.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–10. SATURN Accelerator

The SATURN accelerator is a modular, high-power, variable-spectrum, X-ray simulation source. SATURN is used to simulate the radiation effects of nuclear countermeasures on electronic and material components, as a pulsed-power and radiation source, and as a diagnostic test bed.

HIGH-ENERGY RADIATION MEGAVOLT ELECTRON SOURCE UNIT III (HERMES III)

Function and Description:

HERMES III, a major facility in the Simulation Technology Laboratory (STL), Building 970, is a short-pulse (20- to 30-nsec), high-energy (20-MeV) accelerator that was designed and built to provide intense gamma ray fields over very large areas. This testing provides very realistic conditions associated with some aspects of a nuclear explosion radiation environment. The radiation can be used to test the response of electronics, weapon system components, and entire systems. The accelerator can also be reconfigured to accelerate light ions.

The 55,000-ft^2 (5,110-m^2) HERMES III facility includes the accelerator, indoor and outdoor test cells, and ancillary support systems, including oil storage tanks. The heavily shielded indoor test cell, which is used for most tests, has a usable test area 25 ft deep by 37 ft wide, and can support a load of 100 lb/ft^2, which makes it suitable for testing of most parts and components. The unique shielded outdoor test cell allows testing of large assemblies and entire weapon systems or a variety of other large systems such as tanks.

Specific Processes, Activities, and Capabilities:

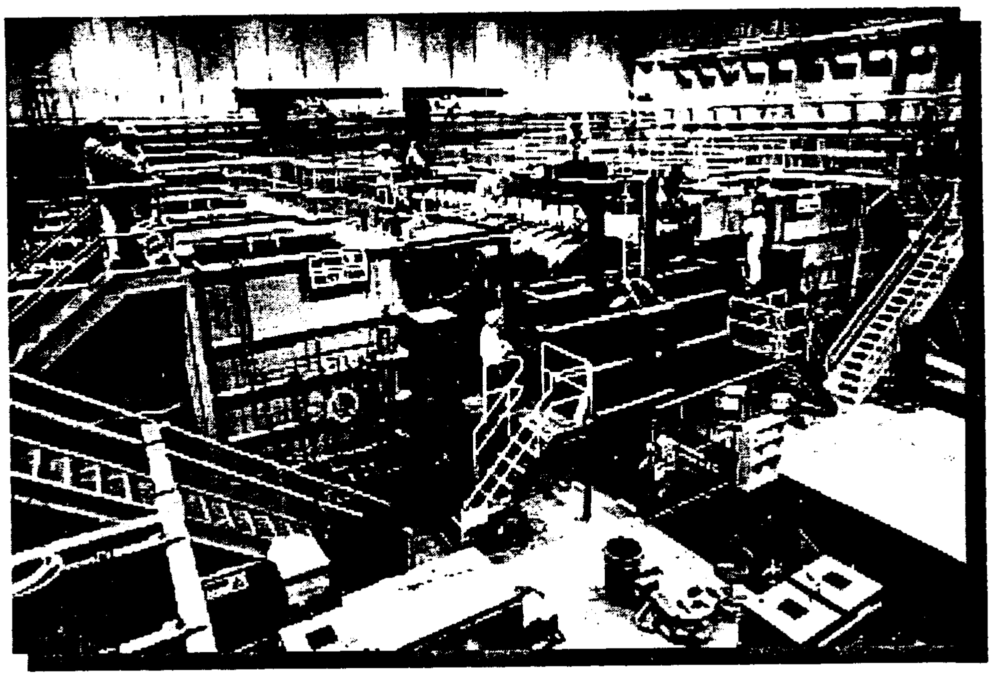
Gamma rays are created by discharging the energy storage systems in a manner that increases their voltage. Then, intermediate storage systems and transmission lines add voltage and form a pulse, and a diode section generates an electron beam and converts the beam into gamma rays. The diode section can also be configured to generate a variety of light ion beams and associated ionizing and nonionizing radiation depending on the type of ion accelerated, the target material, and radioactive decay mode. Objects to be irradiated are placed in either the indoor or outdoor test cells and the radiation environment created by operating the accelerator is tailored to the needs of the test.

HERMES III operations support the following types of programs and activities:

- Direct Stockpile Activities conduct the development and survivability testing of nuclear weapon subsystems and components.
- Experimental Activities in radiation testing and associated diagnostics determine the deleterious or beneficial effects of radiation on electronic, material, and biological systems.
- Inertial Confinement Fusion Program activities validate advanced hydrodynamic radiography techniques and applications to address stockpile stewardship issues on the compact, cost-effective, multi-axis Advanced Hydrotest Facility expected to be located at Los Alamos National Laboratory.
- Performance Assessment Science and Technology Program supports hostile (radiation) environmental testing of weapon components.
- Pulsed-Power Technology Program activities support new pulsed-power components and designs involving modifications to the HERMES III machine for pulsed-power research, development, testing, and evaluation.

A large amount of transformer oil is used as an insulator in the energy storage sections of the facility, but only small amounts of hazardous chemicals, such as solvents, are used. Inert gases are used in switching devices and stored in the facility in sufficient quantities to warrant controls for asphysixiant hazards. Lasers are used to align accelerator components and in switching mechanisms. Radioactive air emissions may be generated by activation of oxygen or nitrogen in air while operating in the gamma ray production mode, particularly with outdoor shots; however, these emissions are at very low levels and decay within seconds.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–11. High-Energy Radiation Megavolt Electron Source Unit III (HERMES III)

The HERMES III accelerator is the world's most powerful gamma simulator. It is used primarily for simulating the effects of prompt radiation for a nuclear burst on electronics and complete military systems.

SANDIA ACCELERATOR & BEAM RESEARCH EXPERIMENT (SABRE)

Function and Description:

The mission of the SABRE pulsed accelerator, located in Building 970 in Technical Area-IV, is to support the Inertial Confinement Fusion (ICF) Program for advanced extraction ion controller research and for target and focusing studies. The accelerator can also be configured for radiography experiments and used as the driver that provides a flash radiography source. SABRE is a pulsed accelerator located within the Simulation Technology Laboratory (STL), along with the High-Energy Radiation Megavolt Electron Source Unit III (HERMES III) accelerator and, soon to be constructed, the Radiographic Integrated Test Stand (RITS) accelerator. The SABRE is comprised of the accelerator itself, a lead- and concrete-shielded test cell, a basement trench where the diode capacitor banks are located, and several screen rooms and work areas located nearby.

Specific Processes, Activities, and Capabilities:

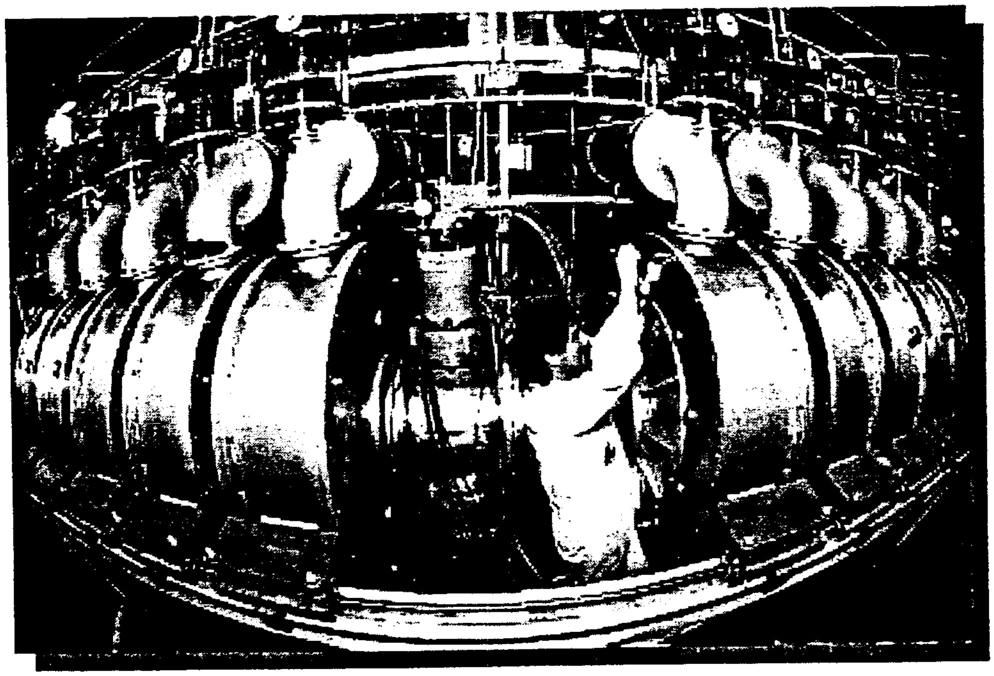
For the ICF Program, the SABRE is the workhorse of the light ion program for investigating extraction diodes and magnetically insulated transmission line coupling; for testing surface and subsurface cleaning, improved vacuum conditions, and advanced ion sources; and for studying lithium ion transport. It uses the inductive voltage adder technology also used on the HERMES III. New high-magnetic-field capability was tested in fiscal year 1996 as part of the Advanced Hydrodynamic Radiography Program in the Sandia National Laboratories/New Mexico Pulsed-Power Sciences. For Stockpile Support activities in testing weapons components, test objects are placed within the accelerator test cell and irradiated by the accelerator-produced radiation. Afterwards, the test objects are examined to determine their survivability from exposure to radiation.

SABRE operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities, include survivability testing of nuclear weapon subsystems and components.
- Performance Assessment Science and Technology Program supports developing pulsed-power technology to provide advanced radiographic characterization techniques useful to applications such as Dual-Axis Radiographic Hydrotesting.
- Inertial Confinement Fusion Program involves light-ion program activities, lithium ion transport, and high-magnetic field testing.

The SABRE facility contains a small chemical inventory and a small radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility. Small, sealed radioactive sources (calibration and monitoring), nondestructive testing (X-rays), and lasers are used in the facility.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–12. Sandia Accelerator & Beam Research Experiment (SABRE)

The SABRE is located in TA-IV and is used to support the ICF Program.

SHORT-PULSE HIGH INTENSITY NANOSECOND X-RADIATOR (SPHINX)

Function and Description:

The mission of the SPHINX facility, located in Building 981 in Technical Area-IV, is to provide radiation environments for testing components of nuclear weapons and for confirming codes used in the certification of nuclear weapons components. Because of the moratorium on underground nuclear testing, the nuclear stockpile integrity must be assured by various simulation testing including computer modeling. The SABRE creates a radiation environment used to validate computer simulations and verify stockpile integrity. The SPHINX accelerator is a high-voltage, high-shot-rate X-ray and electron beam accelerator that is used primarily to measure X-ray-induced photo currents from short, fast-rise-time pulses in integrated circuits and associated heat handling response in materials. The facility, including a concrete-shielded enclosure adjacent to the SATURN accelerator in Building 981, consists of an 18-stage, low-inductance generator; several pulse conduits; and radiation barriers.

Specific Processes, Activities, and Capabilities:

The SPHINX is used primarily as a research facility. The operations and activities taking place in the SPHINX are diverse, although the dominant activity is related to pulsed-power technology. SPHINX is applied as a high-shot-rate, hot-X-ray-effects simulator capable of testing piece parts or components that require small-area exposure. The SPHINX can operate in two distinct modes: as an X-ray source and as an electron beam source. In the X-ray source mode, researchers study the response of electronics to pulsed high-energy X-ray environments. The electron beam mode is used to study the heat handling response of materials to pulsed radiation. It has high usage to support development work in tactical, strategic satellite systems.

Areas of application include

- computer science,
- simulation of X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing, and
- robotics.

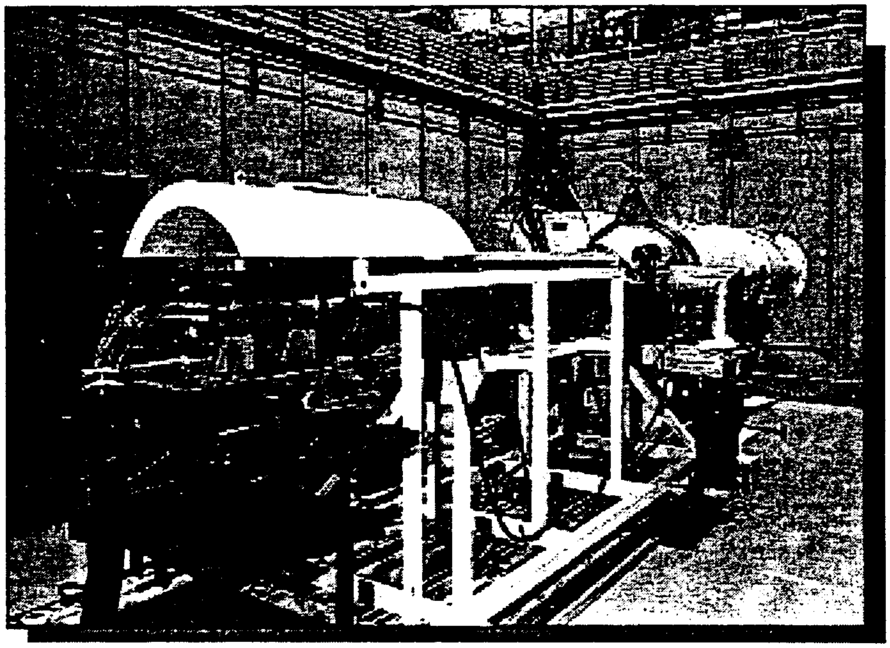
SPHINX operations are allocated, but not limited, to support to the following programs and activities:

- Experimental activities involve testing with high-shot-rate (accelerator firings) and simulating hot X-ray effects for testing of parts and components.
- Performance Assessment Science and Technology Program applications provide high intensity X-ray and electron beam sources for weapons effects studies.
- Studies on the thermostructural response of materials to pulsed radiation.

- Tactical and strategic satellite systems development work.
- Various research and development work for other Federal agencies using SPHINX facility capabilities.

The SPHINX facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–13. Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)

The SPHINX is primarily used to measure the X-ray–induced photocurrents from short, fast-rise-time pulses in integrated circuits.

REPETITIVE HIGH ENERGY PULSED-POWER UNIT I (RHEPP I)

Function and Description:

The mission of the RHEPP I accelerator, located in Building 986 in Technical Area-IV, is to serve as a tool for the technology development of continuous-operation, pulsed-power systems to demonstrate high-energy ion beams and industrial pulsed-power applications. The RHEPP I facility includes a high-energy generator; computer-controlled, pulsed-power equipment; specialized voltage enhancement equipment; specialized electrical current control and storage equipment; and a material test chamber for ion source testing and development. The electrical current control equipment and materials test chamber are located in a below-grade, radiation-shielded test cell under the voltage-enhancement equipment.

Specific Processes, Activities, and Capabilities:

The RHEPP I is primarily a research facility. Its operations and activities are diverse, although the dominant activity is related to pulsed-power technology. During normal operation, the RHEPP systems produces pulses of electrons that may be stopped, converted to ions, or extracted, depending upon the configuration of the accelerator. The RHEPP I was the first Sandia National Laboratories/New Mexico (SNL/NM) accelerator used for the basic technology development of the RHEPP technical concept. It is now used for applications at lower energies and for technology development and some experimental work with materials and organic sterilization processes. Testing in RHEPP I includes exposing test materials (metals and plastics) located in the test cell to shots of proton energy generated by the accelerator. Test objects are then evaluated to determine the effects of the low-level radiation. A new activity for the RHEPP I would be to use ion beams to melt and resolidify near-surface material on small amounts of depleted uranium.

Areas of application include

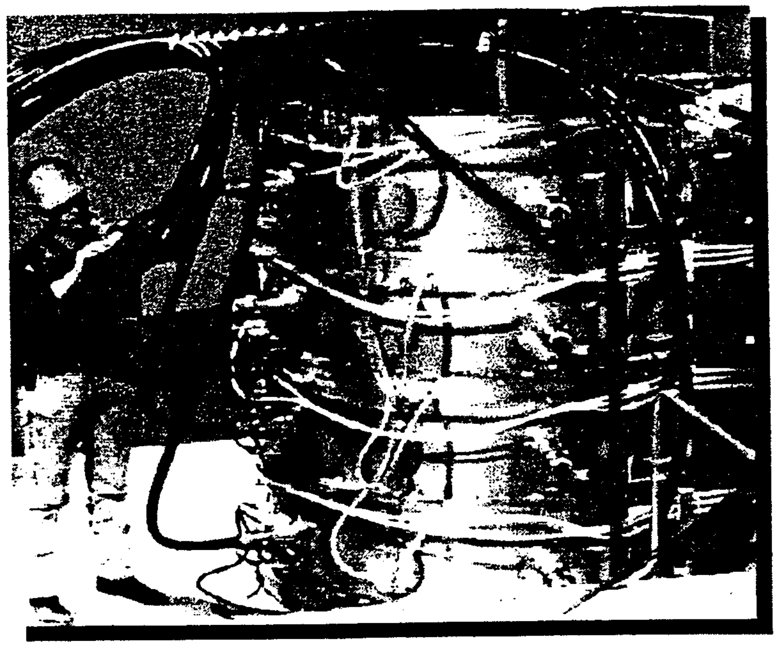
- computer science,
- simulation of the X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing, and
- robotics.

RHEPP I operations support the following types of programs and activities:

- Nonproliferation and Verification Research and Development Program design of advanced accelerators for applications related to the defeat of biological (nonpathenogenic) and chemical agents.
- Performance Assessment Science and Technology Program develops unique pulsed-power materials-processing techniques for weapons applications.
- Pulsed-Power Technology Program technology development and related experimental activities.

The RHEPP I facility contains a small chemical inventory and a small radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–14. Repetitive High Energy Pulsed-Power Unit I (RHEPP I)

The RHEPP I facility is an operational test bed for the development of technology used to melt and resolidify metals and ceramics for a variety of potential industrial applications.

REPETITIVE HIGH ENERGY PULSED-POWER UNIT II (RHEPP II)

Function and Description:

The mission of the RHEPP II accelerator, located in Building 963 in Technical Area-IV, is the development of radiation processing applications using high-dose-rate electron or X-ray beams. The RHEPP II accelerator is also a test center for the continued development of high-power magnetic switches and repetitive magnetically insulated transmission lines.

The RHEPP II facility contains the RHEPP II accelerator and the additional components of the microsecond pulse compressor, water-insulated pulse equipment, voltage enhancement equipment, and a high-power electron beam controller.

Specific Processes, Activities, and Capabilities:

The RHEPP II is primarily a research facility in the area of pulsed-power technology. It is used for basic magnetic switching technology development and as a U.S. Department of Energy (DOE) user facility for high-energy-per-pulse applications. RHEPP technology has been used for ion beam surface treatment to harden material surfaces and for advanced research supporting sterilization projects for organic materials (for example, food products and lumber). Testing in RHEPP II includes exposing test materials in the test cell to high doses of X-rays to both simulate the conditions of nuclear weapon detonation as well as the effects of outer space on satellite components. While RHEPP I testing is confined largely to the surface of materials, RHEPP II produces an X-ray environment used to irradiate the entire test material.

Areas of application include

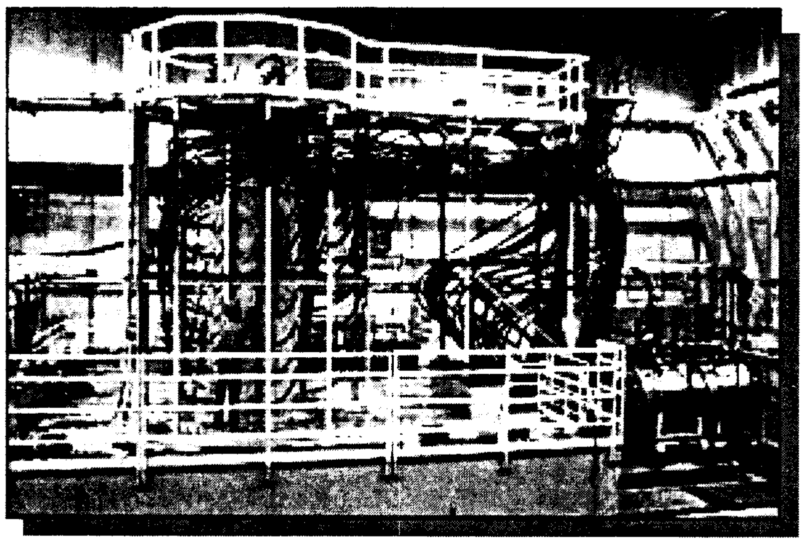
- computer science,
- simulation of the X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing,
- commercial application and technology transfer, and
- robotics.

RHEPP II operations support the following types of programs and activities:

- Performance Assessment Science and Technology Program develops pulsed-power technologies and applications for DOE Defense Programs and work for other Federal agencies.
- Initiatives for Proliferation Prevention Program and Nonproliferation and Verification Research and Development Program activities involve developing advanced accelerators for biosterilization of such items as food and lumber, mentioned earlier.
- Pulsed-Power Technology Program activities involve basic switching technology development, high-energy pulse applications, ion-beam surface treatment for hardened materials, advanced research in support of the programs mentioned above, and the sterilization of organic materials.

The RHEPP II facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–15. Repetitive High Energy Pulsed-Power Unit II (RHEPP II)

RHEPP II, which began operation in July 1994, is a modular accelerator capable of operation up to 300 kW. Scheduled experiments include food pasteurization studies and direct bonding of ceramics.

Z-Machine

Z-MACHINE

Function and Description:

The mission of the Z-Machine facility, formerly known as the Particle Beam Fusion Accelerator II (PBFA II) and located in Building 983 in Technical Area-IV, primarily provides weapons systems survivability testing by simulating the X-rays produced by nuclear weapon detonation for the Inertial Confinement Fusion (ICF) Program and weapon science research.

The Z-Machine facility includes the accelerator high bay, support area high bays, laser and facility support systems including water and oil tank farms, low bay light laboratories, and the control room. The Z-Machine consists of 36 modules arranged radially around a central experiment vacuum chamber. The accelerator is located in a tank approximately 108 ft in diameter and 20 ft high, divided into 3 annular regions.

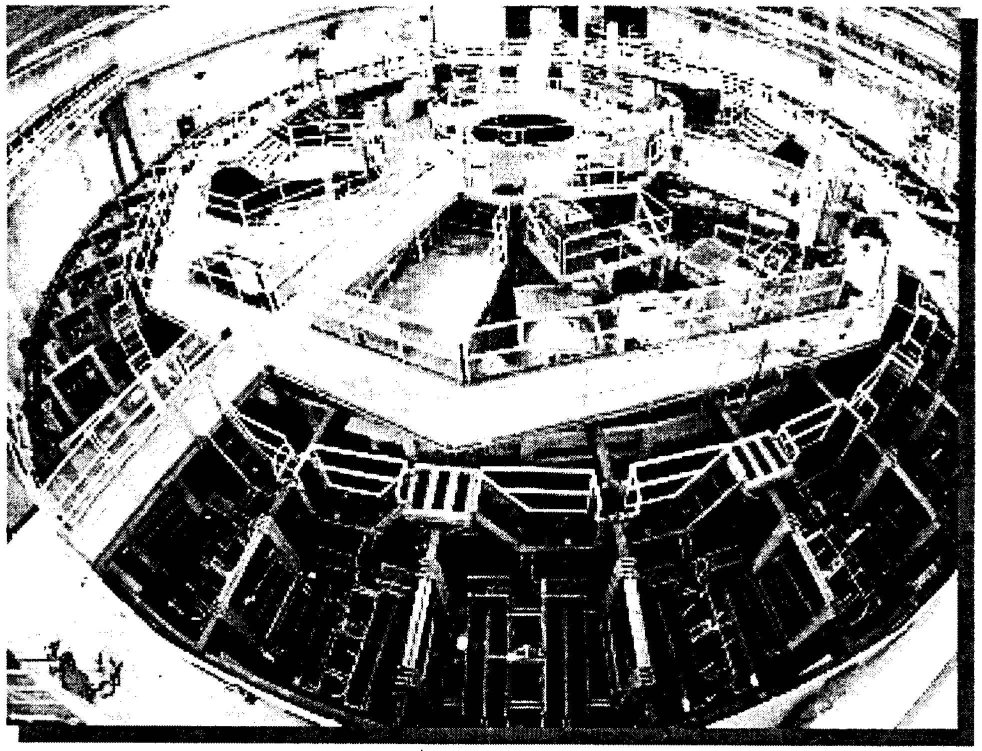
Specific Processes, Activities, and Capabilities:

Operating on the principle of pulsed-power, the Z-Machine stores electrical energy over a period of minutes then releases that energy in a concentrated burst. The accelerator produces a single, extremely short, extremely powerful pulse of energy that can be focused on a target. The primary operating mode of the Z-Machine produces a pulse that lasts 100 nsec with approximately 5 MJ of electrical energy and a peak power of 50 TW. Materials are not irradiated within the Z-Machine, but rather the accelerator provides a radiation environment used to validate computer modeling of the effects of certain X-rays on weapons components. Experiments at the facility are primarily research and development in nature.

Z-Machine operations are allocated, but not limited, to accelerator shots, or firings, in support of the following types of programs and activities:

- Inertial Confinement Fusion (ICF) Program studies involve pulse-shaping, radiation flow, equation of state and opacity measurements, hydrodynamic instabilities, capsule implosion physics, and the production of thermonuclear neutrons using deuterium.
- Pulsed-Power Technology Program develops advanced pulsed-power design and applications to improve performance, z-pinch sources for weapons effects testing, and weapons physics experiments.
- High Energy Density Physics Program tests provide high-temperature, large-volume hohlraums and X-ray environments for weapons physics and ICF applications.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–16. Z-Machine

Raw Power: The Z-Machine is the world's most powerful X-ray source.

TERA-ELECTRON VOLT ENERGY SUPERCONDUCTING LINEAR ACCELERATOR (TESLA)

Function and Description:

The mission of the TESLA facility, located in Building 961 in Technical Area-IV, is to test plasma-opening switches for pulsed-power drivers. The TESLA accelerator facility includes the accelerator high bay, light laboratories, offices, and the screen room. The facility is contained in a rectangular tank, 25 ft wide by 14 ft long by 10 ft high, with a vacuum chamber extension represented by two coaxial cylinders. The TESLA test cell includes electrical charge storage, a magnetically controlled plasma-opening switch, and electron beam storage. The oil tank contains 10,000 gals of transformer oil and a generator, which can store a maximum of 740 kJ in 48 capacitors and is equipped with a mechanical shorting system. The water tank contains 15,000 gals of deionized water and a 150-kilojoule intermediate storage capacitor. Two-foot-thick concrete block walls surround the test cell.

Specific Processes, Activities, and Capabilities:

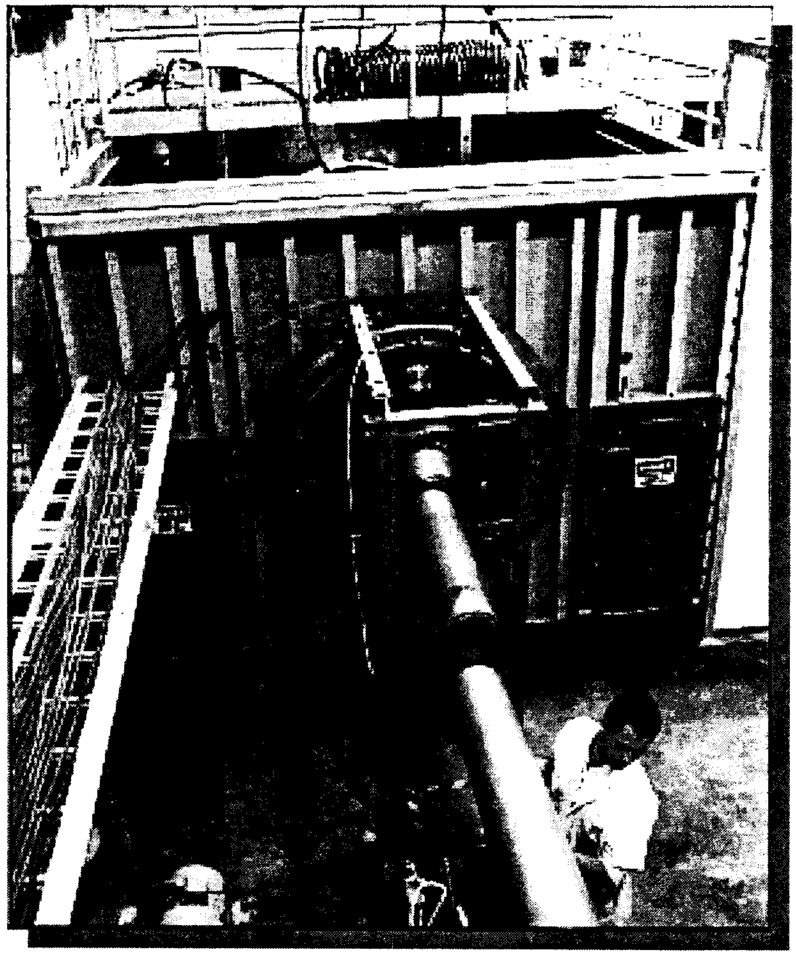
The electron beam storage consists of an electron diode with a graphite converter. Testing at TESLA is primarily focused on evaluating improvements to pulsed-power technology and not on irradiating materials. The maximum possible voltage is 5 MV into a very high impedance load.

TESLA operations support, but are not limited to, the following types of programs and activities:

- Pulsed-Power Technology Program activities including radiation-producing shots (electron-beam into carbon load) and pulsed-power shots into dummy loads (shots that do not produce radiation).
- Performance Assessment Science and Technology Program activities dedicated to advanced pulsed-power development.

The TESLA facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–17. Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA)

The TESLA facility is used to test switches for pulsed-power drivers.

ADVANCED PULSED-POWER RESEARCH MODULE (APPRM)

Function and Description:

The mission of the APPRM, located in the Building 963 in Technical Area-IV, is to evaluate the performance of new pulsed-power components and component alignments to improve the performance of future accelerators. The APPRM is a relatively small, single-pulse accelerator that serves as a test center for other scientific projects and can be used for conducting general pulsed-power research. Pulsed-power technology being tested at the APPRM is a potential candidate technology for future accelerator development beyond Sandia National Laboratories/New Mexico's (SNL/NM's) Z-Machine.

Specific Processes, Activities, and Capabilities:

The operations and activities taking place in the APPRM are diverse, although the dominant activity is related to pulsed-power technology. APPRM is primarily used as a test bed for investigating physical design and pulsed-power issues associated with future accelerator design. None of the research involves the use of radioactive materials. Even in the "full system" configuration of the accelerator, the activation of materials from firing the accelerator is negligible.

Areas of application include

- computer science,
- simulation of X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing, and
- robotics.

APPRM operations support the following types of programs and activities:

- Experimental programs develop pulsed-power modules designed to study power storage, high-voltage switching, power flow for advanced applications, and advanced technologies in support of new designs.
- Performance Assessment Science and Technology Program develops pulsed-power sources for future incorporation into pulsed-power machines designed for weapons effects and weapons physics experiments.
- Inertial Confinement Fusion Program activities are similar to a gas switch design that eliminates the shock generated in the module and is useful to designs of future pulsed-power facilities such as the X-1 accelerator, for which the APPRM is the design prototype.

The APPRM facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are not produced at this facility.

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.

Source: SNL/NM 1998a

FD–18. Advanced Pulsed-Power Research Module (APPRM)

Pulsed-power components are evaluated at the APPRM.

RADIOGRAPHIC INTEGRATED TEST STAND (RITS)

Function and Description:

The RITS is a proposed new accelerator that would be installed in the Technical Area (TA)-IV, Building 970, high bay. The purpose of this new accelerator, planned for fiscal year 1999, would be to demonstrate inductive voltage adder pulsed-power technology for advanced hydrodynamic radiography. The RITS would be an intense electron beam test center bed and would be used to develop and demonstrate the capabilities required for the national Advanced Hydrotest Facility (AHF). The AHF would provide experimental benchmarking for advanced full-physics, three-dimensional numerical models of nuclear weapon primaries. The resulting confidence in the codes would form the basis for confidence in the nuclear performance and safety of the enduring stockpile and provide critical data to qualify remanufacture technologies and lifecycle engineering.

Specific Processes, Activities, and Capabilities:

The operations and activities of the RITS would be diverse, although the dominant activity would be related to pulsed-power technology. Other research that the RITS would support includes validation of pulsed-power architecture (power flow), equipment physics studies, weapons code validation, diagnostic development, and possible long-range research involving explosive component testing. The X-rays would be used to radiograph both static and dynamic (explosively driven) objects within the Building 970 high bay. Under future programs, explosive testing could be conducted within the accelerator test cell. Such explosive tests would be conducted using an approved explosive containment system that could handle explosive charges up to 30 lb of trinitrotoluene (TNT) equivalent.

Areas of application include

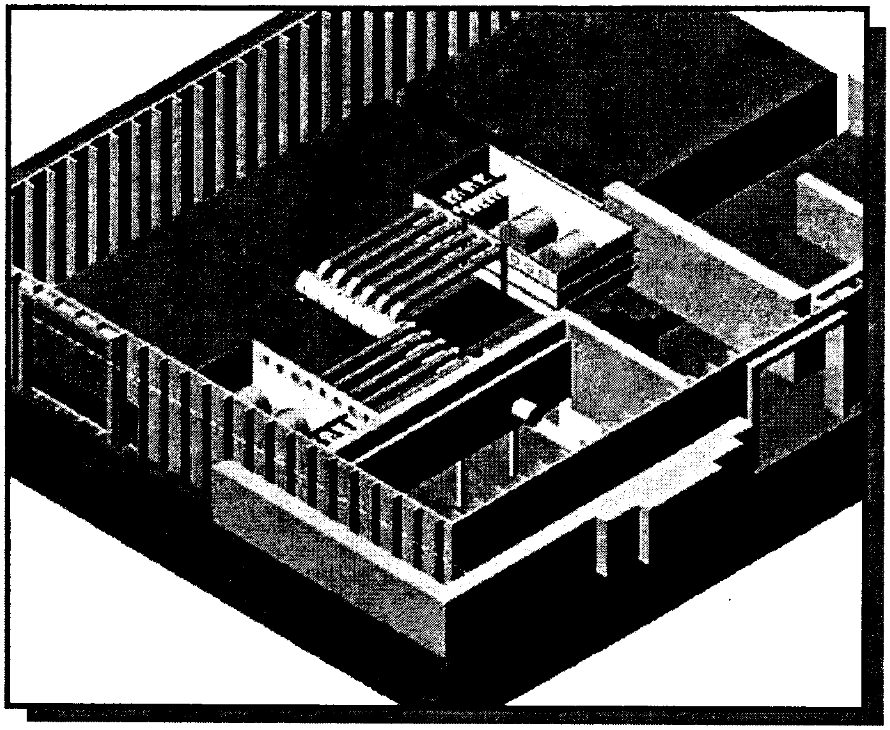
- computer science,
- simulation of the X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing,
- commercial application and technology transfer, and
- robotics.

As planned, RITS operations would initially support the following Assistant Secretary for Defense Program activities:

- Radiography of both static and dynamic objects, including explosives tests in containment systems.
- Research into validating pulse-power architecture (power flow), diode physics studies, weapons code validation, and system diagnostic development.

The RITS facility would contain a small chemical inventory and a small radioactive hardware inventory. This hardware would become radioactive through high-energy activation during tests. Chemical emissions, including alcohols, ketones, and other solvents, would be possible and would be associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions would be produced when the energy releases during a test.

All areas of the facility would have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers would be provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–19. Radiographic Integrated Test Stand (RITS)

The RITS is a proposed accelerator to replace the existing Proto II accelerator.

NEW GAMMA IRRADIATION FACILITY (NGIF)

Function and Description:

The mission of the NGIF, located in Technical Area (TA)-V, is to provide test cells for the irradiation of experiments with high-intensity gamma ray sources. Currently under construction, the NGIF will be a single-story structure located in the northeast area of TA-V. The main features of the NGIF will be the deep water pool and two dry irradiation cells. The facility will include a special air handling system, water recirculation system, and water makeup subsystem to maintain optimal operational conditions and to prevent the potential release of materials. The pool will be able to store up to 2.4 MCi of cobalt-60 or an equivalent source (40 kw) of other gamma-ray sources. The sources will be in the form of pins and could be shared between in-cell irradiation facilities and in-pool irradiation facilities. Ancillary spaces in the high bay will include offices, setup/light laboratories, and restrooms.

The NGIF consolidates several existing Sandia National Laboratories/New Mexico (SNL/NM) gamma sources into a single facility. The planned facility could include sources relocated from the existing Gamma Irradiation Facility (GIF), which is a two-cell dry irradiator located in the Annular Core Research Reactor (ACRR) high bay in TA-V. The NGIF would also include gamma sources relocated from the low-intensity cobalt array, which is located in SNL/NM's TA-I. This would consolidate gamma irradiation sources in a single dedicated facility in a remote area, reducing the potential for radiation exposure of nonoperations personnel. The main hazard associated with the facility would be the potential for inadvertent exposure of operations personnel to the high-intensity radioactive sources.

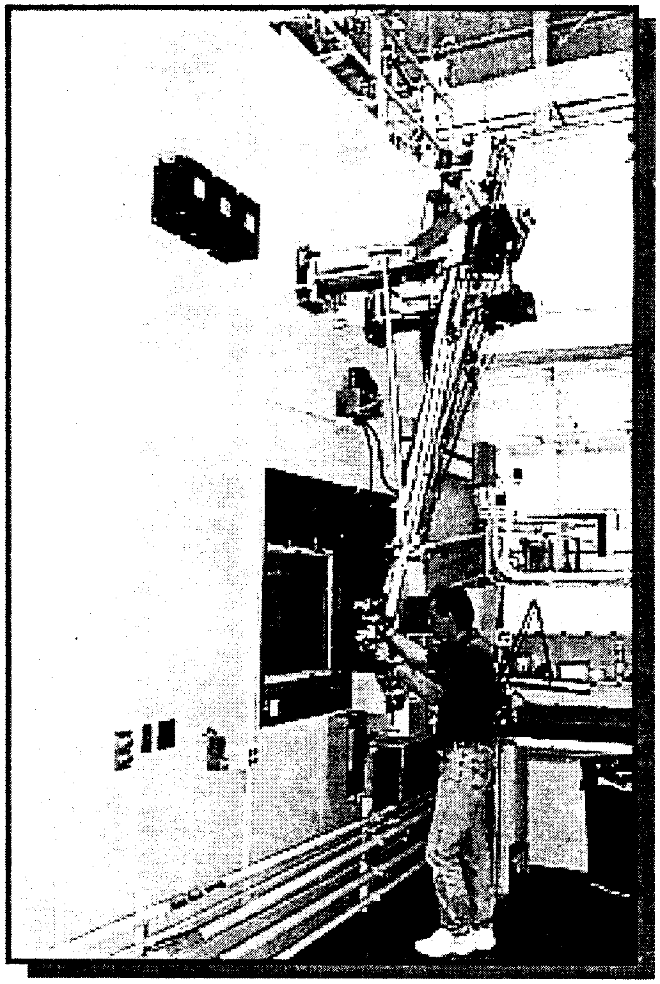
Specific Processes, Activities, and Capabilities:

Testing in the NGIF facility would include irradiation of test packages in one of the available test cells for 13,000 test hours per year (approximately 26 weeks continuous irradiation in each of 3 cells). The key consumable resources in the NGIF facility would be the radioisotope sources that provide the gamma radiation necessary to conduct the tests. The radioactivity of these radioisotope sources would diminish over time regardless of whether or not tests were being conducted. The NGIF has been designed for highly specialized high-intensity gamma ray source experiment work.

Areas of application include

- thermal and radiation effects studies,
- degradation testing of weapon components,
- material and component testing for nuclear reactor accident tests,
- electronic component certification and testing
- survivability and certification tests for military and commercial applications,
- radiation effects on material properties,
- radiation effects on organic materials (such as food or sludge),
- hazardous waste destruction, and
- mixed environment testing (such as steam and radiation or heat and radiation).

The NGIF facility would contain a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, would be possible and would be associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions would not be produced at this facility.



Source: SNL/NM 1998a

FD–20. New Gamma Irradiation Facility (NGIF)

The three new cells being developed at the NGIF would allow complete systems to be tested during irradiating experiments similar to those conducted in the existing GIF (see photo).

GAMMA IRRADIATION FACILITY (GIF)

Function and Description:

The mission of the GIF, located in Technical Area-V, is to provide test cells for the irradiation of experiments with high-intensity gamma ray sources. The GIF facility shares the high bay with the Annular Core Research Reactor (ACRR) in Building 6588 and includes a deep water pool and two dry irradiation cells. The pool is a rectangular, reinforced concrete structure with a stainless steel liner, approximately 8 ft wide by 14.5 ft long by 16 ft deep. The facility also includes a special air handling system, water recirculation system, and water makeup subsystem to maintain optimal operational conditions and to prevent the potential release of materials. The main hazard associated with the facility is the potential for inadvertent exposure of operations personnel to the high-intensity radioactive sources.

Specific Processes, Activities, and Capabilities:

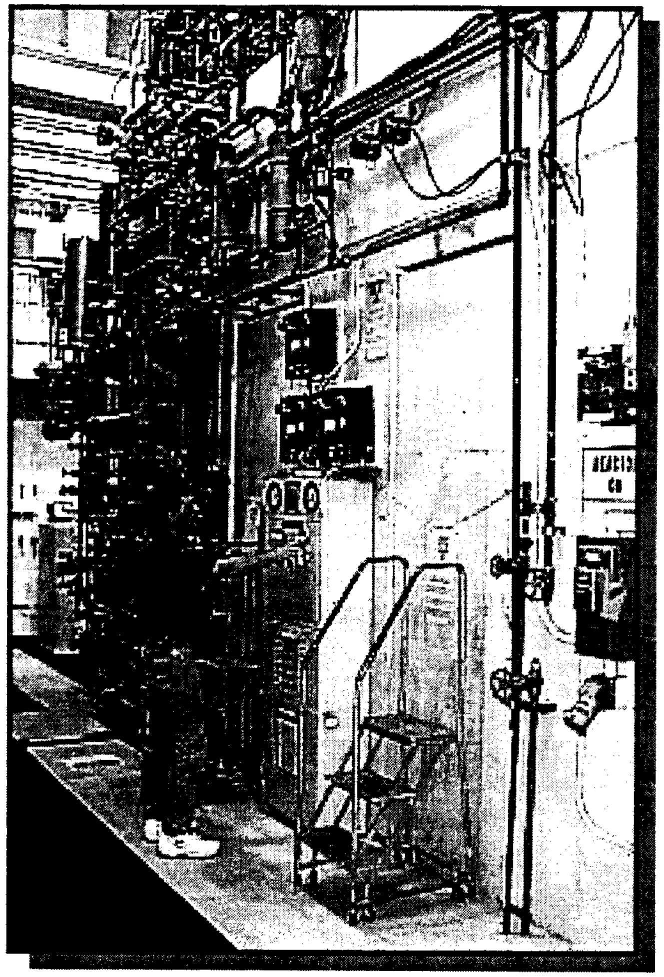
Testing in the GIF facility includes irradiation of test packages in one of the two available test cells for 1,000 test-hours (approximately 40 days of continuous irradiation in each of the two cells) per year. Current plans call for test hours to reach zero by 2003 as the New Gamma Irradiation Facility begins operation. The key consumable resource in the GIF is the radioisotope sources that provide the gamma radiation necessary to conduct the tests. The radioactivity of the radioisotope sources diminishes over time regardless of whether or not tests are being conducted. The GIF is designed for highly specialized high-intensity gamma ray source experiment work.

Areas of application include

- radiation testing of electronic components in satellite and weapon systems,
- dosimetry calibration,
- studies of radiation damage to materials,
- hostile (gamma radiation) environmental testing,
- underwater transfer of material from the reactor to transfer casks, and
- reactor fuel and other radioactive components storage.

The radioactive sources that the GIF uses are pins of cobalt-60, which are sealed in stainless steel cladding with welded end caps. Stainless steel is used as cladding because of its high strength and resistance to corrosion in water. The GIF inventory of sources includes 107 pins of cobalt-60 with a total strength of 109,100 Ci.

The GIF facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.



Source: SNL/NM 1998a

FD–21. Gamma Irradiation Facility (GIF)

The GIF provides two cobalt cells for total dose irradiation environments and is used mainly for radiation certification of satellite and weapons systems electronic components, dosimetry calibration, and radiation damage to materials studies.

SANDIA PULSED REACTOR (SPR)

Function and Description:

The mission of the SPR, which includes the fast-burst reactors SPR II and SPR III, is to provide unique near-fission spectrum radiation environments for testing a wide variety of technologies that support both defense and nondefense activities. The facility, located in Technical Area-V, produces high-neutron fluence or pulsed high-neutron doses for the testing of electronic subsystems and components.

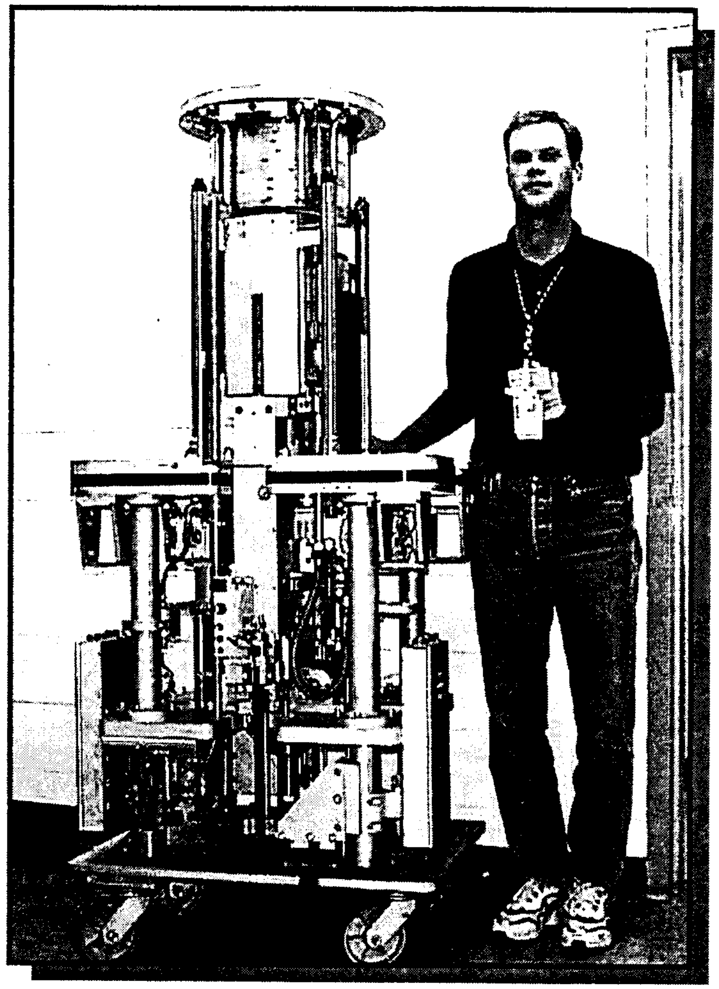
The SPR facility is located in the reactor building, a large, thick-walled, steel-reinforced concrete structure referred to as the Kiva. It is cylindrical, with an outside diameter of about 39 ft, covered with a hemispherical shell. Access to the reactor building is provided by a concrete and steel door, which remains closed for most operations. Experiment support facilities, including the reactor maintenance building and the instrument rooms, are adjacent to the reactor building. Also, several storage vaults, which are integral units in adjacent buildings, are available for the storage of the reactor and fissionable and radioactive materials.

Specific Processes, Activities, and Capabilities:

SPR III uses an unmoderated cylindrical assembly of solid uranium metal, enriched to 93 percent uranium-235 with 10 weight-percent molybdenum. SPR III can be operated at steady-state power levels; however, the capability of the nitrogen cooling system and administrative restrictions effectively limit power and total energy generated in a given period. Normally, steady-state power operations are limited to a maximum of 10 kw, although higher power levels can be achieved.

The SPR facility currently houses the SPR-II and SPR-III and is used for reactor critical experiments. Also, SPR provides a source of pulsed high-energy radiation to simulate neutron and gamma radiation effects and provide data for certifying weapons and components for hostile environments. SPR-II and SPR-III are designed to produce a neutron spectrum very similar to the fission spectrum. The primary experiment chambers are central cavities that extend through the cores. Experiments may also be placed around the reactors. Beam ports are used to transport neutron flows outside the Kiva for other experimental needs.

The SPR facility contains a small chemical inventory and a radioactive nuclear material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are produced at this facility when the energy releases during a test interact with air and produce argon-41. Small sealed radioactive sources are used for calibration and monitoring in the facility.



Source: SNL/NM 1998a

FD–22. Sandia Pulsed Reactor (SPR)

The Sandia Pulse Reactors II and III (SPR-II and SPR-III) are fast-burst core reactors capable of pulse and limited steady-state operation. SPR-II and SPR-III are used primarily for high-dose-rate testing of electronic devices.

ANNULAR CORE RESEARCH REACTOR (ACRR) – DEFENSE PROGRAMS (DP) CONFIGURATION

Function and Description:

The mission of the ACRR, operating in the DP configuration, is to provide neutron and sustained gamma pulsed environments to perform experiments, including those for DP system's components electronics testing. Part of a larger complex located in Technical Area-V, the ACRR is located in Building 6588 and is primarily a low-power research reactor facility. The facility is comprised of the reactor room, low bay, control room, building utilities, several small laboratories, and support staff offices.

The ownership of the ACRR was transferred to the U.S. Department of Energy, Office of Nuclear Energy, for application to radioisotope production. As a result, there are two options for providing an ACRR neutron effects test capability for DP if that should be required in the future: the current molybdnenum-99 ACRR could be reconfigured to allow pulse testing for a "window" of time in the molybdnenum-99 operation; or the DP configuration could be reconstituted using the existing fuel in a new tank in another location in TA-V (a detailed description is being developed).

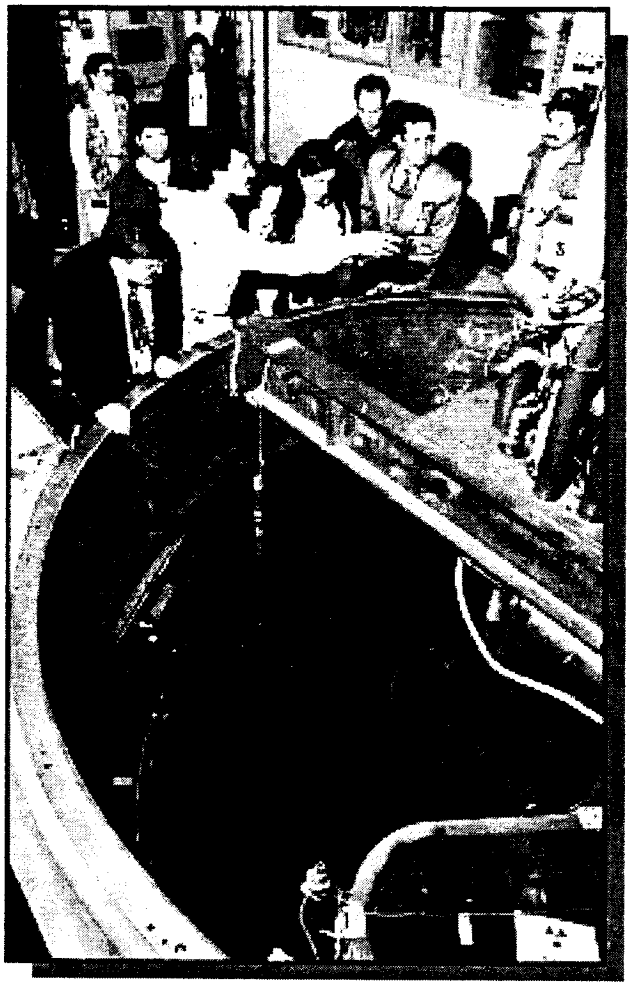
Specific Processes, Activities, and Capabilities:

The ACRR in the DP configuration is a water-moderated and -reflected, low-power research reactor that uses enriched uranium oxide-beryllium oxide cylindrical fuel elements arranged in a close-packed hexagonal lattice around a central experiment cavity. The reactor has several features for conducting experiments, including a dry cavity in the central core region and a radiography tube, and is capable of producing a high yield of high-energy neutrons in the central dry cavity over a very short period of time. The reactor is operated by means of the reactor instrumentation and control system in either the short-duration, steady-state power mode at 2 megawatts or less, or the fast-pulse mode. Specific research activities involve neutron effects on fissile components, radiation effects on various types of electronics, radiography, and testing of materials and systems.

The DOE has identified a recent short-term need to conduct a single test series related to certification of some weapons components (Weigand 1999a). This test would be conducted in the existing ACRR facility, which would have to be temporarily reconfigured to restore DP testing capability (for 12 to 18 months following the Record of Decision) (Weigand 1999b). During this time, medical isotopes preparation and validation testing would be integrated with the weapons certification testing schedule. The reconfiguration to ACRR-DP would be done so that conversion back to ACRR-medical isotope production would be more efficient.

The reconfiguration activities to restore the ACRR to the DP test configuration would mainly consist of replacing the central cavity, enabling the pulse mode of operation, reconfiguring the core fuel, reinstalling the appropriate fuel-ringed external cavity (if required), and executing the necessary battery of tests, documentation, and reviews to certify that the reconfigured reactor is operational. Tests conducted for DP could include weapons systems and components or other DP hardware. After irradiation, test packages could be stored in the ACRR storage holes or similar storage and handling space in the Sandia Pulsed Reactor facility while awaiting shipment, disposal, or examination. Following the test, these changes would be reversed to restore the reactor for isotopes production. Each reconfiguration (isotopes production-to-DP or DP-to-isotopes production) would likely take several months to complete. If a DP test is needed after a new isotopes production core (fuel elements with no pulse test capability) has been installed, the total reconfiguration time would be increased to allow for a complete core refueling to switch back to the uranium oxide-beryllium oxide fuel.

The ACRR facility contains a small chemical inventory and a radioactive nuclear material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are produced at this facility when the energy released during a test interacts with air and produces argon-41. The nuclear material inventory includes enriched uranium fuel, plutonium-239, and cobalt-60.



Source: SNL/NM 1998a

FD–23. Annular Core Research Reactor (ACRR)–Defense Programs (DP) Configuration

The ACRR is a pool-type research reactor capable of steady-state, pulse, and tailored-transient operation.

ANNULAR CORE RESEARCH REACTOR (ACRR) – MEDICAL ISOTOPES PRODUCTION CONFIGURATION

Function and Description:

The mission of the ACRR, operating in the medical and research isotopes production configuration, is the production of medical and research isotopes, primarily molybdenum-99, whose daughter, technetium-99m, is used in nuclear medicine applications. The potential exists for expanding the range of isotopes produced to cover the broad field of medical isotopes and various research isotopes. Located in Building 6588 in Technical Area-V, the ACRR is part of a larger complex that includes two other major structures, Buildings 6580 and 6581. Building 6588 comprises the reactor room, low bay, control room, building utilities, several small laboratories, and support staff offices. Operating in the medical isotopes production configuration, the facility is primarily a low-power medical isotopes production reactor facility.

Specific Processes, Activities, and Capabilities:

In the medical isotopes production configuration, the ACRR would operate for 52 weeks to irradiate targets to produce approximately 30 percent of the U.S. demand (on average) for molybdenum-99 and other isotopes such as iodine-131, xenon-133, and iodine-125. The estimates for the years 2003 and 2008 assume that the Sandia National Laboratories/New Mexico medical isotopes production program operates primarily as a backup to Nordion, Inc., the current supplier for the U.S. market, producing a nominal 30 percent of U.S. demand level. This would require the irradiation of about 375 highly enriched uranium targets per year.

The isotopes production needs may require varying scenarios that would range from periods of shutdown to periods of operation at 100 percent of the U.S. demand level (approximately 25 targets per week). However, it is anticipated that the annual total would not exceed approximately 1,300 targets irradiated in a particular year (100 percent production level). The irradiation schedule could require reactor operations that vary from as little as a single worker shift (typically an 8-hour shift) for only a few days per week to 24-hour-per-day, 7-day-per-week operation. The U.S. Department of Energy has evaluated this program in an environmental impact statement (DOE/EIS-0249F) and has issued a record of decision that addresses operations and production levels to meet the entire U.S. demand continuously at this facility.

The long-term, steady-state operation of the reactor for isotopes production allows the associated use of the reactor for neutron irradiation, radiography experiments, and other activities that are suitable for concurrent use of the ACRR while it is in operation for the production of isotopes.

The ACRR in the medical isotopes production configuration contains a small chemical inventory and a radioactive nuclear material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are produced at this facility when the energy released during operation interacts with air and produces argon-41. The nuclear material inventory includes enriched uranium fuel and cobalt-60.

Source: SNL/NM 1998a

**FD–24. Annular Core Research Reactor (ACRR)–
Medical Isotopes Production Configuration**

Production Site–Jeff Wemple of Isotopes Project and Compliance Initiatives Dept. 9361 peers toward the center of the ACRR where targets are placed for irradiation.

HOT CELL FACILITY (HCF)

Function and Description:

The mission of the HCF, located in Technical Area-V, is to operate primarily as a medical isotopes production facility that supports the U.S. Department of Energy's (DOE) Isotopes Production and Distribution Program (IPDP). Among other activities, the IPDP has responsibility for ensuring that the U.S. health care community has access to a reliable supply of molybdenum-99. The IPDP activities at Sandia National Laboratories/New Mexico (SNL/NM) would provide the only domestic capability to produce a continuous supply of molybdenum-99 and related medical isotopes and is currently under modification for enhanced production capability. Targets produced at Los Alamos National Laboratory are irradiated in the Annular Core Research Reactor (ACRR) and then transferred to the HCF for processing. Besides molybdenum-99, other isotopes produced in the process include iodine-131, xenon-133, and iodine-125.

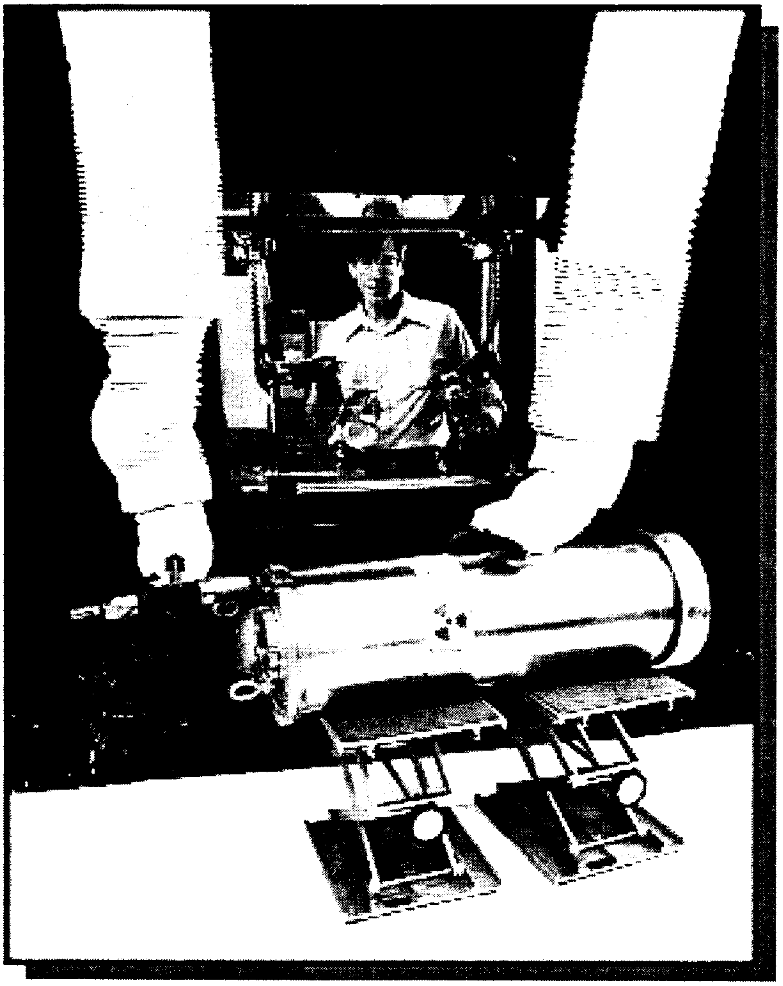
Specific Processes, Activities, and Capabilities:

A few days after its production, molybdenum-99 decays to form metastable technetium-99m, the most widely used medical radioisotope in the U.S. The primary operations and capabilities of the HCF are geared to support efficient isotopes production. Experiments and chemical and material science analysis activities with radioactive and other hazardous materials can be accommodated, but would impact isotopes production. If isotopes production is low during a period, it may be possible to accommodate some limited experiments in support of other programs.

Isotopes production operations and associated capabilities of the HCF include receipt, extraction, and separation processing of molybdenum-99 from the irradiated targets. In addition, isotopes product packaging and quality sample extraction is also performed. Quality control analysis samples are produced in the ventilation hoods, using small quantities of prepared chemicals. Isotopes product final packaging is performed in the product packaging and shipping area. Finally, radioactive waste neutralization and solidification is done at the HCF prior to offsite disposal.

The HCF would process approximately 30 percent of the U.S. demand for molybdenum-99 and other isotopes, such as iodine-131, xenon-133, and iodine-125. This would require the processing of about 375 irradiated highly-enriched uranium targets per year. The production needs may require varying scenarios that would range from periods of shutdown to periods of operation at 100 percent of the U.S. demand level (approximately 25 targets per week). However, it is anticipated that the annual total would not exceed approximately 1,300 targets processed in a particular year. The HCF associated facilities would be in use continuously for activities that fall within their operating parameters.

The predominant HCF radiological air emissions result from the chemical separation of molybdenum-99 from irradiated fission targets including isotopes of iodine, krypton, and xenon. A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (including hydrogen), liquid, and solid forms, in relatively small quantities, are used in many of these specific processes. Chemical emissions, including corrosives, alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, material processing, manufacturing, testing, and quality control.



Source: SNL/NM 1998a

FD–25. Hot Cell Facility (HCF)

The HCF at SNL/NM is a highly shielded area for the remote handling, processing, storage, and analysis of radioactive materials.

CONTAINMENT TECHNOLOGY TEST FACILITY - WEST

Function and Description:

The Containment Technology Test Facility - West conducts containment model testing for the U.S. Nuclear Regulatory Commission and the Nuclear Power Engineering Test Center, Tokyo, Japan. The facility is located in the Coyote Test Field and includes two scale-model containment buildings. One model is a 1:4 to 1:6 scale representation of a two-buttress, prestressed concrete containment structure with a flat concrete base, cylindrical sides, and hemispheric dome. The other model is a 1:8 to 1:10 scale steel containment structure that will be fabricated in Japan and shipped to Sandia National Laboratories/New Mexico for testing. All support facilities will be temporary and portable.

Both the prestressed concrete containment structure and the steel containment structure will be tested to failure by pneumatic over-pressurization with nitrogen gas. Following the test program, the sites will be restored (SNL/NM 1997b).

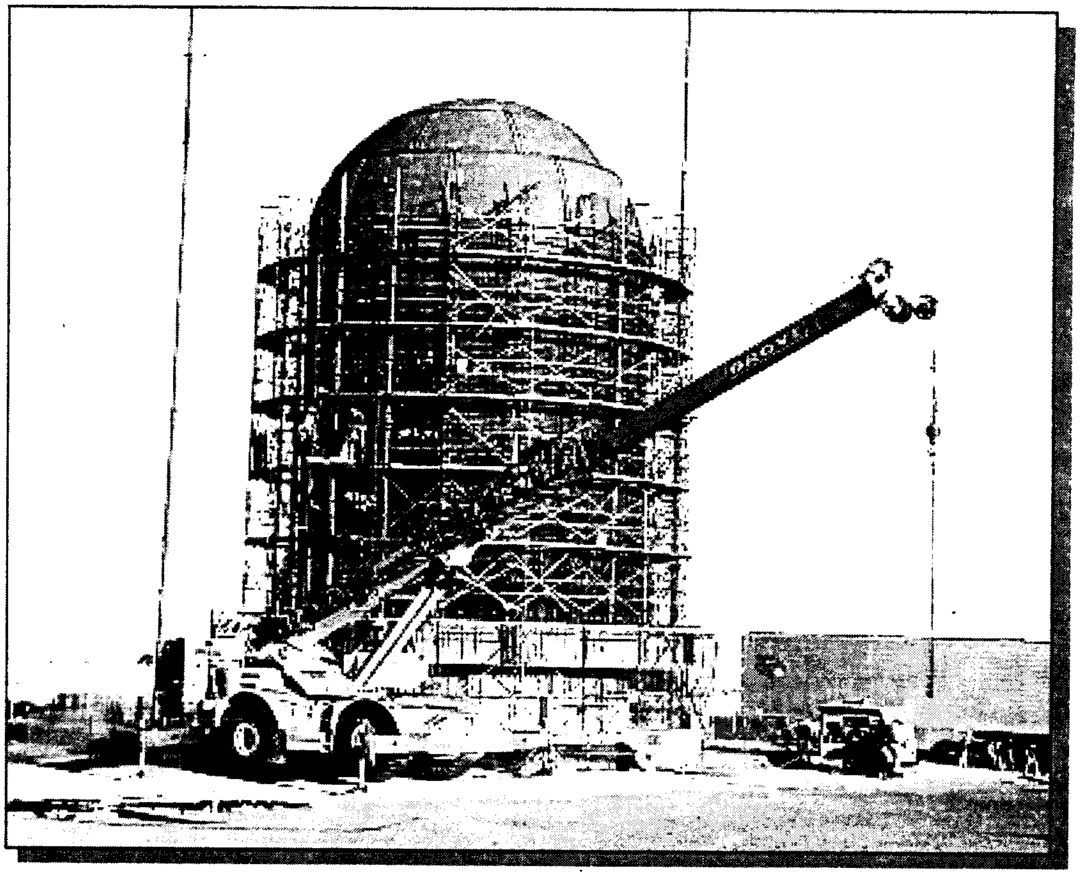
Specific Processes, Activities, and Capabilities:

The Containment Technology Test Facility-West operations are allocated, but not limited, to the following:

- Nuclear Regulatory Commission activities involve testing the reactor containment building.
- Other projects not associated with the U.S. Department of Energy include work for the Nuclear Power Engineering Corporation, Tokyo, Japan, and consist of activities needed to support reactor containment research and development.

Both the prestressed concrete containment structure and steel containment were constructed to be tested to failure by pneumatic overpressurization with nitrogen gas. Operations include planning, analysis, instrumentation, pressure testing, and data acquisition.

A variety of chemicals (adhesives, corrosives, solvents, organics, and inorganics) in gaseous, liquid, and solid forms in relatively small quantities will be used in material handling and maintenance. Small quantities of air emissions result during operations. Radioactive air emissions are not produced at this facility. Noise generation during construction should be moderate, and the sound pressure wave from catastrophic failure testing of the models will dissipate to below 145 dB at the boundary of the exclusion zones.



Source: SNL/NM 1998a

FD –26. Containment Technology Test Facility (CTTF)- West

The CTTF-West is used to test reactor containment designs.

EXPLOSIVES APPLICATIONS LABORATORY (EAL)

Function and Description:

The mission of the EAL, located in Building 9930 in the Coyote Test Field, is to support the design, assembly, and testing of explosive experiments. The facility is essentially a laboratory used to design, assemble, and test explosives. The EAL is a low-hazard, nonnuclear facility.

Specific Processes, Activities, and Capabilities:

The EAL is used to test the performance of explosive or energetic materials together with materials and components as part of various systems or subsystems. Other activities include fabrication and assembly of explosion test packages and operation of a small machine shop.

Operations at the EAL support the following programs and initiatives:

- U.S. Department of Energy (DOE) Direct Stockpile Activities in support of research, development, application, and surveillance of energetic materials and components.
- Experimental activities support the development and testing of a full range of explosive devices, components, subsystems, and complete systems. The site is also used for activities that support Nuclear Safety testing requirements, Nuclear Emergency Search Team activities and other similar programs
- Work for other agencies not associated with the DOE in the development and testing of explosive devices, components, subsystems, and complete systems in support of nuclear safety testing requirements.

A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (acetylene for welding), liquid, and solid forms, in relatively small quantities, are used for surface preparation, cleaning, material processing, fabrication of test parts, pre-explosive testing, and quality control. Associated emissions include corrosives, alcohols, ketones, and other solvents. Additional emissions are associated with the conduct of outdoor explosive tests. Nondestructive tests, using X-rays and lasers, are conducted within the facility.

Source: SNL/NM 1998a

FD–27. Explosives Applications Laboratory

The EAL is used to design, assemble, and test explosives.

AERIAL CABLE FACILITY

Function and Description:

The primary mission of the Aerial Cable Facility, located in the Coyote Test Field, is to help ensure that the nation's nuclear weapons systems meet the highest standards of safety and reliability. The Aerial Cable Facility is a restricted-access field test facility consisting of several cables spanning Sol Se Mete canyon. The Aerial Cable Facility comprises a control building, explosives assembly building, instrument bunker, and several explosive storage facilities (magazines and igloos). The complex conducts precision testing of full-scale, air-deliverable weapon systems using realistic target engagement scenarios for verification of design integrity and performance. Activities at the facility include explosives storage and assembly, rocket motor staging and assembly, and test data collection.

Specific Processes, Activities, and Capabilities:

Testing activities at the Aerial Cable Facility include gravitational accelerated (drop) tests and rocket sled pull-down tests. The rocket pull-down technique uses towing cables to accelerate rocket sleds carrying the test items. The test items are released from the overhead cable as the rockets are ignited and directed toward a target. Multiple types of targets can be simulated for worst-case scenarios involving weapons systems, defensive systems, shipping containers, and transportation systems.

Operations at the Aerial Cable Facility support the following programs and initiatives:

- U.S. Department of Energy (DOE) programs in support of Direct Stockpile Activities involving environmental, safety, and survivability testing for nuclear weapons applications.
- Joint-funded Research and Development Special Projects between the DOE and the U.S. Department of Defense to exploit and transfer the technology base resident at the DOE national laboratories for the development of advanced, cost-effective, nonnuclear munitions.
- Performance Assessment, Science, and Technology support to the DOE to provide full-scale, highly instrumented impact environments, aircraft crash environments, captive flight, and missile intercept simulation, as well as providing elevated hoisting capability for advanced sensor development and parachute testing.
- Support to Major Program Initiatives such as sustaining Critical Progress in Model Validation designed to provide controlled environments for high-velocity experiments in code validation, such as penetrator performance in frozen soil.
- Work for other entities that are not associated with the DOE, including aerial targets tests and drop/ pull-down tests.

Operations require the use of a variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous, liquid, and solid forms, in relatively small quantities. No radioactive emissions are produced at this facility. Compressed gases used in the assembly areas include acetylene and oxygen (for welding), argon, and helium. There are some chemical emissions, including alcohols, ketones, and other solvents. Small amounts of airborne emissions, including carbon monoxide and lead, are released during explosives tests. Operations associated with preparation of test payloads, fixtures, and rocket sleds involve machining that generates residues, bonding of parts with epoxies, cleaning of parts, and wiping of excess materials.

Source: SNL/NM 1998a

FD–28. Aerial Cable Facility

The Aerial Cable Facility is used for drop tests and rocket sled pull-down tests.

LURANCE CANYON BURN SITE

Function and Description:

The mission of the Lurance Canyon Burn Site, located in the Coyote Test Field, is to help ensure that the nation's nuclear weapons systems meet the highest standards of safety and reliability. The facility is specifically designed for the validation of analytical modeling and the functional certification of weapons systems. The Lurance Canyon Burn Site is also used to test and evaluate the design integrity and performance of weapon components and shipping containers in the event of their accidental exposure to various fires. In addition, the Lurance Canyon Burn Site is used extensively for transportation package certification and to verify designs in transportation technology.

Specific Processes:

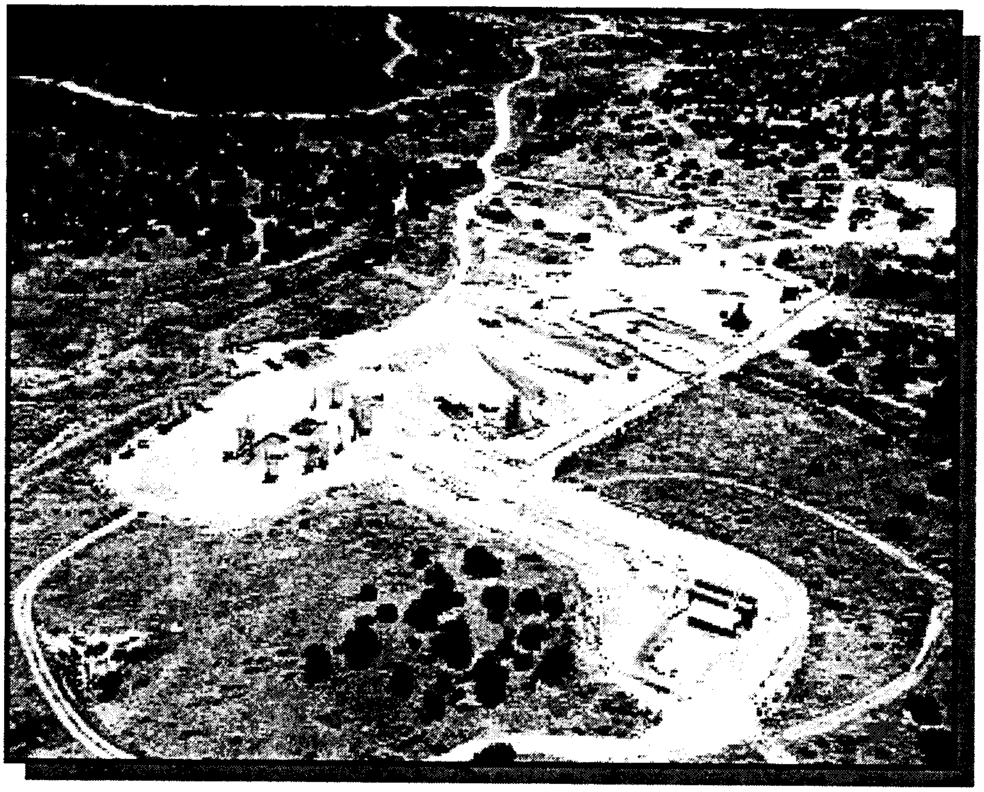
Aviation fuel fire tests are conducted at a combination of outdoor and indoor test facilities. There are four outdoor test areas with water pools to simulate the burning of fuels spilled on open water surfaces. Various test objects may be placed on pool surfaces during test events. Duration of test fires vary from 60 to 150 minutes. The principal emission products from aviation fuel fires are carbon dioxide, carbon soot, and very small amounts of carbon monoxide.

There are three indoor test facilities used for conducting tests similar to those performed outdoors (that is, on the surface of water), but under more controlled conditions (that is, no wind), per test specifications and to provide emission controls when required. Operations at the Lurance Canyon Burn Site support the following programs and initiatives:

- U.S. Department of Energy (DOE) Direct Stockpile Activities in support of Environmental, Safety, and Survivability testing for nuclear weapon applications.
- DOE Performance Assessment Science and Technology Programs to simulate fuel fire environments for testing and certification of weapon systems and components.
- DOE Programs in support of Environmental Technology Management.
- Support to Major Program Initiatives such as sustaining Critical Progress in Model Validation to verify models for fire characterization such as air and fuel mixing, vortices, soot production and destruction, soil and fuel interactions, and enclosure fires driving a hot-gas layer as a function of ventilation; and model validation of component and system response, such as fire-induced response of polyurethane foam, devolitization processes, and burn front movement.
- Work for other entities not associated with the DOE for research and development activities in the national interest. Major Program Initiatives such as Energy Programs including support to Transportation Package Certification Programs to verify designs in Transportation Technology.

There is also an outdoor test facility that uses wood fires or crib fires for certifying U.S. Department of Transportation explosive component shipping containers.

To support test preparations, the Lurance Canyon Burn Site contains a small chemical inventory but no radioactive material. Chemical emissions, including alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, and material processing including quality control of test packages. The Lurance Canyon Burn Site has been classified a low-hazard, nonnuclear facility.



Source: SNL/NM 1998a

FD–29. Lurance Canyon Burn Site

The Lurance Canyon Burn Site is used to test shipping containers and weapons components.

THUNDER RANGE COMPLEX

Function and Description:

Historically, the mission of the Thunder Range Complex, located southeast of Technical Area-III, has been environmental, safety, and survivability testing of nuclear weapon components. Current activities at the site are primarily associated with the disassembly, inspection, and documentation of special items, such as nonnuclear munitions. The complex includes other capabilities, such as outdoor explosives or shock-tube testing, although none is scheduled or planned in the foreseeable future.

Specific Processes, Activities, and Capabilities:

The specific processes at the Thunder Range Complex are focused on the evaluation of test materials. Evaluation activities involve physical examination, cleaning, mechanical disassembly, physical measurement, sampling, and photography of test materials.

The Thunder Range Complex also has a combination of essential characteristics not available at any other single Sandia National Laboratories/New Mexico location. These include

- conductive floors and grounding provisions for handling explosives;
- explosive storage bunkers;
- alarms and security provisions for "vault classification," allowing for classified work;
- established explosive quantity distance boundaries; and
- a 4,000-lb explosive materials handling rating.

Thunder Range projections are provided for two primary activities: equipment disassembly and evaluation and ground truthing tests.

Examination of objects in support of Equipment Disassembly and Evaluation activities is done on an as-needed basis. The site may be used continuously for 30- to 60-days once a year for this activity, or used only 1 to 2 days per month throughout the year. Operations and activities occurring at the Thunder Range Complex support the following programs and initiatives:

- Direct Stockpile Activities conduct survivability testing of nuclear weapon systems and components.
- Arms Control and nonproliferation activities include conventional weapon disassembly and inspection work.
- Special Projects include projects not associated with the U.S. Department of Energy (DOE) involving disassembly, inspection, and evaluation.
- Work for other agencies not associated with the DOE for the disassembly, inspection, and documentation of special items, including special nonnuclear munitions, and joint work with the U.S. Air Force Research Laboratory (formerly called Phillips Laboratory or Air Force Weapons Laboratory). Use of Thunder Range for the placement of targets for testing airborne sensors may also be performed in support of various U.S. Department of Defense (DoD) agencies.

- DOE Programs in Arms Control and Nonproliferation for disassembly and inspection.
- DOE and DoD support to Nonproliferation Verification Research and Development, including aerial observation activities.

The Thunder Range Complex maintains a small inventory of chemicals, but no radioactive material inventory. Various aspects of the preparation and evaluation of test materials can result in emissions from a variety of solvents, including alcohols and ketones. Although sealed sources are not part of any permanent inventory at the Thunder Range Complex, they may also be present at the complex as part of a test sponsor's radiation monitoring device. Radioactive air emissions are not produced at this facility.

Source: SNL/NM 1998a

FD–30. Thunder Range Complex

The Thunder Range Complex is used for testing explosives.

Steam Plant

STEAM PLANT

Function and Description:

The mission of the steam plant is to provide uninterrupted steam supply through a steam distribution system to all of Sandia National Laboratories/New Mexico Technical Area (TA)-I and Kirtland East. The steam is used for heating domestic hot water and for building heat and freeze protection. The steam is also essential to various other programmatic missions, such as those conducted at the Standards Laboratory and the Microelectronics Development Laboratory.

Specific Processes, Activities, and Capabilities:

The steam plant consists of five operational boilers with supporting systems that supply steam to TA-I buildings, U.S. Department of Energy buildings, and U.S. Air Force buildings from Eubank to Pennsylvania Boulevards and from O Street to the Wyoming Boulevard base gate. For the majority of buildings in TA-I, steam is the only heating medium used; therefore, during winter months, the plant is a critical operation because it could have a direct impact on the mission of the laboratories.

The five boilers in the plant are all dual-fired (dual-fuel capability) and collectively have the capacity to provide 370,000 lb per hour of steam to the distribution system. This capacity is much greater than the current or anticipated supply requirements. The boilers are primarily fired on natural gas and use #2 diesel fuel as an emergency backup during natural gas pressure interruptions.

The steam plant contains a chemical inventory and no radioactive material inventory. Chemicals include phosphate, sulfite, amine, and salt to maintain water and steam quality. Chemical emissions include alcohols, ketones, and other solvents. Emissions from other cleaning agents are possible and are associated with various aspects of boiler preparation, cleaning, and steam production quality control. Criteria pollutants are produced from the burning of an estimated 779 million standard cubic feet of natural gas to supply 544 million pounds of steam annually. Radioactive air emissions are not produced at this facility. For backup fuel, 1.5 million gallons of diesel fuel are stored in reserve.

Source: SNL/NM 1998a

FD–31. Steam Plant

The steam plant provides steam to TA-I and Kirtland East.

HAZARDOUS WASTE MANAGEMENT FACILITY (HWMF)

Function and Description:

The HWMF, located in Technical Area–II, performs safe handling, packaging, short-term storing, and shipping (for recycling, treatment, or disposal) of all nonradioactive *Resource Conservation and Recovery Act* (RCRA)-regulated and other hazardous and toxic waste categories (except explosives). The HWMF is a low-hazard facility that consists of two permanent buildings: the Waste Packaging Building (Building 959) and the Waste Storage Building (Building 958). Both buildings are located within an 8-ft-high single fence enclosure. Additionally, the following structures are located at the facility within the fenced area:

- six supply sheds,
- two self-contained prefabricated storage structures,
- a waste oil storage area,
- a catchment pond, and
- three office trailers.

Specific Processes, Activities, and Capabilities:

Hazardous, nonradioactive chemical waste (excluding explosive waste), which is generated by Sandia National Laboratories (SNL) operations described in the RCRA Part B Permit, is collected and transported to the HWMF for packaging and short-term (less than 1 year) storage prior to offsite transportation for recycling, treatment, or disposal at a licensed facility. The waste is managed in accordance with the RCRA Part B Permit. The HWMF also manages small amounts of waste from other SNL or U.S. Department of Energy (DOE) operations, such as SNL's Advanced Materials Laboratory on the University of New Mexico campus in Albuquerque or the DOE's Albuquerque Operations Office.

In the normal conduct of business, contract personnel use a variety of power equipment such as hydraulic drum handlers and empty drum compactors, forklifts, lift trucks, flatbed trucks, and hauling trucks. Personnel routinely handle containers of various nonradioactive hazardous waste, including oxidizers, flammable waste, and irritants. Personnel typically handle waste on a day-to-day basis.

No radioactive materials and no explosive materials are managed at the HWMF. Chemical emissions are small and related to the waste handled in the HWMF.

Source: SNL/NM 1998a

FD–32. Hazardous Waste Management Facility (HWMF)

The HWMF is used for handling, packaging, short-term storing, and shipping of nonradioactive RCRA waste and other hazardous and toxic waste.

RADIOACTIVE AND MIXED WASTE MANAGEMENT FACILITY (RMWMF)

Function and Description:

The RMWMF at Sandia National Laboratories (SNL)/New Mexico serves as a centralized facility for receipt, characterization, compaction, treatment, repackaging, certification, and storage of low-level waste (LLW), transuranic (TRU) waste (including mixed TRU), and low-level mixed (LLMW) waste. The RMWMF is used for extended storage until disposal (or treatment) sites are identified that could accept these materials. The RMWMF is located in the southeastern portion of Technical Area-III and includes Buildings 6920, 6921, and 6925, and the land, structures, and systems on the paved area within the compound fence. Building 6920 is known as the Waste Management Facility; Building 6921 is the Waste Assay Facility; and Building 6925 is the Waste Storage Facility. Other structures include prefabricated, skid-mounted storage buildings (used for storage of reactive waste, flammable waste, and compressed gas cylinders); a paved outdoor LLW and LLMW storage area; an unpaved (gravel) outdoor storage area for LLW; a lined retention pond designed to hold site surface water runoff, the sprinkler discharge from a design fire, and fire-hose streams; and office trailers.

Building 6920 is designed to manage classified and unclassified waste and includes waste storage and staging areas, drum compactor rooms, and areas for *Resource Conservation and Recovery Act* (RCRA)-regulated hazardous waste treatment. Buildings 6921 and 6925 are used for limited RCRA-regulated hazardous waste storage and treatment activities. Building 6921 provides waste characterization capabilities. The maximum storage capacity at the RMWMF is approximately 285,000 ft^3.

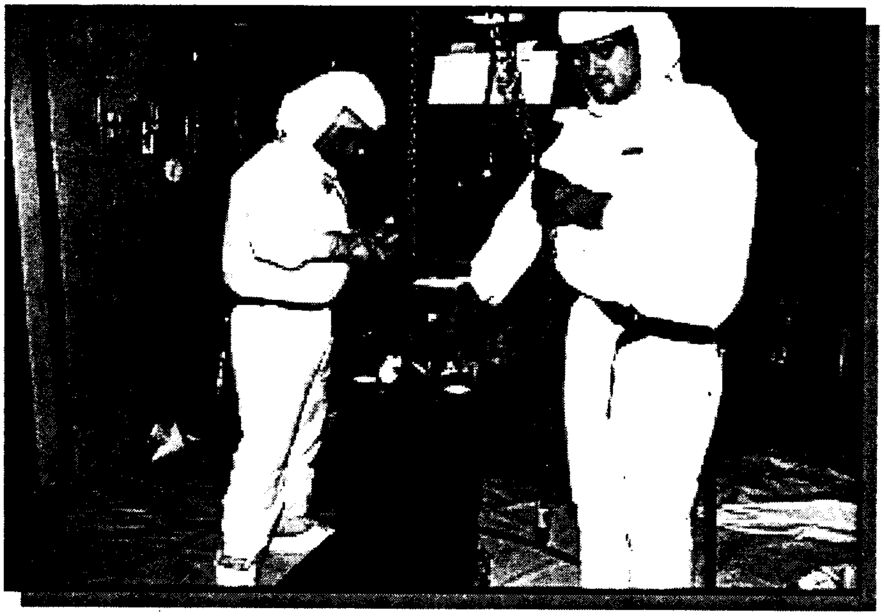
Specific Processes, Activities, and Capabilities:

Activities at the RMWMF include unpacking, sorting, repackaging, sampling, storing, staging, treating (dewatering, separating, neutralizing, solidifying, stabilizing, amalgamating, cutting, decontaminating, and compacting), and preparing waste for offsite shipment to a permitted disposal site. Most of this waste is generated by SNL. Small amounts may be generated by other SNL or U.S. Department of Energy (DOE) activities such as DOE funded research at the Lovelace Respiratory Research Institute at Kirtland Air Force Base.

Most LLMW stored in Buildings 6920 and 6921 exhibits the characteristic of toxicity (for example, from heavy metals), or contains RCRA F-listed constituents (such as paper products contaminated with trace quantities of solvents). Negligible quantities of corrosive, ignitable, or reactive waste are stored in Buildings 6920 and 6921. Reactive, ignitable, and flammable waste and combustible liquid waste are stored in skid-mounted storage sheds that are located at a safe distance from the buildings. Liquid waste is stored with secondary containment.

Hazard control at the RMWMF is maintained by using the following engineered features, as needed: waste containers, secondary containment, glove boxes, fume hood, air supply and exhaust systems, high-efficiency particulate air filters, air monitoring systems, radiation area monitor system, breathing air supply, fire detection and notification system, fire suppression system, and backup electrical power generator.

Operations that generate radioactive air emissions include preparation of tritium waste for shipment in Building 6920. Radioactive air emissions are monitored through the use of stack monitors. All detectable releases are from tritium, based on sampling the stack effluent. Small sealed radioactive sources are stored at the RMWMF. Some sealed radioactive sources are used for calibrating equipment, such as emission stack monitors. Chemical emissions are small and related to the waste handled in the RMWMF.



Source: SNL/NM 1998a

FD–33. Radioactive and Mixed Waste Management Facility (RMWMF)

The RMWMF is used for characterization, repackaging, and certification of radioactive waste.

Thermal Treatment Facility

THERMAL TREATMENT FACILITY (TTF)

Function and Description:

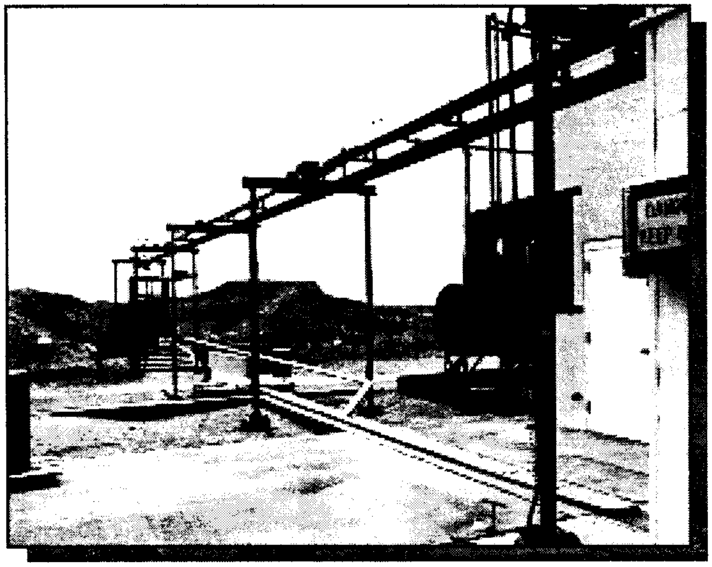
The TTF, located in the northeast corner of Technical Area-III, is used to thermally treat (burn) small quantities of waste explosive substances, waste liquids (for example, water and solvents) contaminated with explosive substances, and waste items (for example, rags, wipes, and swabs) contaminated with explosive substances. No radioactive waste is treated at the Thermal Treatment Facility.

The TTF consists of a square burn pan of 3/8-inch steel, 29.25 inches on each side and 5-5/8 inches deep. A remotely operated metal lid can be raised to open or lowered to cover the burn pan. A grated metal cage, which is open to the air and is approximately 4 ft on each side and 8 ft tall, encloses the burn pan. The burn cage sits in the center of a steel-lined concrete pad approximately 13 ft on each side with a 4-inch-high curb at the perimeter. The concrete pad is surrounded on the west, south, and east sides by an 8-ft-tall earthen berm. An 8-ft-high chain link security fence surrounds the entire TTF. Three gates, located on the north side of the fence, provide access to the facility. A door on the north side of the burn cage provides access to the burn pan.

Specific Processes, Activities, and Capabilities:

The TTF conducts thermal treatment of CHNO (comprised entirely of elemental carbon, hydrogen, nitrogen, and oxygen) explosives; waste propellants and pyrotechnics; waste items that are contaminated with CHNO high explosives, waste propellants, and pyrotechnics; and liquids that are contaminated with CHNO high explosives, waste propellants, and pyrotechnics.

Emissions include carbon monoxide, nitrogen compounds, sulfur compounds, and other compounds associated with the specific type of explosive material treated.



Source: SNL/NM 1998a

FD–34. Thermal Treatment Facility (TTF)

The TTF is used to burn small quantities of waste explosives.

CHAPTER 3

Alternatives for Continuing Operations at SNL/NM

This chapter describes the three alternatives the U.S. Department of Energy (DOE) has analyzed in detail regarding continuing operations at Sandia National Laboratories/New Mexico (SNL/NM). It describes the activities and the level of activities, which will vary depending on the alternative analyzed, at SNL/NM's selected facilities. In addition, the chapter identifies the alternatives the DOE has considered, but not analyzed in detail because they were not reasonable. It concludes by summarizing the comparison of the environmental consequences of the three alternatives.

3.1 INTRODUCTION

Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508) require that the DOE and other Federal agencies use the review process established by the *National Environmental Policy Act* (NEPA) of 1969, as amended (42 United States Code [U.S.C.] 4321 *et seq.*) and the DOE regulations implementing NEPA (10 CFR Part 1021) to evaluate not only the proposed action, but also to identify and review reasonable alternatives to the proposed action, as well as a "no action" alternative. This comprehensive review ensures that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The alternatives are central to an environmental impact statement (EIS).

The proposed action for the Site-Wide Environmental Impact Statement (SWEIS) is to continue to operate SNL/NM as a DOE national laboratory. The DOE, with public input, developed three alternatives to accomplish this proposed action and assess environmental impacts of activities at SNL/NM. This chapter examines and compares the three alternatives. For clarity and brevity, the descriptions of the alternatives in the text (Sections 3.2, 3.3, and 3.4) and in the tables (Section 3.6) focus on significant distinguishing features that characterize the variation of activities across alternatives. More complete descriptions of the activities at SNL/NM are provided by facility in Chapter 2. All of the activities discussed in Chapter 2 were used in evaluating the impacts of each alternative. The alternatives are defined below.

- *No Action Alternative (Section 3.2)*
- *Expanded Operations Alternative (Section 3.3), the DOE's Preferred Alternative*
- *Reduced Operations Alternative (Section 3.4)*

These three alternatives represent the range of levels of operation necessary to carry out DOE mission lines, from the minimum levels of activity that maintain core capabilities (Reduced Operations Alternative) to the highest reasonable activity levels that could be supported by current facilities, and the potential expansion and construction of new facilities for specifically identified future actions (Expanded Operations Alternative, the DOE's Preferred Alternative).

Under the No Action Alternative, ongoing DOE and interagency programs and activities at SNL/NM would continue the status quo, that is, operating at planned levels as reflected in current DOE management plans. In some cases, these planned levels include increases over today's operating levels. This would also include any recent activities that have already been approved by the DOE and have existing NEPA documentation.

Under the Expanded Operations Alternative, DOE and interagency programs and activities at SNL/NM would increase to the highest reasonable activity levels, as set forth in this SWEIS, that could be supported by current facilities and their potential expansion and construction of new facilities for future actions specifically identified in the SWEIS. In this Final SWEIS the Expanded Operations Alternative has two potential configurations for the Microelectronics Development Laboratory (MDL) facility. In the first configuration, the SWEIS analyzed the expansion of operations in the existing MDL (analyzed in the Draft SWEIS). In the second configuration, the SWEIS presents the available information on the developing proposal for the Microsystems and Engineering Sciences Applications (MESA) Complex, including impacts from the construction and operation of the facility (see Sections 3.3 and 5.4) adjacent to the existing MDL. The DOE has included in the second configuration of the Expanded Operations Alternative all available programmatic and environmental information on the

MESA Complex based on its approved Microsystems and Engineering Sciences Applications Complex Conceptual Design Plan (SNL/NM 1999).

The conceptual design for the MESA Complex will be finalized in the December 1999 timeframe with the issuance of the Conceptual Design Report currently under preparation. Thus, because the information on the MESA Complex in this SWEIS is preliminary and incomplete (based on the Conceptual Design Plan), and was added after issuance of the Draft SWEIS for public review and comment, the DOE has determined that an additional NEPA review will be conducted for the construction and operation of the proposed MESA Complex after the conceptual design is finalized. Based on the current configuration for the proposed MESA Complex, the DOE will prepare an environmental assessment (EA) to determine whether an environmental impact statement is required and will include the opportunity for public participation. The decision whether or not to construct and operate the MESA Complex will be made following the additional NEPA review. The DOE did not include the MESA Complex in "Projects Under Consideration" in the Draft SWEIS because the DOE had not then decided to proceed with conceptual design for the project. Once the DOE decided to go forward with conceptual design, however, it elected to present the information it had gathered thus far from the ongoing conceptual design. Nothing in the Final SNL/NM SWEIS is intended to influence the findings of any subsequent NEPA review of the MESA Complex. Similarly, the Record of Decision (ROD) based on the Final SWEIS will not affect the DOE's eventual decision with respect to the MESA Complex. Any decision to construct and operate the MESA Complex will be based solely on a NEPA review specific to the MESA Complex.

While the DOE will not make a decision on MESA based on this SWEIS, construction and operation of the MESA Complex is nonetheless presented in the SWEIS. The DOE has elected to share with the public such information as it has assembled in the course of its ongoing conceptual design of the MESA Complex to give the public an idea of the additional consequences that could potentially occur at SNL/NM should the project go forward (see Section 5.4, Expanded Operations Alternative). Because conceptual design is ongoing, environmental impact information is also incomplete and preliminary and may differ from what will be presented in the subsequent EA.

Under the Reduced Operations Alternative, DOE and interagency programs and activities at SNL/NM would be reduced to the minimum level of operations needed to maintain SNL/NM facilities and equipment in an operational readiness mode.

The Notice of Intent (NOI) (62 Federal Register [FR] 29332) proposed that the No Action and Expanded Operations Alternatives be considered in the SWEIS (see Chapter 14); however, a third alternative, the Reduced Operations Alternative, was added to show a broader range of alternatives and respond to comments received from the public during the scoping process (Section 1.7).

The SWEIS analyzes the environmental impacts of activities at SNL/NM associated with these three alternatives, as well as activities common to all alternatives including maintenance support and material management. The alternatives are more fully described in Chapter 3.

The DOE did not present a Preferred Alternative in the Draft SNL/NM SWEIS. The DOE has now selected the Expanded Operations Alternative (exclusive of the MESA Complex) as its Preferred Alternative. Under the Expanded Operations Alternative, the DOE would expand operations at SNL/NM as the need arose (until 2008), subject to the availability of congressional appropriations, to increase the level of existing operations to the highest reasonable foreseeable activity levels that are analyzed in the SWEIS. The Preferred Alternative would only implement expansion at the existing MDL, without addition of the MESA Complex.

DOE work assignments to SNL/NM are based on using existing personnel and facility capabilities, as described in Chapters 1 and 2. The DOE has examined the various activity levels typical of past SNL/NM operations (generally within the past few years), and assumes that future work descriptions will resemble current and recent activities.

The three alternatives represent the range of operating levels that could be reasonably implemented in the 10-year time frame of the SWEIS analysis (1998–2008). Many of SNL/NM's ongoing and planned activities do not vary by alternative. The No Action Alternative reflects currently planned activities or projects, some of which may already have NEPA documentation and analysis.

Table 3.1–1 provides a brief summary of the facilities evaluated in this SWEIS. Table 3.6–1 (see Section 3.6) provides an expanded look at the materials used and wastes generated at each facility.

In order to provide comprehensive baseline data from which operational levels could be projected, the DOE gathered the best-available data representing the facilities' normal levels of operation. In most cases, the base year for data was 1996. For some facilities, several years of data were gathered in order to determine normal trends. Facilities that have base years other than 1996 are noted in the tables in Section 3.6. Also, note that projected activity levels under the Reduced Operations Alternative could be above the base years' because some facilities were operating below the minimum levels of activity necessary to maintain core capabilities or facilities were not yet in full operation (Section 3.4).

The DOE is not revisiting any programmatic decisions previously made in other NEPA documents, such as those addressing weapons complex consolidation and reconfiguration, materials disposition, or waste management. The SWEIS includes these programmatic activities in order to provide the DOE and the public with an overall understanding of the activities at SNL/NM.

Many of the selected facilities are engaged primarily in activities supporting the DOE's national security mission. Other facilities are engaged in energy resources and research and development (R&D) efforts, such as materials research, radiochemistry, and health research. The DOE examined specific activities performed at SNL/NM facilities that relate to issues identified from public input, the DOE mission lines, and the potential for environmental impacts.

The DOE did not identify a Preferred Alternative in the Draft SWEIS. In this Final SWEIS, the Expanded Operations Alternative becomes the Preferred Alternative (exclusive of the MESA Complex).

3.2 NO ACTION ALTERNATIVE

Summary Description

Under the No Action Alternative, ongoing DOE and interagency programs and activities at SNL/NM would continue the status quo, that is, operating at planned levels as reflected in current DOE management plans for 1998 through 2008. In some cases, these planned levels include increases over today's operating levels. This would also include any recent activities that have already been approved by DOE and have existing NEPA documentation. If these planned operations are implemented in the future, they could result in increased activity above present levels. Thus, the No Action Alternative forecasts, over 10 years, the level of activity for facility operations that would implement current management plans for assigned programs.

The CEQ's NEPA implementing regulations (40 CFR Parts 1500-1508) require analyzing the No Action Alternative to provide a benchmark against which the impacts of the activities presented in the other alternatives can be compared. The No Action Alternative analysis includes current operations and ongoing and planned environmental restoration activities. Some of these activities have already had NEPA review. It also includes any approved and interim actions and facility expansion or construction, where detailed design and associated NEPA documentation were completed by the end of March 1998. The analysis also includes facilities, including new construction and upgrades, for which NEPA documents have been prepared, decisions made, and funds allocated in the fiscal year 2000 planning year budget (submitted in 1998).

3.2.1 Basis for Current Planned Operations

DOE management plans include continued support of major DOE programs, such as Defense Programs (DP), Nuclear Energy, Fissile Material Disposition, Environmental Management, and Science. They also include projects to maintain existing facilities and capabilities and projects for which a NEPA determination has been made (for example, the Medical Isotopes Production Project).

Other plans used to prepare the description of the No Action Alternative include the site development plans for SNL/NM, interagency agreements between the DOE and the U.S. Department of Defense (DoD), programmatic environmental impact statements (PEISs), Presidential Decision Directives, and DOE Work for Others (WFO) proposals and guidance. Some documents have future projects included for planning purposes; others have been deleted due to lack of funding or other reasons. The activities reflected in this alternative include planned increases in some SNL/NM operations and activities over previous years' levels (for example, medical isotopes production). There may also be decreases in some SNL/NM activities (for example, a decrease in certain outdoor testing activities).

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Neutron Generator Facility	Development or production of devices, processes, and systems	Neutron generators	Neutron generators	600	2,000	2,000	2,000	2,000
Microelectronics Development Laboratory	Development or production of devices, processes, and systems	Microelectronic devices and systems	wafers	4,000	5,000	7,000	7,500[e]	2,666
Advanced Manufacturing Processes Laboratory	Development or production of devices, processes, and systems	Materials, ceramics/glass, electronics, processes, and systems	operational hours	248,000	310,000	310,000	347,000	248,000
Integrated Materials Research Laboratory	Other	Research and development of materials	operational hours	395,454	395,454	395,454	395,454	363,817
Explosive Components Facility	Test activities	Neutron generator tests	tests	200 (FY 1998)	500	500	500	500
		Explosive testing	tests	600	750	850	900	300
		Chemical analysis	analyses	900	950	1,000	1,250	500
		Battery tests	tests	50	60	60	100	10

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
PHYSICAL TESTING AND SIMULATION FACILITIES								
Terminal Ballistics Complex	Test activities	Projectile impact testing	tests	50	80	100	350	10
		Propellant testing	tests	25	40	50	100	4
Drop/Impact Complex	Test activities	Drop test	tests	18	20	20	50	0
		Water impact	tests	1	1	1	20	1
		Submersion	tests	1	1	1	5	0
		Underwater blast	tests	0	2	2	10	0
Sled Track Complex	Test activities	Rocket sled test	tests	10	10	15	80	2
		Explosive testing	tests	12	12	12	239	0
		Rocket launcher	tests	3	4	4	24	0
		Free-flight launch	tests	40	40	40	150	0
Centrifuge Complex	Test activities	Centrifuge	tests	32	46	46	120	2
		Impact	tests	0	10	10	100	0

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
ACCELERATOR FACILITIES								
SATURN	Test activities	Irradiation of components or materials	shots	65	200	200	500	40
HERMES III	Test activities	Irradiation of components or materials	shots	262	500	500	1,450	40
Sandia Accelerator & Beam Research Experiment	Test activities	Accelerator shots	shots	187	225	225	400	0
Short-Pulse High Intensity Nanosecond X-Radiator	Test activities	Irradiation of components or materials	shots	1,185	2,500	2,500	6,000	200
Repetitive High Energy Pulsed Power Unit I	Test activities	Accelerator tests	tests	500	5,000	5,000	10,000	100
Repetitive High Energy Pulsed Power Unit II	Test activities	Radiation production	tests	80	160	160	800	40
Z-Machine	Test activities	Accelerator shots	shots	150	300	300	350	84
Tera-Electron Volt Semiconducting Linear Accelerator	Test activities	Accelerator shots	shots	40	1,000	1,000	1,300	40

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Advanced Pulsed Power Research Module	Test activities	Accelerator shots	shots	500	1,000	1,000	2,000	40
Radiographic Integrated Test Stand	Test activities	Accelerator shots	shots	0	400	600	800	100
REACTOR FACILITIES								
New Gamma Irradiation Facility	Test activities	Tests	hours	0	13,000	13,000	24,000	0
Gamma Irradiation Facility	Test activities	Tests	hours	1,000	0	0	8,000	0
Sandia Pulsed Reactor	Test activities	Irradiation tests	tests	100	100	100	200	30
Annular Core Research Reactor (DP for No Action and Reduced Operations Alternatives, ACPR-II for Expanded Operations Alternative)	Test activities	Irradiation tests	test series	0	1	0	2 to 3	0
		Fissile component tests	tests	0	0	0	2	0
		Materials/ electronics tests	tests	0	0	0	6	0

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Annular Core Research Reactor (medical isotopes production configuration)	Test activities	Irradiation of production targets	targets	8	375	375	1,300	40
Hot Cell Facility	Development or production of devices, processes, and systems	Processing of production targets	targets	8	375	375	1,300	40
OUTDOOR TEST FACILITIES								
Aerial Cable Facility	Test activities	Drop/pull-down	tests	21	32	38	100	2
		Aerial target	tests	6	6	6	30	0
		Scoring system tests	series	0	1	1	2	0
Lurance Canyon Burn Site	Test activities	Certification testing	tests	12	12	12	55	1
		Model validation	tests	56	56	56	100	0
		User testing	tests	37	37	37	50	0
Containment Technology Test Facility - West	Test activities	Survivability testing	tests	1	1	0	2	1
Explosives Applications Laboratory	Test activities	Explosive testing	tests	240	240	240	275 to 360	50

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Thunder Range Complex	Other	Equipment disassembly and evaluation	days	60	82	82	144	42
	Test activities	Ground truthing tests	test series	1	5	8	10	1
INFRASTRUCTURE FACILITIES								
Steam Plant	Infrastructure	Generate and distribute steam to DOE, TA-I, KAFB East, Coronado Club	lb	544 M	544 M	544 M	544 M	362 M
Hazardous Waste Management Facility	Infrastructure	Collection, packaging, handling, and short-term storage of hazardous and other toxic waste[b]	kg	203,000	192,000	196,000	214,000 (215,200)[e]	175,000
	Waste managed[c]	RCRA hazardous waste	kg	55,852	70,469	74,358	92,314 (93,514)[e]	53,123
Radioactive and Mixed Waste Management Facility	Infrastructure	Receipt, packaging, and shipping of radioactive waste[d]	lb	1.6 M	2.1 M	2.1 M	2.7 M[e]	0.8 M
	Waste managed[c]	Low-level waste	ft^3 (m^3)	11,874 (337)	15,436 (438)	15,436 (438)	19,592[e] (556)	5,937 (168)

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (concluded)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Thermal Treatment Facility	Infrastructure	Treatment of waste	lb	Minimal	336	336	1,200	Minimal

Source: SNL/NM 1998a
ACPR: Annular Core Pulsed Reactor
DOE: U.S. Department of Energy
DP: Defense Programs
FTE: full-time equivalent
FY: fiscal year
HERMES: High Energy Radiation Megavolt Electron Source
HWMF: Hazardous Waste Management Facility
KAFB: Kirtland Air Force Base
lb: pound
MDL: Microelectronics Development Laboratory
MESA: Microsystems and Engineering Sciences Applications
RCRA: *Resource Conservation and Recovery Act*
RMWMF: Radioactive and Mixed Waste Management Facility
TA: technical area
TSCA: *Toxic Substances Control Act*

[a] Base year is the year selected as most representative of normal operations (SNL/NM 1998ee).
[b] Larger number is a total including TSCA waste, other solid waste, recyclable materials, and inventory (non-RCRA).
[c] Numbers do not represent totals (generation), only quantities to be managed by the specific facility.
[d] Includes inventory.
[e] The Expanded Operations Alternative with MESA (if implemented): The MDL maximum production capability with or without MESA would be 7,500 wafers per year. Because MESA would not increase personnel and because MDL operations to support 7,500 wafers per year would require three shifts, an increase would be unlikely. In the case of the HWMF, the quantity of 214,000 kg would change because of an additional 1,200 kg of hazardous waste per year due to MESA. In the case of the RMWMF, the quantities would not show an increase of 0.1 ft^3 of radioactive low-level waste because the amount is not significant compared to the total.

Organization of Chapter 3

Sections 3.2 through **3.4** describe the activities that would occur at selected facilities under each of the three alternatives.

Section 3.5 describes alternatives that were considered but eliminated from detailed analysis.

Section 3.6 compares the environmental consequences of the three alternatives.

The *Facilities and Safety Information Document* (SNL/NM 1997b, SNL/NM 1998ee) and facility source documents (SNL/NM 1998a) provide in-depth information concerning the activities, operations, and hazards of selected facilities. These documents have been used extensively to describe the following facility activities in this chapter. The facilities discussed below are also described in detail in the Facility Descriptions following Chapter 2. For most facilities, the base year considered is 1996. The base year for the Neutron Generator Facility (NGF) is 1998, the first year in which the facility will have achieved its initially planned level of production.

3.2.2 Selected Facilities in Technical Areas-I and -II

Under the No Action Alternative, the following activities would take place at the facilities in Technical Areas (TAs)-I and -II.

3.2.2.1 Neutron Generator Facility

Under all alternatives, the NGF, TA-I, would continue to be used to fabricate neutron generators and neutron tubes. Support activities would include a wide variety of manufacturing, testing, and product development techniques and processes. An addition to an existing building would be constructed to meet production projections. Additionally, Building 870 would undergo extensive renovations. Approximately 2,000 neutron generators and associated neutron and switch tubes would be manufactured per year by 2008.

3.2.2.2 Microelectronics Development Laboratory

The MDL, TA-I, would continue to be used to conduct R&D activities on microelectronic devices for nuclear weapons. A broad range of microtechnology development and engineering activities, including integrated circuit and wafer production, would occur. Approximately 4,000 wafers would be produced in the base year, increasing to 5,000 wafers by 2003 and 7,000 wafers by 2008.

The Compound Semiconductor Research Laboratory (CSRL) (Building 893) would remain in operation in its present location.

3.2.2.3 Advanced Manufacturing Process Laboratory

Advanced manufacturing technologies are developed and applied at the Advanced Manufacturing Process Laboratory (AMPL), TA-I. Under the No Action Alternative, AMPL activities would include hardware manufacturing, emergency and prototype manufacturing, development of manufacturing processes, and design and fabrication of production equipment. The activities conducted in the AMPL would be typical of other laboratories and small-scale manufacturing plants working with ceramics, glass, plastics, electronics, and other materials. There would be a slight increase in WFO. Operational hours (the number of employees multiplied by the number of hours worked) under the No Action Alternative would be 248,000 hours per year in the base year (1996-1997), increasing to 310,000 hours per year in 2003 and 2008. Personnel would increase from 150 in the base year to 184 in 2003 and 2008.

3.2.2.4 Integrated Materials Research Laboratory

Research on materials and advanced components would continue to be conducted at the Integrated Materials Research Laboratory (IMRL), TA-I. A wide variety of materials would be investigated, including metallic alloys, semiconductors, superconductors, ceramics, opticals, and dielectric materials. Basic research activities would continue in chemistry, physics, and energy technologies. The 1998 number for operational hours was derived by multiplying the number of workers in the IMRL by the number of hours worked by one employee during a year. This totals approximately 395,000 hours per year for 1998, 2003, and 2008.

3.2.2.5 Explosive Components Facility

The Explosive Components Facility (ECF), TA-II, would continue to be used to support the work performed at the NGF and the R&D performed on a variety of energetic components. Energetic component research, testing, development, and quality control activities focus in four areas: neutron generators, explosives, chemicals, and batteries. Expected operating levels at the ECF would include 200 neutron generator tests in the base year, increasing to approximately 500 neutron generator tests per year through 2008. Other tests would involve 600 explosive tests in the base year, growing to 750 tests in 2003 and 850 tests in 2008. Chemical analyses would increase from 900 analyses in the base year to 1,000 in 2008. Battery tests would range from 50 tests in the base year to 60 tests in 2003 and 2008.

3.2.3 Physical Testing and Simulation Facilities

TA-III incorporates four principal testing facilities: the Terminal Ballistics Complex, Drop/Impact Complex, Sled Track Complex, and Centrifuge Complex, described below.

3.2.3.1 Terminal Ballistics Complex

Ballistic studies and solid-fuel rocket motor tests would continue to be conducted at the Terminal Ballistics Complex. Testing capabilities would include research in areas of armor penetration, vulnerability, acceleration, flight dynamics, and accuracy. Projectile impact tests would include all calibers of projectiles, from small arms to the 155-mm gun. For projectile impact testing, 50 tests would occur in the base year, increasing to approximately 80 tests each year by 2003 and 100 tests annually by 2008. Approximately 25 propellant tests would occur in the base year, increasing to 40 tests annually by 2003 and 50 tests annually by 2008.

3.2.3.2 Drop/Impact Complex

Tests designed for the validation of analytical modeling and weapons system certification would continue to be conducted at the Drop/Impact Complex. Test activities would focus on water and underwater tests, design verification, and performance assessments. After the base year activity level of 18 tests, up to 20 tests would be conducted each year through 2008. One water impact test, one submersion test, and as many as two underwater blast tests would be planned annually through 2008.

3.2.3.3 Sled Track Complex

The Sled Track Complex is a test facility that simulates high-speed impacts of weapon shapes, substructures, and components to verify design integrity, performance, and fuzing functions. Sled Track Complex capabilities would continue to include testing parachute systems, transportation equipment, and reactor safety. Tests would include rocket sleds; short-duration, free-flight launches; rocket launches; and explosives using SNL/NM instrumentation capabilities in lasers, photometrics, telemetry, and other data collection techniques. Current plans would number 10 to 15 rocket sled tests per year through 2008. Other tests would number 40 short-duration, free-flight launches, up to 4 rocket launches, and 12 explosive detonations per year through 2008.

3.2.3.4 Centrifuge Complex

The Centrifuge Complex would continue to be used to test objects weighing up to 5 tons or more with over 100 *g* of force. Following 32 tests in 1998, this would increase to an estimated 46 tests annually in 2003 and 2008 on a variety of test objects. Although no impact tests have occurred, 10 tests per year are planned for 2003 through 2008.

3.2.4 Accelerator Facilities

3.2.4.1 SATURN

Under the No Action Alternative, the SATURN accelerator would continue to be used to produce X-rays to simulate the radiation effects of nuclear bursts on electronic and material components. SATURN capabilities would be used to test satellite systems, weapons materials and components, and reentry vehicle and missile subsystems. Accelerator activities would include an estimated activity of 65 shots in 1998, increasing to 200 shots per year by 2003. Accelerator activity would remain at this level (200 shots) through 2008.

3.2.4.2 High-Energy Radiation Megavolt Electron Source III

High-Energy Radiation Megavolt Electron Source III (HERMES III) would continue to be used to provide gamma ray effects testing capabilities. HERMES III would test electronic components and weapon systems and would include high-fidelity simulation over large areas in near nuclear-explosion radiation environments. Activity levels would be approximately 262 shots per year in 1998, increasing to approximately 500 shots per year through 2003 and 2008.

3.2.4.3 Sandia Accelerator & Beam Research Experiment

The Sandia Accelerator & Beam Research Experiment (SABRE) would continue to be used to provide X-ray and gamma ray effects testing capabilities. SABRE capabilities would allow testing of pulsed-power technologies, fusion systems, and weapons systems. Other activities would include computer science, flight dynamics, satellite systems, and robotics testing. Approximately 187 shots would occur in 1998, increasing to approximately 225 shots per year in 2003 and 2008.

3.2.4.4 Short-Pulse High Intensity Nanosecond X-Radiator

The Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) accelerator would continue to be used to produce high-voltage accelerations to measure X-ray-induced currents in integrated circuits and heat response in materials. The SPHINX would provide testing capabilities in radiation environments for a variety of weapons components. Approximately 1,185 shots would occur in 1998, increasing to approximately 2,500 shots per year in 2003 through 2008.

3.2.4.5 Repetitive High Energy Pulsed Power I

The Repetitive High Energy Pulsed Power (RHEPP) I would continue to be used for the development of pulsed-power technology, including high-power energy tests. Activities would include basic scientific research, development, and testing. The RHEPP I averaged approximately 500 tests per year over 1996 and 1997. This would increase to approximately 5,000 tests per year by 2003 through 2008.

3.2.4.6 Repetitive High Energy Pulsed Power II

The RHEPP II would continue to be used to develop radiation processing applications using powerful electron or X-ray beams. Activities would include testing of high power magnetic switches and specialty transmission lines. Operations in 1996 included 80 tests per year. As many as 4 tests per week for 40 weeks (160 tests per year) would be completed at the RHEPP II by 2003 through 2008.

3.2.4.7 Z-Machine

The Z-Machine would continue to be used to produce extremely short, extremely powerful energy pulses at various targets. The Z-Machine capabilities simulate special atmospheric conditions and fusion reaction conditions. The average activity in 1996 and 1997 was approximately 150 shots per year. A projected 165 accelerator firings would occur per year using tritium, deuterium, plutonium, and depleted uranium (DU). An additional 135 accelerator firings would support performance assessment and development of advanced pulsed-power sources, for a total of 300 shots per year by 2003 through 2008.

3.2.4.8 Tera-Electron Volt Energy Superconducting Linear Accelerator

The Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA) facility would continue to be used to test plasma opening switches for pulsed-power drivers. Other activities would include basic research science, material development, and material testing. TESLA activities in 1998 increased to 40 shots. Following a base year of 40 test shots, as many as 1,000 test shots per year would be completed for pulsed-power technology development in 2003 through 2008.

3.2.4.9 Advanced Pulsed Power Research Module

The Advanced Pulsed Power Research Module (APPRM) would be used to evaluate the performance and reliability of components including next-generation accelerators. Activities would include research and development in pulsed-power technologies such as power storage, high-voltage switching, and power flow. Following base year operations of 500 shots, the APPRM would fire approximately 1,000 shots per year in 2003 and 2008.

3.2.4.10 Radiographic Integrated Test Stand

The Radiographic Integrated Test Stand (RITS) accelerator is anticipated to start operations in 1999. It would be used to develop and demonstrate capabilities for future accelerator facility design. The DOE categorically excluded the project. The proposed accelerator would replace the existing Proto II accelerator. Capabilities would focus on demonstrating inductive voltage technology. It is estimated that there will be 200 shots in the startup year (1999). Approximately 400 shots would occur per year in 2003, increasing to 600 shots per year in 2008.

3.2.5 Reactor Facilities

3.2.5.1 New Gamma Irradiation Facility

Under the No Action Alternative, the New Gamma Irradiation Facility (NGIF) would be used to perform a wide variety of gamma irradiation experiments under both dry and water-pool conditions. The NGIF would replace the Gamma Irradiation Facility (GIF) prior to

2003. The NGIF would provide capabilities for studies in thermal and radiation effects, weapons component degradation, nuclear reactor material and components, and other nonweapon applications. The NGIF was not operational in 1998. This facility would be constructed after the No Action baseline time frame; hence, there are no activities planned prior to 2003. Operations would begin in 2000 or 2001, depending on operational approval. By 2003, a wide variety of test packages would be conducted each year. Approximately 13,000 test hours per year would be expected from 2003 through 2008.

3.2.5.2 Gamma Irradiation Facility

The GIF would continue to be used to perform gamma irradiation experiments until the NGIF begins operation. The facility would irradiate test packages for approximately 1,000 test hours per year. Operating levels by 2003 would decrease to zero, coinciding with the startup and operation of the NGIF. The decision to reuse, modify, or demolish the GIF will be addressed in future NEPA documentation.

3.2.5.3 Sandia Pulsed Reactor

The Sandia Pulsed Reactor (SPR) would continue to provide multiple fast-burst reactor, near-fission spectrum radiation environments. Testing activities would include a wide variety of technologies that support both defense and nondefense projects. Approximately 100 tests per year would be expected through 2008.

3.2.5.4 Annular Core Research Reactor–Medical Isotopes Production or Defense Programs Testing Configuration

The Annular Core Research Reactor (ACRR) may be operated in either of two ways: to produce medical isotopes or to support DP. Descriptions of these two operating configurations follow. The impacts for each of these configurations are presented separately in Table 3.6–1 and Chapter 5.

ACRR—Medical isotopes production configuration activities would produce medical and research radioactive isotopes. Research activities that are compatible and capable of being conducted concurrently with production would continue. Under the No Action Alternative, the ACRR would operate for 52 weeks to irradiate targets to produce approximately 30 percent of the U.S. demand (on average, not necessarily a "fixed" amount each week) for molybdenum-99 and other medical and research isotopes, such as iodine-131, xenon-133, and iodine-125. The 2003 and 2008 estimates assume that the SNL/NM medical isotopes production program would operate primarily as a backup to Nordion, Inc. At the 30 percent of U.S. demand production level expected for the 2003 and 2008 scenarios, it is assumed that the reactor would be operated for 16 hours per day, 5 days per week (4,160 hours per year) at a maximum power level of 4 MW (approximately 16,640 MWh per year).

The production needs could require varying scenarios that would range from periods of shutdown to periods of operation at 100 percent of the U.S. demand level (approximately 25 targets per week). Under the No Action Alternative, irradiation of eight targets is planned in the base year, increasing to 375 targets in 2003 through 2008.

ACRR — DP testing configuration capabilities would be maintained. The DOE also has identified a recent, short-term need to conduct a single test series related to the certification of some weapons components (Weigand 1999a). The ACRR would be reconfigured to pulse-mode operation for a limited-duration test period (12 to 18 months following the ROD) (Weigand 1999b). This test campaign would be conducted in the existing ACRR facility, which would have to be temporarily reconfigured to restore DP testing capability. The reconfiguration activities required to change the reactor to the DP test configuration would mainly consist of replacing the central cavity, enabling the pulse mode of operation, reconfiguring the core fuel, reinstalling the appropriate fuel-ringed external cavity (if required), executing the necessary battery of tests, preparing documentation, and conducting reviews to certify that the reconfigured reactor is operational. The reconfiguration to ACRR-DP would be done so that conversion back to ACRR-medical isotope production would be more efficient. The DOE is evaluating the potential need for long-term DP test requirements for ACRR, but currently the DOE has no plans for such tests. Any future long-term test campaigns would undergo the appropriate NEPA reviews. The readiness capability to maintain the DP-testing configuration is described in detail in the April 1996, *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b).

The DOE considered the possibility of conducting this short-term test series at other DOE sites. Only Transient Reactor Test Facility (TREAT), Idaho National Engineering & Environmental Laboratory (INEEL), was a possible alternate, but was dismissed because of the limited timeframe needed to complete the test campaign (Minnema 1999). The DOE is also evaluating the possibility of using nondestructive simulations (computer modeling) to accomplish certification.

3.2.5.5 Hot Cell Facility

The Hot Cell Facility (HCF) would primarily support medical isotopes production. Isotopes production operations and associated capabilities include isotope extraction and separation, isotope product purification, product packaging, and quality control. The base year level of activity would include 8 targets per year and would increase to 375 by 2003, continuing at the same rate until 2008.

3.2.6 Outdoor Test Facilities

3.2.6.1 Aerial Cable Facility

The Aerial Cable Facility would be used to conduct a variety of impact tests involving weapon systems and aircraft components. Capabilities include free-fall drop, rocket pull-down, and captive flight tests with state-of-the-art instrumentation, data recording, and simulation technologies. Under this alternative, approximately 21 drop/pull-down tests would be completed in the base year, increasing to 32 tests in 2003 and 38 tests in 2008. Approximately one-half dozen other tests would be completed each year.

3.2.6.2 Lurance Canyon Burn Site

The Lurance Canyon Burn Site is a group of facilities that would be used to test, certify, and validate material and system tolerances. Test objects would be burned for short periods of time under controlled conditions. Approximately 12 certification tests would be conducted each year through the year 2008, with 56 model validation tests and 37 user tests.

3.2.6.3 Containment Technology Test Facility - West

Planning for the two tests at the Containment Technology Test Facility-West began in 1991. Each test would involve a series of successive events leading up to ultimate failure of the two test vessels. The first test was completed in 1997, and the second test is scheduled for completion in 2000. After the second test, there are no further plans for additional testing.

3.2.6.4 Explosives Applications Laboratory

The Explosives Applications Laboratory (EAL) would continue to design, assemble, and test explosive materials, components, and equipment for multiple programs. Work at the facility would involve arming, fuzing, and firing of explosives and testing of components. The EAL would use X-ray analysis, fabrication technology, photographic analysis, and machine shop techniques to complete energetic material research and development. Approximately 240 tests would be completed each year through 2008.

3.2.6.5 Thunder Range Complex

The Thunder Range Complex capabilities would range from disassembly and evaluation to calibration and verification testing of special nuclear and nonnuclear systems. Examination and testing of objects would involve cleaning, physical examination, disassembly, measurement, sampling, photography, and data collection. Equipment disassembly would take place during 60 days per year in the base year, increasing to 82 days per year in 2003 through 2008. Ground-truthing tests consist of one test series in the base year, increasing to five test series in 2003 and eight test series in 2008.

3.2.7 Infrastructure Facilities

3.2.7.1 Steam Plant

The steam plant would continue to produce and distribute steam to SNL/NM and Kirtland Air Force Base (KAFB) facilities. The steam would be primarily used for domestic hot water and building heat. Approximately 544 M lb would be produced each year.

3.2.7.2 Hazardous Waste Management Facility

The Hazardous Waste Management Facility (HWMF) would handle, package, short-term store, and ship hazardous, toxic, and nonhazardous chemical wastes. The HWMF is a *Resource Conservation and Recovery Act* (RCRA), Part B-permitted facility that would support waste generators throughout SNL/NM. The HWMF would prepare wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would operate one shift. Quantities of RCRA hazardous waste managed (see Section 3.6, Table 3.6–1) would range from 55,852 kg in the base year to 74,358 kg through 2008. Infrastructure-related activities are rated at approximately 200,000 kg per year (see Section 3.6, Table 3.6–1).

3.2.7.3 Radioactive and Mixed Waste Management Facility

The Radioactive and Mixed Waste Management Facility (RMWMF) would continue to serve as a centralized facility for receipt, characterization, compaction, treatment, repackaging, certification, and storage of low-level waste (LLW), transuranic (TRU) waste, low-level mixed waste (LLMW), and mixed transuranic (MTRU) waste. A new prefabricated storage building would be constructed to replace an existing building to improve flexibility and operational efficiencies. The replacement of the existing facility is covered by Categorical Exclusion B6.10 (10 CFR Part 1021). Like the HWMF, the RMWMF would support waste generators throughout SNL/NM. The RMWMF would prepare waste for offsite treatment and disposal at permitted and licensed facilities. The facility would operate one shift. Total wastes by waste type are presented in Section 3.6, Table 3.6–1. Annual quantities of radioactive waste managed (see Section 3.6, Table 3.6–1) would range from 11,874 ft^3 (337 m^3) for LLW (only 3,322 ft^3 [94 m^3] are generated; the remainder is legacy waste [see Section 3.6, Table 3.6–2]) in the base year to 15,436 ft^3 (438 m^3) for LLW (only 5,993 ft^3 [170 m^3] are generated; the difference is legacy waste [see Section 3.6, Table 3.6–2]) through 2008. Annually, for LLMW, TRU, and MTRU, the quantities to be managed (see Section 3.6, Table 3.6–1) through the RMWMF, including legacy waste and the expected quantities to be generated (see Section 3.6, Table 3.6–2), are as follow: 5,353 ft^3 (152 m^3) to 6,959 ft^3 (197 m^3) LLMW managed; 153 ft^3 (4.33 m^3) to 258 ft^3 (7.31 m^3) LLMW generated; 214 ft^3 (6.1 m^3) to 278 ft^3 (7.9 m^3) TRU managed; zero ft^3 (zero m^3) to 26 ft^3 (0.74 m^3) TRU generated; and 16 ft^3 (0.45 m^3) to 23 ft^3 (0.65 m^3) MTRU managed; 16 ft^3 (0.45 m^3) to 23 ft^3 (0.65 m^3) MTRU generated. Infrastructure-related activities are rated at 2.1 M lb per year (see Section 3.6, Table 3.6–1).

3.2.7.4 Thermal Treatment Facility

The Thermal Treatment Facility (TTF) would thermally treat (burn) small quantities of explosive materials and explosives-contaminated waste. Quantities would range from minimal in the base year to 336 lb of waste through 2008. This assumes that the RCRA permit is reissued.

3.3 EXPANDED OPERATIONS ALTERNATIVE – THE DOE'S PREFERRED ALTERNATIVE

The Expanded Operations Alternative, the DOE's Preferred Alternative (exclusive of the MESA Complex), assumes implementation of assignments that would result in the highest reasonable foreseeable activity levels that could be supported by current facilities and the potential expansion and construction of new facilities. Appropriate NEPA documentation would be prepared prior to any new construction. This alternative addresses the same facilities described in Section 3.2 for the No Action Alternative. Under this alternative, operations could increase to the highest reasonably foreseeable levels over the next 10 years. The following sections describe the activities that would occur at specific facilities as a result of implementing assignments under the Expanded Operations Alternative.

The DOE did not present a Preferred Alternative in the Draft SNL/NM SWEIS. The DOE has now selected the Expanded Operations Alternative (exclusive of the MESA Complex) as its Preferred Alternative. Under the Expanded Operations Alternative, the DOE would expand operations at SNL/NM as the need arose (until 2008), subject to the availability of congressional appropriations, to increase the level of existing operations to the highest reasonable foreseeable activity levels that are analyzed in the SWEIS. The Preferred Alternative would only implement expansion at the existing MDL, without addition of the MESA Complex.

3.3.1 Selected Facilities in Technical Areas-I and -II

3.3.1.1 Neutron Generator Facility

Under all alternatives, the NGF, TA-I, would continue to be used to fabricate neutron generators and neutron tubes. Support activities would include a wide variety of manufacturing, testing, and product development techniques and processes. An addition to an existing building would be constructed to meet production projections. Additionally, Building 870 would undergo extensive renovations. Approximately 2,000 neutron generators and associated neutron and switch tubes would be manufactured per year by 2008.

3.3.1.2 Microelectronic Development Laboratory

The MDL could operate in either of two configurations: 1) to support R&D and production of silicon-based microelectronic devices, or 2) to support R&D and production of silicon-based microelectronic devices along with producing war reserve microsystems-based components with specialty alloys (such as gallium arsenide and indium arsenide). The following paragraphs describe these two operating configurations. Where appropriate, information has been added to Table 3.6–1, which lists the differences in activity levels between these two configurations. The impacts of the two configurations are described in Sections 3.6 and 5.4.

The MDL silicon-based production configuration (including R&D) would produce 7,500 wafers per year, using three shifts. The DOE anticipates that the use of new technologies and manufacturing processes would meet expanded activities. There would be no construction of new facilities to meet this expanded wafer production and the CSRL (Building 893) would remain in operation in its present location.

The MESA configuration (including R&D) would produce a mix of 7,500 silicon/specialty alloy wafers per year. The DOE has identified a need related to the surety improvements in weapon systems incorporating microelectronics, microoptics, and microelectromechanical systems in these silicon/specialty alloy wafers. This configuration would include a state-of-the-art complex (260,000 gross ft^2) of new facilities. The estimated $300 M project would integrate and leverage the scientific and technological capabilities existing separately at the MDL and CSRL in a new laboratory to replace the outdated CSRL and by collocating it adjacent to the current MDL. The project would include retooling existing operations. Related infrastructure needs would include small laboratories, offices, and gas storage. If implemented, MESA would become operational about 2003, after which the DOE would phase out and eventually decontaminate and demolish the existing CSRL. Based on current project information, an EA would be completed before this configuration could be implemented.

3.3.1.3 Advanced Manufacturing Processes Laboratory

Activities at the AMPL would be similar to those under the No Action Alternative. Operations would increase beyond a single shift, adding 54 employees. Operations would increase to 347,000 hours per year.

3.3.1.4 Integrated Materials Research Laboratory

Activities at the IMRL would be the same as under the No Action Alternative (approximately 395,000 hours per year). Currently, the IMRL is operating at maximum capacity. No expansion would be anticipated.

3.3.1.5 Explosive Components Facility

Activities at the ECF would be similar to those under the No Action Alternative. Operations would be maximized to complete 500 neutron generator tests, 900 explosive tests, 1,250 chemical analyses, and 100 battery tests annually.

3.3.2 Physical Testing and Simulation Facilities

3.3.2.1 Terminal Ballistics Complex

Activities would be the same as under the No Action Alternative. No additional capabilities or new activities would be undertaken. The operating level would be increased to 350 projectile impact tests and 100 propellant tests per year.

3.3.2.2 Drop/Impact Complex

The Drop/Impact Complex tests would be expanded for all four capabilities: drop test, water impact, submersion, and underwater blasting. The projected increase would be beyond historic use but within the complex capabilities. Approximately 50 drop tests, 20 water impact tests, 5 submersion tests, and 10 underwater blast tests would occur each year.

3.3.2.3 Sled Track Complex

Activities would be the same as those described under the No Action Alternative. Operating levels would be increased to approximately 80 rocket sled tests, 239 explosive tests, 24 rocket launches, and 150 free-flight launches per year.

3.3.2.4 Centrifuge Complex

The Centrifuge Complex activities would be the same as those described under the No Action Alternative. However, the number of tests per year would increase to 120 centrifuge tests and 100 impact tests.

3.3.3 Accelerator Facilities

3.3.3.1 SATURN

Under the Expanded Operations Alternative, the accelerator output would increase by 3 shots or firings every other day for a maximum of 500 shots annually. Activities would be the same as those described under the No Action Alternative.

3.3.3.2 High-Energy Radiation Megavolt Electron Source III

The HERMES III capabilities would remain the same under the Expanded Operations Alternative. The maximum number of shots per year would be 1,450. This level of activity would be achieved through the addition of multiple shifts.

3.3.3.3 Sandia Accelerator & Beam Research Experiment

Testing at the SABRE would increase to 400 shots per year. Activities would be the same as those described in the No Action Alternative.

3.3.3.4 Short-Pulse High Intensity Nanosecond X-Radiator

The SPHINX would operate at a maximum of 6,000 shots per year. Activities would be the same as those described under the No Action Alternative. This would be an increase from 1,185 shots in the 1997 base year. This increase would be achieved through multiple shifts.

3.3.3.5 Repetitive High Energy Pulsed Power I

The tests projected for the RHEPP I would be in both the single and repetitive pulse modes. The RHEPP I would provide support for approximately 10,000 tests per year. No new capabilities or activities would be expected.

3.3.3.6 Repetitive High Energy Pulsed Power II

The RHEPP II capacity would be maximized at 20 tests per week for 40 weeks per year (800 tests). Activities would be similar to those described under the No Action Alternative.

3.3.3.7 Z-Machine

The Z-Machine capability would be maximized to 350 firings per year. Approximately 78 percent would involve nuclear materials identified under the No Action Alternative. Upgrades would be planned to maximize the Z-Machine's operations.

3.3.3.8 Tera-Electron Volt Energy Superconductor Linear Accelerator

The operating levels at the TESLA would be increased to 1,300 shots per year.

3.3.3.9 Advanced Pulsed Power Research Module

The APPRM activity would increase to 2,000 shots per year.

3.3.3.10 Radiographic Integrated Test Stand

The RITS would operate at a maximum of approximately 800 tests per year. Capabilities would remain the same as those described under the No Action Alternative.

3.3.4 Reactor Facilities

3.3.4.1 New Gamma Irradiation Facility

The NGIF would irradiate test packages for approximately 24,000 test hours per year. Capabilities would remain the same as those described under the No Action Alternative.

3.3.4.2 Gamma Irradiation Facility

GIF operations would continue under the Expanded Operations Alternative. Actual operations would expand to complete tests in two available cells. The GIF would supplement the capabilities of the NGIF. Approximately 8,000 test hours would be expected.

3.3.4.3 Sandia Pulsed Reactor

Several new, yet-to-be-designed reactors would be added to the SPR facility. Modifications would be completed to enhance and expand current capabilities. Operating levels would increase to 200 tests per year.

3.3.4.4 Annular Core Pulse Reactor II

The Annular Core Pulse Reactor (ACPR-II) would be an additional pulse-power reactor similar to the ACRR. The ACPR-II would operate in pulse mode using the same fundamental design as the ACRR prior to its conversion to the medical isotopes production configuration. The Expanded Operations Alternative assumes that there would be an ongoing need for DP testing in a pulsed-power reactor facility. Approximately two major fissile component tests and approximately six material irradiation, electronics effects tests would be performed each year. These tests would involve setup, calibration, and operation sequences that could require from 1 to 2 days to several weeks, depending on the conditions of the test. To meet this need, an additional ACPR facility would be reconstituted using the same fundamental design as the ACRR facility. If this additional ACPR facility is proposed at some time in the future, the DOE would prepare a separate project-specific NEPA review.

The specially designed uranium oxide-beryllium oxide fuel from the existing ACRR medical isotopes production configuration would be used for the reconstituted ACPR-II to support DP test requirements. New fuel of a more standard design would be purchased for the original ACRR medical isotopes production configuration to support ongoing isotope production activities.

Under the Expanded Operations Alternative for DP testing in the ACPR-II, approximately two or three test campaigns (consisting of several individual tests) would be conducted each year. A test campaign would consist of a test setup period of a few days to 2 weeks and a test duration (time in reactor) of 1 day to 2 weeks. These tests would typically use the ACPR-II in its pulse mode or steady-state operations that would not exceed a few days in duration. Hence, a minimal amount of resources such as uranium fuel and water would be expended for these tests for high-use, steady-state operation.

3.3.4.5 Annular Core Research Reactor–Medical Isotopes Production Configuration

The ACRR medical isotopes production configuration would be operated for 24 hours per day, 7 days per week, at a maximum power level of 4 MW (approximately 35,000 MWh per year) to meet the entire U.S. demand for molybdenum-99 and other isotopes such as iodine-131, xenon-133, and iodine-125. This would require the irradiation of about 25 highly enriched uranium targets per week (1,300 per year).

3.3.4.6 Hot Cell Facility

Under the Expanded Operations Alternative, the HCF would continuously process 100 percent of the U.S. demand for molybdenum-99 and other isotopes such as iodine-131, xenon-133, and iodine-125. This would require the processing of about 25 irradiated, highly enriched uranium targets per week (1,300 per year).

3.3.5 Outdoor Test Facilities

3.3.5.1 Aerial Cable Facility

The Aerial Cable Facility drop, pull-down, aerial target, and system testing capabilities would remain the same as under the No Action Alternative. Drop tests of joint test assemblies that contain DU, enriched uranium, and insensitive high explosives would represent a new test activity at the complex. These test articles would contain less than 45 lb of DU, less than 120 lb of enriched uranium, and less than 104 lb of insensitive high explosives (plastic-bonded explosive [PBX]-9502 or press-moldable explosive [LX]-17). Test articles would be designed using insensitive high explosives because of the low probability of detonation under test conditions. In addition, the nuclear material contained in the test article would be configured in a manner that prevents a criticality event from occurring. The number of tests using this kind of test article (containing DU, enriched uranium, and insensitive high explosives) could range from one to five per year depending upon programmatic requirements. The total number of drop/pull-down tests would increase to an estimated 100 experiments per year. Aerial target tests would increase to 30 tests per year. Two series of scoring system tests would be conducted each year.

3.3.5.2 Lurance Canyon Burn Site

The Lurance Canyon Burn Site activities in certification, model validation, and user testing would remain similar to those described under the No Action Alternative. The number of certification tests would increase to an estimated 55 tests per year under the Expanded Operations Alternative. Model validation tests and user tests would increase to 100 and 50 per year, respectively.

3.3.5.3 Containment Technology Test Facility - West

The Containment Technology Test Facility - West would perform two survivability tests per year under the Expanded Operations Alternative. No new programs would be anticipated.

3.3.5.4 Explosives Applications Laboratory

Activities at the EAL would increase slightly under the Expanded Operations Alternative. The number of explosive tests would range from 275 to a maximum of 360 tests per year.

3.3.5.5 Thunder Range Complex

Activities at the Thunder Range Complex would increase slightly to 10 test series per year in 2008. Equipment disassembly would increase to 144 days per year. A moderate increase in workload would occur and the number of facility personnel would increase slightly.

3.3.6 Infrastructure Facilities

3.3.6.1 Steam Plant

The steam plant would require upgrades of several boilers, steam distributors, and natural gas supply systems. The actual boiler upgrade would potentially include a technology change to cogeneration units. Steam production, however, would remain similar (544 M lb per year) to that under the No Action Alternative.

3.3.6.2 Hazardous Waste Management Facility

The HWMF activities would remain the same as under the No Action Alternative. Operating conditions, however, would increase from one to three shifts. Quantities of RCRA hazardous waste managed (see Section 3.6, Table 3.6–1) would be 92,314 kg each year. Infrastructure-related activities are rated at 214,000 kg per year (see Section 3.6, Table 3.6–1).

Under the MESA Complex configuration, HWMF activities would remain the same; however, infrastructure-related activities would increase from 214,000 kg to 215,200 kg per year (see Section 3.6, Table 3.6–1), and managed RCRA hazardous waste would increase from 92,314 kg to 93,514 kg per year.

3.3.6.3 Radioactive Mixed Waste Management Facility

The RMWMF capabilities would remain the same as under the No Action Alternative. A new prefabricated building would be constructed to replace an existing building to improve flexibility and operational efficiencies. The operations would be increased from one to two shifts. Annual quantities of radioactive waste managed (see Section 3.6, Table 3.6–1) would be 19,592 ft^3 (556 m^3) for LLW (only 9,897 ft^3 [280 m^3] are generated; the remainder is legacy waste [see Section 3.6, Table 3.6–2]). Annually, for LLMW, TRU, and MTRU, the quantities to be managed (see Section 3.6, Table 3.6–1) through the RMWMF, including legacy waste and the expected quantities to be generated (see Section 3.6, Table 3.6–2), are as follow: 8,833 ft^3 (251 m^3) LLMW managed; 258 ft^3 (7.31 m^3) LLMW generated; 353 ft^3 (10 m^3) TRU managed; 26 ft^3 (0.74 m^3) TRU generated; and 37 ft^3 (1.05 m^3) MTRU managed; 37 ft^3 (1.05 m^3) MTRU generated. Infrastructure-related activities are rated at 2.7 M lb per year (see Section 3.6, Table 3.6–1).

Under the MESA configuration, RMWMF activities would remain the same; MESA would increase radioactive waste generation by 0.1 ft^3 per year.

3.3.6.4 Thermal Treatment Facility

Activities at the TTF would remain the same as under the No Action Alternative; quantities of wastes treated, however, would increase. Approximately 1,200 lb of waste per year would be thermally treated. This rate assumes that 60 burns are performed at 20 lb of waste per burn. This rate also assumes that the RCRA permit is reissued.

3.4 REDUCED OPERATIONS ALTERNATIVE

The Reduced Operations Alternative reflects minimum levels of activity required to maintain a facility's assigned capability over the next 10 years (1998-2008). In some specific facilities, the Reduced Operations Alternative includes activity levels that represent an increase over the base period activity levels (typically 1996). The facilities are those that, during the base period, have not been operated at a level sufficient to maintain capability or to satisfy DOE-assigned theoretical or experimental R&D product requirements.

This alternative does not eliminate assigned missions or programs, but could entail not meeting technical program requirements or could increase program or technological risk (for example, not meeting program deliverables, reduced technology demonstration activities, or a decline in technological capability). However, under this alternative, SNL/NM operations would not be reduced beyond those required to maintain safety and security activities, such as maintaining nuclear materials, high explosives, or other hazardous materials in storage or use.

The following sections describe the activities that would occur at specific facilities as a result of implementing the Reduced Operations Alternative.

3.4.1 Selected Facilities in Technical Areas-I and -II

3.4.1.1 Neutron Generator Facility

Under all alternatives, the NGF, TA-I, would continue to be used to fabricate neutron generators and neutron tubes. Support activities would include a wide variety of manufacturing, testing, and product development techniques and processes. An addition to an existing building would be constructed to meet production projections. Additionally, Building 870 would undergo extensive renovations. Approximately 2,000 neutron generators and associated neutron and switch tubes would be manufactured per year by 2008.

3.4.1.2 Microelectronics Development Laboratory

All existing capabilities would remain to produce a reduced number of wafers. Operations would be single-shift only. Approximately 2,700 wafers would be manufactured each year.

3.4.1.3 Advanced Manufacturing Processes Laboratory

The level of effort projected for the Reduced Operations Alternative would be similar to that under the No Action Alternative because the facility would be operating with the minimum number of personnel (minus administrative staff) required to maintain operational capability in each of the various areas of expertise. Approximately 248,000 operational hours would be expected.

3.4.1.4 Integrated Materials Research Laboratory

The level of effort projected under the Reduced Operations Alternative would be slightly lower than that under the No Action Alternative. A reduction in capabilities would not occur; however, there could be a slight reduction in the number of personnel and operational hours (approximately 364,000 per year).

3.4.1.5 Explosive Components Facility

Existing activities would continue at reduced levels. Activities at the ECF would include 500 neutron generator tests, 300 explosive tests, 500 chemical analyses, and 10 battery tests per year.

3.4.2 Physical Testing and Simulation Facilities

3.4.2.1 Terminal Ballistics Complex

All existing capabilities would remain under the Reduced Operations Alternative. Operating levels would be reduced to a minimum to support those capabilities. An estimated 10 projectile impact tests and 4 propellant tests would be conducted each year.

3.4.2.2 Drop/Impact Complex

All existing capabilities would remain under the Reduced Operations Alternative. No drop tests would be conducted, but one water impact test would be conducted annually to maintain operational capability. No submersion or underwater blasts would occur.

3.4.2.3 Sled Track Complex

All existing activities would remain viable under the Reduced Operations Alternative. Approximately two rocket sled tests would occur each year. While other types of tests would not be conducted, the capability would be maintained.

3.4.2.4 Centrifuge Complex

Existing activities would be reduced to a minimum level of testing required to maintain operational capability. Testing would cease for certification of weapon modifications and special items. At least two annual centrifuge tests would be conducted. No impact testing would be done under the Reduced Operations Alternative.

3.4.3 Accelerator Facilities

3.4.3.1 SATURN

The SATURN capabilities would remain at a sufficient level to maintain operational readiness. The number of shots would decrease to 40 each year.

3.4.3.2 High-Energy Radiation Megavolt Electron Source III

Existing capabilities would be maintained at the HERMES III facility. Annual tests would be reduced to an estimated 40 shots per year.

3.4.3.3 Sandia Accelerator & Beam Research Experiment

Under the Reduced Operations Alternative, the SABRE would be placed in standby mode. No test shots would be required to keep the facility operational. With minimal testing and general maintenance, operational capabilities would remain in place.

3.4.3.4 Short-Pulse High Intensity Nanosecond X-Radiator

Under the Reduced Operations Alternative, approximately 200 test shots would be completed each year. All existing capabilities would remain in a state of operational readiness.

3.4.3.5 Repetitive High Energy Pulsed Power I

All existing capabilities would be maintained. The number of tests would be reduced to 100 per year.

3.4.3.6 Repetitive High Energy Pulsed Power II

Activities would continue at the RHEPP II facility; however, the number of tests would decrease to 40 tests per year.

3.4.3.7 Z-Machine

Under the Reduced Operations Alternative, an estimated 84 tests per year would be required to maintain existing capabilities.

3.4.3.8 Tera-Electron Volt Energy Superconductor Linear Accelerator

All existing capabilities would be maintained under the Reduced Operations Alternative. To maintain operational readiness, an estimated 40 shots would be completed each year.

3.4.3.9 Advanced Pulsed Power Research Module

The level of activity necessary to maintain the operational capabilities would be 40 shots per year.

3.4.3.10 Radiographic Integrated Test Stand

Under the Reduced Operations Alternative, the minimum level of shots required to ensure operational capability in both the pulse-power and explosive modes would be an estimated 1 to 3 per week over the 40-week operational year. A total of 100 shots per year would be necessary to maintain operational capacity.

3.4.4 Reactor Facilities

3.4.4.1 New Gamma Irradiation Facility

Under the Reduced Operations Alternative, the NGIF would not conduct any irradiation tests.

3.4.4.2 Gamma Irradiation Facility

Under the Reduced Operations Alternative, the GIF would not conduct irradiation tests.

3.4.4.3 Sandia Pulsed Reactor

Under the Reduced Operations Alternative, the SPR facility would conduct 30 tests to maintain existing capabilities. No new reactors would be added to the facility.

3.4.4.4 Annular Core Research Reactor–Medical Isotopes Production Configuration

Under the Reduced Operations Alternative, the ACRR medical isotopes production configuration would irradiate the minimum number of targets required to maintain the facility, staff, processes, and material inventories needed to restart production activities on short notice. This would consist of the irradiation of approximately 40 targets per year. Although the ACRR would not be used in the DP configuration, the readiness capability to operate would be maintained.

3.4.4.5 Hot Cell Facility

Under the Reduced Operations Alternative, the HCF would process the minimum number of targets required to maintain the facility, staff, processes, and material inventories needed to restart production activities on short notice. This would consist of the processing of approximately 1 target per week over 40 weeks, or 40 targets per year. The HCF-associated facilities would be maintained at the minimum operational level. Occasional activities would be performed to support those programs that require the capabilities of these facilities. Total wastes by waste type are presented in Section 3.6, Table 3.6–1.

3.4.5 Outdoor Test Facilities

3.4.5.1 Aerial Cable Facility

All existing capabilities would remain as described under the No Action Alternative. Some activities would be reduced to zero tests per year. Two drop/pull-down tests would be conducted annually.

3.4.5.2 Lurance Canyon Burn Site

All existing capabilities would be maintained with minimal testing (one certification test per year).

3.4.5.3 Containment Technology Test Facility - West

To maintain the existing capability, at least one test would be required over a period of several years. A typical test cycle would be 6 years.

3.4.5.4 Explosives Applications Laboratory

Maintaining the site capability and qualifications would require approximately 50 tests per year to ensure minimum qualifications for arming, fuzing, and firing of explosives and explosives components.

3.4.5.5 Thunder Range Complex

All existing capabilities would be maintained. One test, ranging in duration from 1 to 30 days, would be completed each year. Equipment disassembly would be reduced to 42 days per year.

3.4.6 Infrastructure Facilities

3.4.6.1 Steam Plant

Steam plant production would decline to 362 M lb per year.

3.4.6.2 Hazardous Waste Management Facility

The HWMF capability would be maintained through the life of the current permit. The facility would be operated with one shift. Quantities of RCRA hazardous waste managed (see Section 3.6, Table 3.6–1) would be 53,123 kg each year. Infrastructure-related activities are rated at 175,000 kg per year.

3.4.6.3 Radioactive Mixed Waste Management Facility

The RMWMF capability would be maintained consistent with the applicable permit requirements. The facility would be operated with one shift. Annual quantities of radioactive waste managed (see Section 3.6, Table 3.6–1) would be 5,937 ft^3 (168 m^3) for LLW (only 3,616 ft^3 [102.4 m^3] are generated; the remainder is legacy waste [see Section 3.6, Table 3.6–2]). Annually, for LLMW, TRU, and MTRU, the quantities to be managed (see Section 3.6, Table 3.6–1) through the RMWMF, including legacy waste and the expected quantities to be generated (see Section 3.6, Table 3.6–2), are as follow: 2,677 ft^3 (76 m^3) LLMW managed; 134 ft^3 (3.79 m^3) LLMW generated; 107 ft^3 (3 m^3) TRU managed; no TRU generated; and 8 ft^3 (0.23 m^3) MTRU managed; 8 ft^3 (0.23 m^3) MTRU generated. Infrastructure-related activities are rated at approximately 0.8 M lb per year.

3.4.6.4 Thermal Treatment Facility

The TTF capability would be maintained at minimal operational levels without treating waste.

3.5 ALTERNATIVES THAT WERE CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The CEQ regulations implementing NEPA require that all reasonable alternatives be evaluated in an EIS (40 CFR §1502.14[a]). The term *reasonable* has been interpreted by CEQ to include those alternatives that are practical or feasible from a common sense, technical, and economic standpoint. The range of reasonable alternatives is, therefore, limited to continued SNL/NM operations. DOE mission line assignments to SNL/NM define the agency's purpose and need for action, as discussed in Chapter 1.

The DOE carefully considered public input and comments received during the pre-scoping and scoping processes. Some alternatives suggested for SNL/NM's future operations were not considered in detail in the SWEIS because they were deemed unreasonable within the next 10 years. These alternatives are defined and the reasons why they were eliminated from detailed analysis are presented in the following sections.

3.5.1 Shutdown of Sandia National Laboratories/New Mexico

Under this alternative, SNL/NM operations would shut down and all facilities would be subject to decontamination and decommissioning (D&D). All DOE property would be transferred following D&D.

Public Law (PL) 103-160, the *National Defense Authorization Act of 1994,* and Presidential policy statements on the future of the laboratories (The White House 1995) require maintaining a safe and reliable nuclear weapons stockpile as a cornerstone of the nation's nuclear deterrent for the near future. The continued viability of all three DOE weapons laboratories, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and SNL, is essential to ensuring national security. Unique competencies and facilities at SNL/NM provide for R&D, surveillance, testing, reliability and safety assessment, certification, and manufacturing associated with nuclear weapons.

Because continuing operations at SNL/NM are essential to DOE's implementation of PL 103-160, Presidential Decision Directives, U.S. compliance with treaties, as well as Congressional guidance and national security policy, the shutdown of SNL/NM is not a reasonable alternative and is not analyzed in the SWEIS.

SNL/NM's continued operations fulfill national security requirements for stockpile stewardship and management (based on PL 103-160, the DoD Nuclear Posture Review, Presidential Decision Directives, and the Nuclear Weapon Stockpile Memorandum), and it is not economically feasible to reassign certain SNL/NM activities to other DOE laboratories (see PL 103-160 and the Stockpile Stewardship and Management (SSM) PEIS, Volume I, Sections 2.2 and 2.3 [DOE 1996a]).

3.5.2 Expansion of Nonweapons Environmental and Renewable Energy Research

During the public scoping process, the DOE received a suggestion that it consider changing the focus of SNL/NM's mission statement from ensuring the safety, reliability, and security of the nuclear weapons stockpile to expanding SNL/NM's capabilities in the areas of improving energy and material efficiency; renewable resources, waste management and recycling research; and biodegradable and reusable material development.

The DOE's mission lines and funding come from Congress and the President. In the course of the implementation process, the DOE assigns aspects of its mission lines to its laboratory and plant facilities across the country, based on the unique skills and capabilities of each facility. SNL/NM is one of only three national laboratories whose primary mission from DOE is to contribute its specialized capabilities to the assurance of a safe, secure, and reliable nuclear weapons stockpile. The 1996 SSM PEIS reaffirmed the continuation of SNL/NM's role in DOE's nuclear weapons program. To fulfill its primary mission, SNL/NM has developed and perfected unique capabilities, such as high explosives R&D and testing, radiation effects experimentation through the use of accelerators and research reactors, neutron generator production, engineering and production of nonnuclear components, and microelectronics and photonics research.

Notwithstanding SNL/NM's primary mission, the energy crisis in the 1970s and other events caused the DOE to request that SNL/NM apply its knowledge and expertise to support its other mission lines (Section 2.1). SNL/NM accomplished this task by expanding its research, developed primarily as an offshoot of weapons research, into a number of environmental and energy fields. Areas where SNL/NM has been active include waste management, environmental restoration, energy efficiency, renewable energy, magnetic fusion, and nuclear, fossil, and solar energy.

This alternative was not analyzed in detail because the three alternatives analyzed in detail evaluate and bound levels of *activity* (Section 3.1) for facilities where ongoing environmental and energy research activities are conducted. If, during the next 10 years, the DOE wants to consider increasing or reallocating existing weapons resources to any of the environmental or energy fields, the increased activities are already encompassed in the evaluation of the three alternatives described in Sections 3.2, 3.3, and 3.4.

3.5.3 Returning Withdrawn Forest Service Land to Public Use

During the public scoping and public meeting processes, a commenter suggested that the DOE consider returning all or part of the withdrawn Forest Service lands to public use, including carrying out the necessary decontamination and decommissioning activities.

As discussed in Section 3.5.2, the SSM PEIS established SNL/NM's programmatic roles and responsibilities. To accomplish the primary mission from the DOE, SNL/NM contributes its specialized capabilities to ensure a safe, secure, and reliable nuclear weapons stockpile. In fact, SNL/NM has developed and perfected some unique outdoor testing capabilities in the Withdrawn Area. Specifically, the Aerial Cable Facility and the Lurance Canyon Burn Site provide unique testing capabilities that are an essential complement to the other physical testing capabilities and facilities available in TA-III (Physical Testing and Simulation Facility Group) and Coyote Test Field (Outdoor Test Facility Group). Areas surrounding these two sites are necessary for safety buffer zones and the physiography is optimal to minimize the areal extent of these zones. The current location at SNL/NM provides a configuration that would be cost prohibitive and physically difficult to duplicate at another DOE site. In addition, if another DOE site could be found that was available and compatible for relocation of these testing facilities, moving the facilities would result in the temporary unavailability of these capabilities to the weapons program.

3.6 COMPARISON OF ENVIRONMENTAL CONSEQUENCES AMONG ALTERNATIVES

The SWEIS combines the results of several studies to address consequences to the environment and risks associated with the DOE's operations at SNL/NM. The affected environment evaluated in the SWEIS includes the following 13 resource areas: land use and visual resources, infrastructure, geology and soils, water resources and hydrology, biological and ecological resources, cultural resources, air quality, human health and worker safety, transportation, waste generation, noise and vibration, socioeconomics, and environmental justice (see Chapter 4).

The following subsections summarize the environmental consequences and risks by resource area under each alternative. Tables 3.6–1 through 3.6–4 present the comparison of environmental consequences in tabular form. Table 3.6–1 summarizes operational data from the selected facilities for each alternative. The facilities are arranged by selected facility/facility group, including the infrastructure facilities. Table 3.6–2 compares important parameters used in performing impact analyses described in Chapter 5. Table 3.6–3 compares impacts determined from these analyses for each alternative. Table 3.6–4 presents a condensed list of high-consequence impacts determined from the accidents analyses for each alternative. A complete list may be found in Appendix F.

3.6.1 Land Use and Visual Resources

No adverse impacts to land resources are expected as a result of the No Action, Expanded Operations, or Reduced Operations Alternatives. The extent of DOE land and U.S. Air Force (USAF)-permitted acreage currently available for use by SNL/NM facilities on KAFB would remain approximately the same. Operations would remain consistent with industrial and research park uses and would have no foreseeable effects on established land use patterns or requirements. Buffer zones would continue to remain at their current size and location. New SNL/NM facilities, expansions, and upgrades would be limited and would not require changes to current land ownership or classification status because these activities would be planned in or near existing facilities, within already disturbed or developed areas, or on land already under DOE control. There would be no adverse impacts to visual resources that change the overall appearance of the existing landscape, obscure views, or alter the visibility of SNL/NM structures. New facilities, expansions, and upgrades would be planned in or near existing facilities in areas with common scenic quality. Efforts initiated by SNL/NM to incorporate a campus-style design would continue.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would have a negligible effect on land or visual resources. The facility would be built on land owned by the DOE in an area (TA-I) that is already well developed with structures of common scenic quality.

3.6.2 Infrastructure

Annual projected utility demands for all alternatives would be well within system capacities. The consumption of electricity would range from 185,000 MWh per year (Reduced Operations Alternative) to 198,000 MWh per year (Expanded Operations Alternative). Projected water usage would range from 416 M gal to 495 M gal per year. Actual water usage probably would be lower because SNL/NM has implemented a conservation program to reduce usage by 30 percent by 2004. For comparison purposes, a conservation scenario is provided under the No Action Alternative. Other infrastructure-related factors, including maintenance, roads, communications, steam, natural gas, and facility decommissioning, would be similar for each alternative and would not be adversely affected by the projected levels of SNL/NM operations. Although not listed in Table 3.6–2, for the Expanded Operations Alternative, the infrastructure analysis included a 10-percent additional increase to illustrate that the utility systems supporting SNL/NM have adequate capacity.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would increase the consumption of electricity from 198,000 MWh per year to 204,000 MWh per year. Projected water use would increase from 495 M gal per year to 499 M gal per year. Projected wastewater and natural gas quantities would increase slightly.

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Neutron Generator Facility	Development or production of devices, processes, and systems	Neutron generators	Neutron generators	600	2,000	2,000	2,000	2,000
	Expenditures		dollars	2.6 M	5.2 M	5.2 M	5.2 M	5.2 M
	Hazardous waste		kg	2,760	3,680	3,680	3,680	3,680
	Low-level waste		kg	3,000	4,000	4,000	4,000	4,000
	Low-level mixed waste		kg	150	300	300	300	300
	Nuclear consumption	Tritium	Ci	386	652	652	652	652
	Nuclear inventory	Tritium	Ci	682	836	836	836	836
	Radioactive air emissions	Tritium	Ci	94	156	156	156	156
	Personnel		FTEs	160	320	320	320	320
	Process water		gal	4.5 M	5 M	5 M	5 M	5 M
	Wastewater		gal	4.5 M	5 M	5 M	5 M	5 M
Microelectronics Development Laboratory (with MESA)	Development or production of devices, processes, and systems	Microelectronic devices and systems	wafers	4,000	5,000	7,000	7,500 (7,500)	2,666
	Boiler energy consumption	Natural gas	ft^3	34.3 M	34.3 M	34.3 M	34.3 M (40.8 M)	34.3 M
	Hazardous waste		kg	2,520	3,150	4,410	4,738 (5,938)	1,688
	Low-level waste		ft^3	4	5	7	8 (8.1)	3
	Process electricity		kWh	28.6 M	28.6 M	28.6 M	28.6 M (40 M)	28.6 M

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
	Expenditures[k]		dollars	4.0 M	5.0 M	7.0 M	7.5 M (300 M)	2.7 M
	Personnel[k]		FTEs	267	333	467	500 (500)	178
	Process water		gal	44.1 M	55.1 M	77.2 M	77.2 M (81 M)	44.1 M
	Process wastewater		gal	44 M	55 M	77 M	77 M (80.8)	44 M
Advanced Manufacturing Processes Laboratory	Development or production of devices, processes, and systems	Materials, ceramics/glass, electronics, processes, and systems	operational hours	248,000	310,000	310,000	347,000	248,000
	Expenditures		dollars	32 M	40 M	40 M	45 M	32 M
	Hazardous waste		kg	4,732	5,915	5,915	6,625	4,732
	Personnel		FTEs	150	184	184	204	150
Integrated Materials Research Laboratory	Other	Research and development of materials	operational hours	395,454	395,454	395,454	395,454	363,817
	Expenditures		dollars	45 M	55 M	60 M	62 M	48 M
	Hazardous waste		kg	2,400	2,100	1,850	2,000	2,000[f]
	Nuclear inventory	Depleted uranium	mCi	0.93	1.0	1.0	1.0	0
	Personnel		FTEs	250	250	250	250	230
Explosive Components Facility	Test activities	Neutron generator tests	tests	200 (FY 1998)	500	500	500	500
		Explosive testing	tests	600	750	850	900	300

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Explosive Components Facility (continued)		Chemical analysis	analyses	900	950	1,000	1,250	500
		Battery tests	tests	50	60	60	100	10
	Boiler energy consumption	Natural gas	ft^3	24 M	27 M	27 M	29 M	16 M
	Expenditures		dollars	1.7 M	2.1 M	2.1 M	2.5 M	1.4 M
	Hazardous waste		kg	360	400	500	500	200
	Low-level waste		ft^3	95	190	190	190	190
	Low-level mixed waste		kg	1,000	1,000	1,000	1,000	1,000
	Nuclear inventory	Tritium	Ci	49	49	49	49	49
	Radioactive air emissions	Tritium	Ci	1×10^{-3}	2×10^{-3}	2×10^{-3}	2×10^{-3}	2×10^{-3}
	Personnel		FTEs	81	94	94	102	94
	Process electricity		kWh	2.9 M	3.1 M	3.1 M	3.4 M	2.5 M
	Process water		gal	6 M	6.5 M	6.5 M	7 M	4 M
	Process wastewater		gal	4.8 M	5 M	5 M	6.4 M	3.2 M
PHYSICAL TESTING AND SIMULATION FACILITIES								
Terminal Ballistics Complex	Test activities	Projectile impact testing	tests	50	80	100	350	10
		Propellant testing	tests	25	40	50	100	4
	Expenditures		dollars	8,500	9,500	11,000	12,000	3,000
	Hazardous waste		kg	0.25	0.50	0.50	0.75	0
	Personnel		FTEs	0.3	0.4	0.6	2	0.05

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Drop/Impact Complex	Test activities	Drop test	tests	18	20	20	50	0
		Water impact	tests	1	1	1	20	1
		Submersion	tests	1	1	1	5	0
		Underwater blast	tests	0	2	2	10	0
Drop/Impact Complex (continued)	Expenditures		dollars	50,000	55,000	60,000	146,000	31,000
	Personnel		FTEs	2.5	2.5	2.5	8	2.5
Sled Track Complex	Test activities	Rocket sled test	tests	10	10	15	80	2
		Explosive testing	tests	12	12	12	239	0
		Rocket launcher	tests	3	4	4	24	0
		Free-flight launch	tests	40	40	40	150	0
	Expenditures		dollars	334,000	376,000	451,000	2.0 M	190,000
	Hazardous waste		kg	15	15	15	50	3
	Personnel		FTEs	8	8	8	40	8
Centrifuge Complex	Test activities	Centrifuge	tests	32	46	46	120	2
		Impact	tests	0	10	10	100	0
	Expenditures		dollars	400,000	450,000	480,000	750,000	250,000
	Hazardous waste		kg	10	12	12	15	12
	Personnel		FTEs	3.5	4.5	4.5	10	3.5

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
ACCELERATOR FACILITIES								
SATURN	Test activities	Irradiation of components or materials	shots	65	200	200	500	40
	Expenditures		dollars	1.5 M	3 M	3 M	5.4 M	1.2 M
	Hazardous waste		kg	167	501	501	1,286	100
	Personnel		FTEs	5	10	10	18	4
HERMES III	Test activities	Irradiation of components or materials	shots	262	500	500	1,450	40
	Expenditures		dollars	2.4 M	3.0 M	3.0 M	4.4 M	1.98 M
	Hazardous waste		kg	167	316	316	915	25
	Low-level waste		ft^3	0.25	0.48	0.48	1.38	0.04
	Radioactive air emissions	Nitrogen-13	Ci	6.55×10^{-4}	12.45×10^{-4}	12.45×10^{-4}	36.03×10^{-4}	1×10^{-4}
		Oxygen-15	Ci	6.55×10^{-5}	12.45×10^{-5}	12.45×10^{-5}	36.03×10^{-5}	1×10^{-5}
	Personnel		FTEs	12	15	15	22	10
Sandia Accelerator & Beam Research Experiment	Test activities	Irradiation of components or materials	shots	187	225	225	400	0
	Expenditures		dollars	640,000	800,000	800,000	960,000	80,000
	Hazardous waste		kg	63	76	76	132	0
	Low-level waste		ft^3	4.0	4.8	4.8	8.4	0.0
	Personnel		FTEs	4.0	5.0	5.0	6.0	0.5

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Short-Pulse High Intensity Nanosecond X-Radiator	Test activities	Irradiation of components or materials	shots	1,185	2,500	2,500	6,000	200
	Expenditures		dollars	300,000	500,000	500,000	710,000	70,000
	Hazardous waste		kg	21	45	45	107	3.6
	Personnel		FTEs	2.7	3.5	3.5	5	0.5
Repetitive High Energy Pulsed Power Unit I	Test activities	Accelerator tests	tests	500	5,000	5,000	10,000	100
Repetitive High Energy Pulsed Power Unit I (continued)	Expenditures		dollars	1.5 M	2.5 M	2.5 M	5.5 M	750,000
	Hazardous waste		kg	0	5	5	10	0
	Nuclear consumption	Depleted uranium	μg	0	10	10	100	0
	Nuclear inventory	Depleted uranium	μg	0	10	10	100	0
	Personnel		FTEs	5	8	8	10	2
Repetitive High Energy Pulsed Power Unit II	Test activities	Radiation production	tests	80	160	160	800	40
	Expenditures		dollars	252,000	353,000	353,000	754,000	126,000
	Hazardous waste		kg	0	1	1	1	0
	Personnel		FTEs	0.9	1.4	1.4	3	0.45
Z-Machine	Test activities	Accelerator shots	shots	150	300	300	350	84
	Expenditures		dollars	1.2 M	3 M	3 M	40 M	800,000
	Hazardous waste		kg	750	1,000	1,000	1,250	400

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
	Low-level waste		ft^3	44	20	20	28	12
	Nuclear consumption	Tritium	Ci	0	2,500	2,500	7,500	0
		Deuterium[b]	L	0	3,750	3,750	5,000	0
		Plutonium-239	mg	0	800	800	2,000	0
		Depleted uranium	mg	0	800	800	2,000	0
	Nuclear inventory	Tritium	Ci	0	1,000	1,000	50,000	0
		Deuterium[b]	L	0	1,000	1,000	5,000	0
Z-Machine (continued)	Nuclear inventory (continued)	Plutonium-239	mg	0	200	200	200	0
		Depleted uranium	mg	0	200	200	200	0
	Radioactive air emissions	Nitrogen-13	Ci	0.042	0	0	0	0
		Oxygen-15	Ci	0.005	0	0	0	0
	Personnel		FTEs	50	85	85	115	50
TESLA	Test activities	Accelerator shots	shots	40	1,000	1,000	1,300	40
	Expenditures		dollars	500,000	1 M	1 M	1.6 M	500,000
	Hazardous waste		kg	2	50	50	65	2
	Personnel		FTEs	1	3	3	5	1
Advanced Pulsed Power Research Module	Test activities	Accelerator shots	shots	500	1,000	1,000	2,000	40
	Expenditures		dollars	3.5 M	5 M	5 M	5.5 M	1.5 M
	Hazardous waste		kg	50	100	100	200	5
	Personnel		FTEs	5	7	7	7	5

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Radiographic Integrated Test Stand	Test activities	Accelerator shots	shots	0[c]	400	600	800	100
	Expenditures		dollars	0	2.25 M	2.25 M	4 M	1.75 M
	Hazardous inventories	Insulator oil	gal	0	40,000	40,000	40,000	40,000
	Hazardous waste		kg	0	136	204	272	34
	Low-level waste		kg	0	60	90	120	15
	Radioactive air emissions	Nitrogen-13	Ci	0	0.08	0.12	0.16	0.02
Radiographic Integrated Test Stand (continued)	Radioactive materials inventory	Activated hardware	kg	0	500	500	500	500
	Personnel		FTEs	0	6	6	10	4
REACTOR FACILITIES								
New Gamma Irradiation Facility	Test activities	Tests	hours	0[c]	13,000	13,000	24,000	0
	Expenditures		dollars	0	6 M	500,000	1 M	0
	Hazardous waste		ft^3	0	14	14	14	7
	Low-level waste		ft^3	0	92	92	126	56
	Personnel		FTEs	0	3	3	4	2
	Process water		gal	0	166,000	166,000	255,000	0
	Radioactive consumption	Cobalt-60	Ci	0	142,000	142,000	246,000	0
Gamma Irradiation Facility	Test activities	Tests	hours	1,000	0	0	8,000	0
	Hazardous waste		ft^3	7	0	0	14	7
	Low-level waste		ft^3	56	0	0	126	56

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
	Nuclear inventory	Depleted uranium	kg	13,600	13,600	13,600	13,600	13,600
	Personnel		FTEs	2	0	0	3	2
	Process water		gal	17,000	0	0	17,000	17,000[i]
Sandia Pulsed Reactor	Test activities	Irradiation tests	tests	100	100	100	200	30
	Expenditures		dollars	0	5 M	0	6 M	0
	Hazardous waste		ft^3	7	14	14	30	7
	Low-level waste		kg	440	440	440	900	440
Sandia Pulsed Reactor (continued)	Low-level mixed waste		ft^3	4	4	4	14	4
	Nuclear inventory	Plutonium-239	g	53	10,000	10,000	10,000	53
		Enriched uranium	kg	550	900	550	1,000	550
	Radioactive air emissions	Argon-41	Ci	9.5	9.5	9.5	30.0	2.85
	Personnel		FTEs	10	12	10	17	8
Annular Core Research Reactor (DP for No Action and Reduced Operations Alternatives, ACPR-II for Expanded Operations Alternative)	Test activities	Irradiation tests	test series	0	1	0	2 to 3	0
	Expenditures		dollars	200,000	5 M	200,000	12 M	200,000
	Explosives inventory	Bare UNO 1.2[d]	g	0	500	500	500	0
	Hazardous waste		ft^3	0	2	0	14	0
	Low-level mixed waste		ft^3	0	35	0	170	0
	Low-level waste		ft^3	0	0	0	5	0
	Nuclear consumption	Enriched uranium	g	0	0	0	2	0

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Annular Core Research Reactor DP (continued)	Nuclear material inventory	Cobalt-60	Ci	33.6	19	10	33.6	33.6
		Enriched uranium	kg	12	37	37	85	12
		Plutonium-239	g	148	148	148	8,800	148
	Personnel		FTEs	1	1	1	8	1
	Process wastewater		gal	0	10,000	0	50,000	0
	Process water		gal	0	10,000	0	100,000	0
	Radioactive air emissions	Argon-41	Ci	2.6	2.6	2.6	7.8	0
	Transuranic mixed waste		ft^3	0	0	0	5	0
	Transuranic waste		ft^3	0	0	0	5	0
Annular Core Research Reactor (medical isotopes production configuration)	Test activities	Irradiation of production targets	targets	8[e]	375	375	1,300	40
	Expenditures		dollars	200,000	4.5 M	4 M	0	0
	Explosives inventory	Bare UNO 1.2[d]	g	0	500	500	500	0
	Hazardous waste		ft^3	7	14	14	30	7
	Low-level waste		ft^3	56	370	370	1,090	56
	Nuclear consumption	Enriched uranium	kg	0	0.38	10.6	16	0
	Nuclear inventory	Enriched uranium	kg	25.8	56.7	56.7	56.7	18.3
	Radioactive air emissions	Tritium	Ci	0	1.1	1.1	2.2	0.24
		Argon-41	Ci	35.4	1.1	1.1	2.2	0.24
	Personnel		FTEs	9	14	14	22	7

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
	Process water		gal	600,000	5 M	5 M	11 M	1.2 M
	Process wastewater		gal	125,000	1M	1 M	2.2 M	240,000
	Spent fuel	Spent fuel from fuel elements	kg	0	0	189	399	42
Hot Cell Facility	Development or production of devices, processes, and systems	Processing of production targets	targets	8	375	375	1,300	40
	Expenditures		dollars	0	4 M	0	0	0
	Hazardous waste		ft^3	7	14	14	22	7
	Low-level waste		ft^3	100	2,200	2,200	5,000	270
	Low-level mixed waste		ft^3	7	17	17	40	5
	Nuclear consumption	Enriched uranium	kg	0.2	9.4	9.4	32.5	1.0
	Nuclear inventory	Enriched uranium	g	25	25	25	125	25
	Radioactive air emissions	Iodine-131	Ci	0.00196	1.17	1.17	3.9	0.117
		Iodine-132	Ci	0.000129	3.0	3.0	10.0	0.3
		Iodine-133	Ci	0.00951	5.4	5.4	18.0	0.54
		Iodine-135	Ci	0.00132	3.3	3.3	11	0.33
		Krypton-83m	Ci	0.0000957	198.0	198.0	660.0	19.8
		Krypton-85	Ci	0.00153	0.19	0.19	0.63	0.019
		Krypton-87	Ci	0.0294	57.0	57.0	190	5.7
		Krypton-88	Ci	0.527	480.0	480.0	1,600	48.0
		Xenon-133	Ci	17.5	2,160.0	2,160.0	7,200.0	216.0
		Xenon-133m	Ci	0.768	102.0	102.0	340.0	10.2
		Xenon-135	Ci	14.7	2,070.0	2,070.0	6,900.0	207.0

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
		Iodine-134	Ci	0	0.22	0.22	0.72	0.022
		Xenon-135m	Ci	0.976	360	360	1,200	36
		Krypton-85m	Ci	0.587	290.0	290.0	970.0	29.0
		Xenon-131m	Ci	0.000345	1.8	1.8	5.9	0.18
	Personnel		FTEs	12	32	32	55	12
OUTDOOR TEST FACILITIES								
Aerial Cable Facility	Test activities	Drop/pull-down	Tests	21	32	38	100	2
	Test activities (continued)	Aerial target	tests	6	6	6	30	0
		Scoring system tests	series	0	1	1	2	0
	Expenditures		dollars	250,000	350,000	380,000	725,000	150,000
	Explosives consumption	Bare UNO 1.4[d]	g	410	625	741	2,314	71
		Bare UNO 1.1[d]	kg	18.9	28.4	34.6	78.8	0
		Bare UNO 1.3[d]	kg	1,514	3,268	3,814	22,930	480
	Hazardous waste		kg	5	5	5	9	5
	Personnel		FTEs	8	8	10	24	6
Lurance Canyon Burn Site	Test activities	Certification testing	tests	12	12	12	55	1
		Model validation	tests	56	56	56	100	0
		User testing	tests	37	37	37	50	0
	Expenditures		dollars	250,000	275,000	300,000	625,000	150,000
	Hazardous waste		kg	900	900	900	900	900
	Personnel		FTEs	4.5	4.5	4.5	11	3.5

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
	Process wastewater		gal	25,000	25,000	25,000	25,000	25,000
Containment Technology Test Facility - West	Test activities	Survivability testing	tests	1	1	0	2	1
	Expenditures		dollars	2 M	2 M	0	2 M	2 M
	Hazardous waste		g	100	100	0[j]	100	100
	Personnel		FTEs	12	12	0	12	12
Explosives Applications Laboratory	Test activities	Explosive testing	tests	240	240	240	275 to 360	50
	Expenditures		dollars	650,000	747,500	859,625	975,000	435,500
	Hazardous waste		kg	1	1	1	1.5 to 2	0.5
	Personnel		FTEs	3	3	3	6	2
Thunder Range Complex	Other	Equipment disassembly and evaluation	days	60	82	82	144	42
	Test activities	Ground truthing tests	test series	1	5	8	10	1
	Nuclear inventory	Plutonium-239	Ci	≤ 0.52	≤ 0.52	≤ 0.52	0.52	0
		Plutonium-238	Ci	≤ 0.62	≤ 0.62	≤ 0.62	0.62	0
		Americium-241	Ci	≤ 0.52	≤ 0.52	≤ 0.52	0.52	0
		Americium-243	Ci	≤ 0.52	≤ 0.52	≤ 0.52	0.52	0
		Normal uranium	Ci	≤ 4.2	≤ 4.2	≤ 4.2	4.2	0
	Personnel		FTEs	1.1	1.5	1.5	2.6	0.8
	Expenditures[k]		dollars	110,000	150,000	150,000	260,000	80,000

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
INFRASTRUCTURE FACILITIES								
Steam Plant	Infrastructure	Generate and distribute steam to DOE, TA-I, KAFB East, Coronado Club	lbs	544 M	544 M	544 M	544 M	362 M
	Boiler energy consumption	Natural gas[f]	ft^3	779 M	779 M	779 M	779 M	519 M
	Expenditures		dollars	2.8 M	2.83 M	2.83 M	2.87 M	2.4 M
Steam Plant (continued)	Personnel		FTEs	17	17	17	17	12
	Process electricity		kWh	1.2 M	1.2 M	1.2 M	1.2 M	0.8 M
	Process water		gal	14.3 M	17 M	17 M	20 M	9.5 M
Hazardous Waste Management Facility[g] (with MESA)	Infrastructure	Collection, packaging, handling, and short-term storage of hazardous and other toxic waste	kg	203,000	192,000	196,000	214,000 (215,200)	175,000
	Expenditures		dollars	950,000	890,000	890,000	1.0 M	820,000
	Waste managed	RCRA hazardous waste	kg	55,852	70,469	74,358	92,314 (93,514)	53,123
	Personnel		FTEs	13	12	13	14	11

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (concluded)

FACILITY NAME	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Radioactive and Mixed Waste Management Facility	Infrastructure	Receipt, packaging, and shipping of radioactive waste	lb	1.6 M	2.1 M	2.1 M	2.7 M[i]	0.8 M
	Expenditures		dollars	320,000	416,000	416,000	528,000	160,000
	Waste managed	Low-level waste	ft^3 (m^3)	11,874 (337)	15,436 (438)	15,436 (438)	19,592 (556)[i]	5,937 (168)
		Low-level mixed waste	ft^3 (m^3)	5,353 (152)	6,959 (197)	6,959 (197)	8,833 (251)	2,677 (76)
		Transuranic	ft^3 (m^3)	214 (6.1)	278 (7.9)	278 (7.9)	353 (10)	107 (3.0)
Radioactive and Mixed Waste Management Facility (continued)	Waste managed	Mixed transuranic	ft^3 (m^3)	16 (0.45)	21 (0.60)	23 (0.65)	37 (1.05)	8 (0.23)
	Radioactive air emissions	Tritium	Ci	2.203	2.203	2.203	2.203	2.203
	Personnel		FTEs	30	39	39	49	15
Thermal Treatment Facility	Infrastructure	Treatment of waste	lb	minimal	336	336	1,200	minimal
	Expenditures		dollars	10,000	20,000	20,000	100,000	10,000
	Hazardous waste		kg	minimal	76	76	272	minimal
	Personnel		FTEs	0.1	0.2	0.2	1	0.1

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (concluded)

Source: SNL/NM 1998a
Ci: curie
DP: Defense Programs
ft³: cubic foot
FTE: full-time equivalent
FY: fiscal year
g: gram
gal: gallon
GIF: Gamma Irradiation Facility
IMRL: Integrated Materials Research Laboratory
HWMF: Hazardous Waste Management Facility
kg: kilogram
kWh: kilowatt-hour
L: liter
lb: pound
M: million
mCi: millicurie
MESA: Microsystems and Engineering Sciences Applications
mg: milligram
RCRA: *Resource Conservation and Recovery Act*
RMWMF: Radioactive and Mixed Waste Management Facility
TA: technical area
TSCA: *Toxic Substances Control Act*
yr: year
μg: microgram
≤: less than or equal to

[a] Base year is the year selected as most representative of normal operations (SNL/NM 1998ee).

[b] Deuterium is not a radionuclide; however, it is considered as accountable nuclear material.

[c] Facility not completed as of publication of this SWEIS

[d] The United Nations Organization (UNO) Classification System is used to identify hazard class for explosives.

[e] Eight tests are planned for the base year to test and evaluate Molybdenum-99 separation process

[f] At 14.7 pounds per square inch

[g] Infrastructure and waste management quantities differ from waste generation quantities in Table 3.6–2, because the HWMF does not manage explosive (RCRA hazardous) waste, does not manage all TSCA wastes generated at SNL/NM, and does not manage all other types of wastes (non-RCRA hazardous) generated at SNL/NM.

[h] Infrastructure and waste management quantities differ from waste generation quantities in Table 3.6–2 because the RMWMF manages legacy waste inventories that were previously generated by SNL/NM facilities and activities.

[i] IMRL hazardous waste projection of 2,000 kg per year, under the Reduced Operations Alternative, is based on the assumption that the DOE would implement the alternative immediately and does not consider future potential waste avoidance and pollution prevention measures.

[j] At this time, there are no scheduled tests beyond 2000, so there were no waste projections.

[k] Estimated from Selected Facility/Facility Group data.

[l] GIF process water projection of 17,000 gal, under the Reduced Operations Alternative, is based on the assumption that the DOE would implement the alternative immediately and does not consider decommissioning the reactor water pool.

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives

RESOURCE AREA	UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
LAND USE					
SNL/NM Land Use Within KAFB	ac	8,824	8,824	8,824	8,824
DOE Buffer Zones	ac	9,093	9,093	9,093	9,093
INFRASTRUCTURE					
Utilities (Annual Basis)	Note: Expanded Operations Alternative quantities do not include 10% margin.				
Water Use Water Use with MESA/ Water Capacity	gal/yr	440 M 2.0 B	463 M 2.0 B	495 M (499 M) 2.0 B	416 M 2.0 B
Sanitary Sewer Discharge (Sewer Discharge with MESA)/ Sanitary Sewer Capacity	gal/yr	280 M 850 M	304 M 850 M	322 M (325 M) 850 M	268 M 850 M
Natural Gas Use (Natural Gas Use with MESA)/ Natural Gas Capacity	ft^3/yr[a]	475 M 2.3 B ft^3	450 M 2.3 B ft^3	475 M (481 M) 2.3 B ft^3	385 M 2.3 B ft^3
Electrical Use (Electrical Use with MESA)/ Electrical Capacity	MWh/yr	197,000 1.1 M	186,000 1.1 M	198,000[a] (204,000) 1.1 M	185,000 1.1 M
GEOLOGY AND SOILS					
Potential Soil/Subsurface Contamination Sites Identified	sites	182	182	182	182
Active Sites[b]	sites	20	20	20	20
SNL/NM Usage Areas Near 10% Or Greater Slopes	areas	4	4	4	4

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

RESOURCE AREA	UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
WATER RESOURCES AND HYDROLOGY					
Total SNL/NM Projected Groundwater Use, through 2008 [c] ***(Projected Groundwater Use with MESA)***	ft^3/10 yr	575 M	605 M	628 M (635 M)	571 M
Developed Area	mi^2	0.72	0.72	0.72	0.72
BIOLOGICAL/ECOLOGICAL RESOURCES					
Change in Habitat Area		NA	No change	No change	No change
CULTURAL RESOURCES					
Cultural Resources Located in all Areas of Potential Effect	number	192	192	192	192
AIR QUALITY					
Nonradioactive Emissions					
Nitrogen Oxides	tons/yr	153.92	162.36	162.36	162.36
Carbon Monoxide					
Stationary Sources	tons/yr	15.21	18.36	18.36	18.36
Mobile Sources	tons/yr	4,087	3,489	3,837	3,385
Construction Activities	tons/yr	132	132	132	132
Lurance Canyon Burn Site	tons/yr	0.78	0.78	4.5	0.78
Particulate Matter	tons/yr	3.65	7.46	7.46	7.46
Sulfur Dioxide	tons/yr	0.32	1.10	1.10	1.10
Radioactive Emissions					
Argon-41	Ci/yr	44.9	13.2	40.0	3.1
Tritium	Ci/yr	4.52	159.6	161	158.7
Nitrogen-13	Ci/yr	4.2×10^{-2}	0.12	0.16	0.02

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

RESOURCE AREA	UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Oxygen-15	Ci/yr	$2.6x10^{-2}$	$1.25x10^{-4}$	$3.60.10^{-4}$	$1.0x10^{-5}$
Iodine-131	Ci/yr	$1.96x10^{-3}$	1.17	3.90	0.117
Iodine-132	Ci/yr	$1.29x10^{-4}$	3.0	10.0	0.3
Iodine-133	Ci/yr	$9.51x10^{-3}$	5.4	18.0	0.54
Iodine-134	Ci/yr		0.22	0.72	0.022
Iodine-135	Ci/yr	$1.32x10^{-3}$	3.3	11.0	0.33
Krypton-83m	Ci/yr	$9.57x10^{-5}$	198.0	660.0	19.8
Krypton-85	Ci/yr	$1.53x10^{-3}$	0.19	0.63	0.019
Krypton-85m	Ci/yr	0.587	290	970	29.0
Krypton-87	Ci/yr	0.029	57	190	5.7
Krypton-88	Ci/yr	0.527	480	1,600	48.0
Xenon-131m	Ci/yr	$3.45x10^{-4}$	1.8	5.9	0.18
Xenon-133	Ci/yr	17.5	2,160	7,200	216
Xenon-133m	Ci/yr	0.768	102	340	10.2
Xenon-135	Ci/yr	14.7	2,070	6,900	207
Xenon-135m	Ci/yr	0.976	360	1,200	36.0
TRANSPORTATION (Normal Operations)					
Material (Annual Shipments/Receipts Radioactive, Chemical, and Explosives)	trips	3,358	5,096	7,498	4,170
Radioactive Waste (LLW & LLMW)	shipments	5	16	24	11
Chemical Waste	shipments	102	122	150	95
Solid Waste (Includes Construction/Demolition)	shipments	51	650	650	650
Recyclable Waste (Excludes D&D)	shipments	86	231	233	8

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

RESOURCE AREA		UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Site Related Traffic - Total KAFB Daily traffic		vehicles	37,727	38,406	39,085	37,319
SNL/NM Daily Hazardous Materials Transports		shipments	14.5	24.6	34.4	20.7
WASTE GENERATION[d] (Selected Facilities plus Balance of Operations)						
Radioactive Waste[j]	Low-Level	ft^3 (m^3)	3,322 (94)	5,993 (170)	9,897 (280)	3,616 (102)
	Low-level Mixed	ft^3 (m^3)	153 (4.33)	189 (5.34)	258 (7.31)	134 (3.79)
	Transuranic Waste	ft^3 (m^3)	0 (0)	10 (0.28)	26 (0.74)	0 (0)
	Mixed Transuranic Waste	ft^3 (m^3)	16 (0.45)	23 (0.65)	37 (1.05)	8 (0.23)
	Total Radioactive Waste	ft^3 (m^3)	3,493 (98.9)	6,215 (176.0)	10,220 (289.4)	3,758 (106.4)
Chemical Waste	RCRA Hazardous Waste[e] (with MESA)	kg	55,852	74,358	92,314 (93,514)	53,123
	TSCA (PCBs and Asbestos)[f]	kg	147,055[c]	122,000	122,000	122,000
	Non-RCRA Chemicals[g]	kg	69,321[c]	92,290	114,576	65,934
	Biohazardous[g]	kg	2,463[c]	3,279	4,071	2,343
	Recyclable Materials[g]	kg	60,768[c]	80,903	100,439	57,799
	Total Chemical Waste (with MESA)	kg	340,317	379,298	441,429 (442,629)	305,819
Solid Waste		kg	0.6 M	0.6 M	0.6 M	0.6 M
		m^3	2,022	1,955	2,022	1,955
NOISE/VIBRATION						
SNL/NM Estimated Number of Noise/Vibration-Producing Tests		tests/day	4.1	5.5	15.6	1.5

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives (concluded)

RESOURCE AREA	UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
SOCIOECONOMICS[h]					
Employment[i]	FTEs	7,652 SNL/NM 18,826 (indirect)	8,035 SNL/NM 19,765 (indirect)	8,417 SNL/NM 20,706 (indirect)	7,422 SNL/NM 18,259 (indirect)
Payroll	dollars	480 M SNL/NM 580 M (indirect)	500 M SNL/NM 610 M (indirect)	530 M SNL/NM 640 M (indirect)	470 M SNL/NM 560 M (indirect)
Expenditures	dollars	1.43 B SNL/NM 2.50 B (indirect)	1.50 B SNL/NM 2.63 B (indirect)	1.57 B SNL/NM 2.75 B (indirect)	1.39 B SNL/NM 2.43 B (indirect)

Source: SNL/NM 1998a
ac: acre
B: billion
Ci: curies
D&D: decontamination and decommissioning
FTE: full-time equivalent
ft^3: cubic feet
g: gram
gal: gallon
HSWA: *Hazardous Solid Waste Amendment*
HWMF: Hazardous Waste Management Facility
KAFB: Kirtland Air Force Base
kg: kilogram
M: million
m^3: cubic meter
mi: mile
mi^2: square mile
MWh: megawatt-hour
MESA: Microsystems and Engineering Sciences Applications
PCB: polychlorinated biphenyls
RCRA: *Resource Conservation and Recovery Act*
yr: year

[a] 60 psi
[b] Sites that cannot be removed from HSWA permit because of ongoing activities
[c] Ten-year quantities are sums of annual interpolated quantities.
[d] Quantities do not include special operations or legacy waste and differ from those in Table 3.6–1.
[e] HWMF managed.
[f] 1997 was used as the base year as 1996 was abnormal for PCBs and asbestos wastes.
[g] Multipliers, based on the proportional increase/decrease of hazardous waste, were used for projection of other wastes and materials recycled.
[h] Bounding analysis based on parameters presented in DOE 1997j.
[i] Section 4.12, Affected Environment, differs slightly, using 6,824 full-time employees.
[j] Includes wastes from MESA, which are small in quantity.
[k] Excludes MESA construction costs.

Note: Waste totals bound SNL/NM, DOE, and other small DOE-funded activities. Unless otherwise noted, MESA would not change quantities presented in the Expanded Operations Alternative.

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Land Use		No changes projected in classification or ownership	Same as No Action Alternative	Same as No Action Alternative
Visual Resources		Changes would be minor and transitory. Projected new construction in already developed areas	Same as No Action Alternative	Same as No Action Alternative
Infrastructure		All projected activities within capacities of existing road, waste management, and utility systems	Same as No Action Alternative	Same as No Action Alternative
Water Use (with MESA)		440-463 M gal/yr	495 M gal/yr (499 M gal/yr)	416 M gal/yr
Geology and Soils	Slope Stability	SNL/NM activities are not anticipated to destabilize slopes.	Same as No Action Alternative	Same as No Action Alternative
	Soil Contamination	Minimal deposition of contaminants to soils and continued removal of existing contaminants under the ER Project	Same as No Action Alternative	Same as No Action Alternative
Water Resources and Hydrology	Groundwater Quality	TCE above MCL from SNL/NM disposal activities is present in groundwater beneath the Chemical Waste Landfill (TA-III) and TA-V. Petroleum hydrocarbon components have been detected in groundwater beneath the Lurance Canyon Burn Site. No future activities are anticipated to cause further groundwater contamination.	Same as No Action Alternative	Same as No Action Alternative
	Groundwater Quantity	SNL/NM groundwater use is projected to account for 11% of local aquifer drawdown and 1% of basin-wide use. The potential consequence is considered adverse.	SNL/NM groundwater use is projected to account for 12% of local aquifer drawdown and 1% of basin-wide use.	Same as No Action Alternative

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Water Resources and Hydrology (continued)	Surface Water Quality	No contaminants attributable to SNL/NM activities have been detected in water samples collected onsite. No future activities are anticipated to cause surface water contamination.	Same as No Action Alternative	Same as No Action Alternative
	Surface Water Quantity	SNL/NM s projected portion of Rio Grande flow is 0.07%.	Same as No Action Alternative	Projected portion of Rio Grande flow is 0.06%
Biological and Ecological Resources		Impacts projected for biological or ecological resources are low to negligible.	Same as No Action Alternative	Same as No Action Alternative
Cultural Resources[a]		Potential for impacts to cultural resources is low to negligible. Explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires present a low to negligible potential for impacts. SNL/NM security would likely result in continued protection of archaeological sites.	Same as No Action Alternative	Same as No Action Alternative
Air Quality	Stationary Source Criteria Pollutants	Concentrations would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Modeling results (summary) Carbon monoxide (8 hours): 57% of standard Lead (quarterly): 0.07% of standard Nitrogen dioxide (annually): 30% of standard Total suspended particulates (annually): 69% of standard Sulfur dioxide (annually)	Same as No Action Alternative	Same as No Action Alternative
Nonradiological Air Quality				

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Air Quality (continued)	Chemical Pollutants	Concentrations are below regulatory standards and human health guidelines.	Same as No Action Alternative	Same as No Action Alternative
Nonradiological Air Quality (continued)	Mobile sources (percent of Bernalillo county mobile-source carbon monoxide emissions)	4.6	5.1	4.5
	Fire testing facilities	Chemical concentrations are below OEL/100 guideline.	Same as No Action Alternative	Same as No Action Alternative
Radiological Air Quality	MEI dose	0.15 mrem/yr	0.51 mrem/yr	0.02 mrem/yr
	Collective ROI dose	5.0 person-rem/yr	15.8 person-rem/yr	0.80 person-rem/yr
	Average individual dose within ROI	6.8×10^{-3} mrem/yr	2.16×10^{-2} mrem/yr	1.1×10^{-3} mrem/yr
Human Health and Worker Safety	MEI public risk (from radiation)	7.5×10^{-8} LCF/yr	2.6×10^{-7} LCF/yr	8.0×10^{-9} LCF/yr
	ROI population risk to public (from radiation)	2.5×10^{-3} LCF/yr	7.9×10^{-3} LCF/yr	4.0×10^{-4} LCF/yr
	Fatal SNL/NM worker occupational injuries	none	Same as No Action Alternative	Same as No Action Alternative
	Average radiation-badged SNL/NM worker dose (risk)	47 mrem/yr (1.9×10^{-5} LCF/yr)	Same as No Action Alternative	Same as No Action Alternative

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Human Health and Worker Safety (continued)	Nonfatal SNL/NM worker occupational injuries/illnesses	311/yr	326/yr	287/yr
	Occupational SNL/NM worker chemical exposures	1-2/yr	Same as No Action Alternative	Same as No Action Alternative
	Environmental risk to public (from chemical exposures)	$<1 \times 10^{-6}$ ELCR	Same as No Action Alternative	Same as No Action Alternative
Transportation	Transportation population risk within ROI (from radiation)	8.3×10^{-4} LCF/yr (1.7 person-rem)	2.5×10^{-3} LCF/yr (4.9 person-rem)	2.0×10^{-4} LCF/yr (0.4 person-rem)
	Total transportation population risk (from radiation)	0.1 LCF/yr	0.33 LCF/yr	4.5×10^{-2} LCF/yr
	Traffic accident fatalities	0.49/yr	1.3/yr	0.18/yr
	Total transportation population risk (from truck emissions)	0.03 LCF/yr	0.06 LCF/yr	0.01 LCF/yr
Waste Generation (Annual)	Management capability (infrastructure)	All projected activities are within capacities of existing facilities and systems.	Same as No Action Alternative	Same as No Action Alternative
	Total radioactive waste	Up to 176 m^3	Up to 289 m^3	Up to 106 m^3
	Total chemical waste	Up to approximately 379,000 kg	Up to approximately 441,000 kg (with MESA approximately 443,000 kg)	Up to approximately 306,000 kg

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (concluded)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Noise and Vibration		Impulse noise-producing test activities projected to increase 35% over 1996 level to 1,435 tests by 2008. Effects would be limited to windows rattling or startle reaction. Background noise levels would continue at current levels from generators, air conditioners, and ventilation systems, but increase due to additional vehicular traffic, aircraft noise, and temporary construction projects (range from 50 to 70 dB).	There would be a 250% increase in test activities over 1996 levels, to 2,638 per year, approximately one impulse noise event per hr for an 8-hr work day and a 261-day work year. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed in neighborhoods bounding the site.	Test activities would be 65% less than the 1996 level, 371 tests per year, an average of approximately 1.5 impulse noise tests per day. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore be unnoticed in neighborhoods bounding the site.
Socioeconomics[a,b]	SNL/NM employment[c]	8,035	8,417	7,422
	SNL/NM total economic activity within the ROI	\$4.13 B/yr	\$4.33 B/yr	\$3.81 B/yr
	Percent of ROI total economic activity	9.7	10.1	9.0
Environmental Justice[d]		No disproportionately high and adverse impacts to minority or low-income communities are anticipated.	Same as No Action Alternative	Same as No Action Alternative

B: billion
dB: decibel
ELCR: excess lifetime cancer risk
gal: gallon
hr: hour
kg: kilogram
LCF: latent cancer fatality
M: million
m^3: cubic meter
MCL: maximum contaminant level
MEI: maximally exposed individual
MESA: Microsystems and Engineering Sciences Applications
mrem: millirem
OEL: occupational exposure limit
ROI: region of influence
TA: technical area
TCE: trichloroethene
TCP: traditional cultural property
yr: year

[a] Under one of two configurations within the Expanded Operations Alternative, a developing proposal, still undergoing final conceptual design, the \$300 million MESA Complex could be constructed starting in 2001 and ending in 2003, pending additional NEPA review (an environmental assessment).
[b] Bounding analysis is based on parameters presented in DOE 1997j.
[c] Section 4.12, Affected Environment, differs slightly, using 6,824 full-time employees. Base year in Section 5.3.12, Environmental Consequences (also see Table 3.6–2), used 7,652 full-time employees.
[d] No TCPs have been identified at SNL/NM. If specific TCPs are identified, Native American tribes will be consulted.

Table 3.6–4. Comparison of Potential High Consequences (condensed version) for Accident Scenarios at SNL/NM

RESOURCE AREA	NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
SITE-WIDE EARTHQUAKE			
RADIOLOGICAL IMPACTS			
50-Mile Population (Additional Latent Cancer Fatalities)	8.1×10^{-2}	7.5×10^{-2}	7.5×10^{-2}
Maximally Exposed Individual (Increased Probability of Latent Cancer Fatality)	8.6×10^{-6}	7.7×10^{-6}	7.7×10^{-6}
Noninvolved Worker (Increased Probability of Latent Cancer Fatality)	3.1×10^{-2}	3.0×10^{-2}	3.0×10^{-2}
CHEMICAL IMPACTS			
Onsite Persons at Risk of Exposure Exceeding ERPG-2 Levels	423	423(306)[a]	Same as No Action Alternative
CATASTROPHIC ACCIDENT SINGLE FACILITY			
RADIOLOGICAL IMPACTS			
ACRR Medical Isotopes Production			
50-mile population (additional latent cancer fatalities)	1.6×10^{-6} to 4.9×10^{-3}	Same as No Action Alternative	Same as No Action Alternative
Maximally Exposed Individual (increased probability of latent cancer fatality)	1.0×10^{-6} to 4.9×10^{-7}	Same as No Action Alternative	Same as No Action Alternative
Noninvolved Worker (increased probability of latent cancer fatality)	4.9×10^{-8} to 7.6×10^{-5}	Same as No Action Alternative	Same as No Action Alternative
Hot Cell Facility			
50-mile population (additional latent cancer fatalities)	1.6×10^{-6} to 7.9×10^{-2}	Same as No Action Alternative	Same as No Action Alternative
Maximally Exposed Individual (increased probability of latent cancer fatality)	1.0×10^{-10} to 6.6×10^{-6}	Same as No Action Alternative	Same as No Action Alternative
Noninvolved Worker (increased probability of latent cancer fatality)	4.2×10^{-9} to 7.4×10^{-6}	Same as No Action Alternative	Same as No Action Alternative
Sandia Pulsed Reactor			
50-mile population (additional latent cancer fatalities)	1.2×10^{-3} to 9.2×10^{-3}	Same as No Action Alternative	Same as No Action Alternative
Maximally Exposed Individual (increased probability of latent cancer fatality)	1.5×10^{-7} to 8.4×10^{-7}	Same as No Action Alternative	Same as No Action Alternative
Noninvolved Worker (increased probability of latent cancer fatality)	2.5×10^{-4} to 3.8×10^{-3}	Same as No Action Alternative	Same as No Action Alternative

ACRR: Annular Core Research Reactor
ERPG-2: Emergency Response Planning Guideline Level 2

Table 3.6–4. Comparison of Potential Consequences for Accident Scenarios at SNL/NM (concluded)

RESOURCE AREA	NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
ACRR-Defense Programs Configuration			
50-mile population (additional latent cancer fatalities)	$1.3x10^{-3}$ to $9.0x10^{-3}$	Same as No Action Alternative	Not operational
Maximally Exposed Individual (increased probability of latent cancer fatality)	$1.7x10^{-7}$ to $1.0x10^{-6}$	Same as No Action Alternative	Not operational
Noninvolved Worker (increased probability of latent cancer fatality)	$1.2x10^{-5}$ to $2.2x10^{-4}$	Same as No Action Alternative	Not operational
CHEMICAL IMPACTS			
Technical Area-I			
Persons at risk of exposure exceeding ERPG-2 Levels			
Arsine	409	409/(558)[a]	Same as No Action Alternative
Chlorine	141	Same as No Action Alternative	Same as No Action Alternative
Phosphine	100	Same as No Action Alternative	Same as No Action Alternative
Thionyl Chloride	55	Same as No Action Alternative	Same as No Action Alternative
EXPLOSIVE IMPACTS			
Technical Area-I			
Distance (feet) to reach 2 psi (Damage to cinder block walls)	617	Same as No Action Alternative	Same as No Action Alternative
Distance (feet) to reach 10 psi (rupture of 50% of eardrums)	210	Same as No Action Alternative	Same as No Action Alternative
Distance (feet) to reach 50 psi (50% fatalities)	101	Same as No Action Alternative	Same as No Action Alternative

ERPG: emergency response planning guideline
ACRR: Annular Core Research Reactor
MESA: Microsystems and Engineering Sciences Applications
psi: pounds per square inch
[a] Expanded Operations Alternative with MESA Complex configuration

3.6.3 Geology and Soils

No activities planned for any of the alternatives would present a potential for slope destabilization. Slope instability has not been an issue in past SNL/NM operations and probably would not be a concern in the future. Existing soil contamination is being cleaned up through SNL/NM's Environmental Restoration (ER) Project, which is scheduled for completion between 2003 and 2005. Under the Expanded Operations Alternative, there would be the potential for increased deposition of soil contaminants in outdoor testing areas. Potential contaminants would include DU fragments, explosive residue, and metals contained in the weapons used in the tests. SNL/NM performs periodic sampling and radiation surveys in these testing areas. DU fragments are collected after tests. These areas are not accessible to the general public.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would have a negligible effect on geology or soil resources.

3.6.4 Water Resources and Hydrology

Groundwater contamination attributable to known SNL/NM activities is present at three sites: the Chemical Waste Landfill (CWL) in TA-III; beneath the liquid waste disposal system, septic tanks, and leach fields in TA-V; and the Lurance Canyon Burn Site in the eastern portion of KAFB. Investigations and cleanup planning are ongoing at these sites, and final plans must be approved by the New Mexico Environment Department. Under a no-cleanup scenario at the CWL, the only contaminant exceeding U.S. Environmental Protection Agency concentration limits in groundwater would be trichloroethene (TCE), which occurs in a plume extending 410 ft from the CWL. It is important to note the contamination at these sites is believed to be a result of past activities and the level of contamination is not expected to increase under the alternatives. The TCE would not impact drinking water supplies because the nearest water supply well is approximately 4 mi from the CWL. Groundwater investigation would continue at an additional location where the source of potential contamination has not been identified. Investigation and cleanup at locations with groundwater contamination would continue at the same rate under each of the three alternatives.

The estimated SNL/NM portion of local (in the immediate vicinity of KAFB) aquifer drawdown from 1998 to 2008 would range from 11 to 12 percent for all alternatives. Local drawdown would range from less than 1 to 28 ft across KAFB during this period. The potential consequence is considered adverse. This drawdown would not have an immediate effect on other water users, spring flow, or land subsidence. Water demand under each alternative would be within existing KAFB water rights.

No contaminants attributable to SNL/NM activities have been detected in surface water samples collected onsite.

SNL/NM has little effect on the quantity of surface water in arroyos or the Rio Grande. The combined excess storm water runoff from SNL/NM facilities and discharge to Albuquerque's Southside Water Reclamation Plant would contribute from 0.06 to 0.07 percent to the annual Rio Grande flow under all alternatives, with no measurable impacts to the Rio Grande.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would further increase local drawdown and SNL/NM's contribution of runoff and wastewater discharge.

3.6.5 Biological and Ecological Resources

Beneficial impacts to biological and ecological resources would occur under all alternatives. Restricted access and limited development and use have benefited biological resources at the KAFB. For example, the absence of livestock grazing has improved the quality of the grasslands in relation to the region.

SNL/NM operations in TAs-I, -II, and -V would continue to occur primarily inside buildings. Under all alternatives, proposed construction (analyzed and approved in separate NEPA documents) would remove small areas of vegetation, but would not affect the viability of the plant communities. Proposed activities could result in the local displacement of wildlife. There would be slightly increased levels of noise and activity under the Expanded Operations Alternative. Observations indicate that wildlife has become accustomed to the noise and activities that currently exist. Data from raptor surveys of KAFB support this conclusion, as raptor species at KAFB return to the same nest sites each year. Outdoor activities at TA-III and the Coyote Test Field would continue to affect small localized areas.

Limited site access and management of the biological resources by SNL/NM, KAFB, and the U.S. Forest Service would continue to benefit the animals and plants, including sensitive species on KAFB.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would have a negligible effect on biological and ecological resources. The MESA Complex would be built in a heavily developed area on land that has been largely disturbed and that currently contains structures.

3.6.6 Cultural Resources

Restricted access in association with activities at certain facilities would continue to have a beneficial effect on prehistoric and historic archaeological resources because it would protect the resources from vandalism, theft, or unintentional damage. For all three SWEIS alternatives, there would continue to be a potential for impacts to prehistoric and historic archaeological resources. These impacts would derive from explosive testing debris and shrapnel produced as a result of outdoor explosions, off-road vehicle traffic, and unintended fires and fire suppression. However, the potential for impacts due to these factors would be minimal under all three alternatives.

As a result of consultations with 15 Native American tribes, no traditional cultural properties (TCPs) were identified at SNL/NM; however, consultations are continuing with some tribes. Several tribes have requested that they be consulted under the *Native American Graves Protection and Repatriation Act* (NAGPRA) if human remains are discovered within the region of influence. If specific TCPs are identified in the future, any impacts of SNL/NM activities on the TCP and any impacts of restricting access to the TCP would be determined in consultation with Native American tribes, and further NEPA review would be conducted, if appropriate.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would have a negligible effect on cultural resources. The MESA Complex would be built in a heavily developed area on land that has been largely disturbed and that currently contains structures.

3.6.7 Air Quality

Concentrations of criteria and chemical pollutants in air would be below regulatory standards and human health guidelines. Under a worst-case, 24-hour scenario, the maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b would represent a maximum of 96 percent of the allowable regulatory limit for several criteria pollutants (nitrogen dioxide, total suspended particulates (TSP), and particulate matter smaller than 10 microns in diameter [PM_{10}]) at a public access area (See Table 5.3.7–1).

The Federal and state regulatory standards, in general, are set to provide for an ample margin of safety below any pollutant concentration that might be of concern.

The methodology used in the criteria pollutant analysis also produces maximum concentration projections that are very conservative. For example, 100 percent of the maximum concentration of air pollutants projected for Cobisa Power Station (located 5 mi west of the National Atomic Museum) was added to the background concentration calculated for the Steam Plant location (near the museum). Also, the maximum concentrations of air pollutants, from a monitoring station measuring contributions from the surrounding community that are dominated by traffic emissions, were added to the worst-case contribution of pollutants from operating SNL/NM's diesel fuel-powered backup generators and fuel oil-powered Steam Plant boilers. Consequently, though close to the thresholds, these calculated concentrations for nitrogen dioxide, TSP, and PM_{10} are considered to be very conservative.

Based on the analysis of stationary and mobile source emissions, annual carbon monoxide emissions from SNL/NM would be less than 1996 emissions under any alternative.

With the exception of one chemical (chromium trioxide), concentrations of noncarcinogenic chemicals emitted from 12 facilities on SNL/NM were projected to be below screening levels based on occupational exposure limit (OEL) guidelines generally referenced to determine human health impacts. Concentrations of carcinogenic chemical emissions would pose little cancer risk (less than 1 in 1 million) to onsite workers or the general public. Chemical emissions would be highest for the Expanded Operations Alternative, although they would still be below levels that would affect public health.

The impact from emissions of criteria pollutants for the No Action and Expanded Operations Alternatives would be essentially the same. The major source of criteria pollutants (other than mobile sources) would be the steam plant that supplies steam to the facilities for heating. No increase in floor space is anticipated under the Expanded Operations Alternative; therefore, no increase in steam production would be required. The Reduced Operations Alternative would require less steam, resulting in lower emissions from the steam plant.

If implemented, the MESA Complex configuration for the Expended Operations Alternative would become operational after 2003, and CSRL operations would be relocated and emissions of 1,2-dichloroethane would no longer occur (see Table 5.4.7–3) due to changes in chemical inventory requirements. No new or additional carcinogenic chemicals would be associated with MESA operations. Airborne particulate matter levels would be elevated during the construction period. The temporary increases are expected to be small and would result in negligible air quality impacts.

The radiological dose impacts due to the annual air emissions from SNL/NM facilities during normal operations under each of the alternatives would be much lower than the regulatory National Emissions Standards for Hazardous Air Pollutants (NESHAP) limit of 10 mrem/yr to a maximally exposed individual (MEI). The calculated radiological dose to an MEI would be 0.15 mrem/yr under the No Action Alternative; 0.51 mrem/yr under the Expanded Operations Alternative; and 0.02 mrem/yr under the Reduced Operations Alternative. The dose to an MEI under each alternative would be small in comparison to the average individual background radiation dose of 360 mrem/yr.

The calculated collective dose to the population within 50 mi of SNL/NM from the annual radiological air emissions due to the SNL/NM operations under each alternative would be 5.0 person-rem per year under the No Action Alternative; 15.8 person-rem per year under the Expanded Operations Alternative; and 0.80 person-rem per year under the Reduced Operations Alternative. The collective dose would be much lower than the collective dose of 263,700 person-rem to the same population from background radiation.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would not produce radiological emissions.

3.6.8 Human Health

Routine releases of hazardous radiological and chemical materials would occur during SNL/NM operations. These releases would have the potential to reach receptors (workers and members of the public) by way of different environmental pathways. The levels of exposure to chemicals and radionuclides were assessed for each environmental medium determined to be a pathway for these releases.

The SWEIS impact analyses identified air as the primary environmental pathway having the potential to transport hazardous material from SNL/NM facilities to receptors in the SNL/NM vicinity. In the assessment of human health risk from air emissions, a number of receptor locations and possible exposure scenarios were analyzed. The total composite cancer health risk is the sum of potential chemical and radiation exposures, calculated from the radiation cancer health risk to the MEI, plus the upper bound chemical cancer health risk from a hypothetical worst-case exposure scenario. This very conservative estimate of maximum health risk is greater than any of the individual health risks based on more likely exposure estimates at specific receptor locations.

> **Maximally Exposed Individual**
>
> A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

Both the composite cancer health risk estimate of 1 in 385,000 and the cancer health risk estimates for specific receptor locations are below levels that regulators consider protective of public health. No adverse health effects would be expected from any of the three alternatives for SNL/NM. The small amounts of chemical carcinogens and radiation released from SNL/NM facilities would increase the maximally exposed individual lifetime risk of cancer for the hypothetical MEI by less than 1 chance in 434,000 under the No Action Alternative and by less than a possible 1 chance in 126,000 under the Expanded Operations Alternative. Noncancer health effects would not be expected based on hazard index values of less than 1. No additional nonfatal cancers, genetic disorders, or latent cancer fatalities (LCFs) would be expected in the population living within a 50-mi radius.

If the CSRL were replaced, as described in the MESA Complex configuration for the Expanded Operations Alternative, the number of chemicals of concern would decrease to six because there would be no emissions of 1,2-dichloroethane. A corresponding decrease in total excess lifetime cancer risk would occur (see Section 5.4.8.1).

3.6.9 Transportation

The SNL/NM material and waste truck traffic offsite would be projected to increase from 14.5 shipments per day (1996) to 34.4 shipments per day under the Expanded Operations Alternative. However, the SNL/NM truck traffic would comprise less than

0.03 percent of the total traffic, including all types of vehicles entering and leaving the Albuquerque area by way of interstate highways. Therefore, the impact under the Expanded Operations Alternative would be minimal. The total local traffic on roadways would be expected to increase by a maximum of 3.6 percent overall under the Expanded Operations Alternative.

The overall maximum lifetime fatalities from SNL/NM annual shipments of all types of materials and wastes due to SNL/NM operations were estimated to be 1.7 fatalities under the Expanded Operations Alternative. Of these estimates, 1.2 fatalities would be due to traffic accidents; 0.33 fatalities would be due to incident-free transport of radiological materials and wastes; and 0.06 fatalities would be due to air pollution from truck emissions.

The maximum lifetime LCFs in the population within a 50-mi radius were estimated, based on a population dose of 4.93 person-rem, to be 0.0025 from the annual transport of radiological materials and wastes.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would not change the number of shipments of materials and wastes. The SNL/NM workforce traffic would not increase because there would be no new employees.

3.6.10 Waste Generation

Generation of radioactive waste, hazardous waste, process wastewater, and nonhazardous solid wastes was reviewed. The goal of the review was to determine the adequacy of existing onsite and offsite storage, treatment, and disposal capabilities. Storage capacity for all anticipated waste types would be adequate. Limited onsite hazardous and mixed waste treatment capacity would be within current permit limits. Most hazardous waste would be treated and disposed of offsite within the commercial sector. Commercial offsite capacity is currently adequate and would exceed anticipated future demand.

The recycling of wastes was not included in the modeling to bound actual projected waste quantities. LLW and LLMW would increase by a maximum of 198 percent (from 3,322 ft^3 to 9,897 ft^3 per year, Table 3.6–2) and 69 percent (from 153 ft^3 to 258 ft^3 per year, Table 3.6–2), respectively, under the Expanded Operations Alternative. One new operation, the Medical Isotopes Production Project, would be the major contributor to the LLW increase. Capacity currently exists to manage the waste generated from all operations at the Expanded Operations Alternative level.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would increase hazardous waste and LLW generation slightly (see Table 3.6–2). Under this configuration, the CSRL would undergo decontamination, decommissioning, and demolition and would generate approximately 2,000 tons of demolition debris (see Section 5.4.10.2, Special Projects).

Trends for all hazardous waste clearly show a significant reduction due to the implementation of pollution prevention protocols at SNL/NM. New procedures and recycling for the solid waste and process wastewater would have similar impacts on the nonhazardous waste volumes being generated.

3.6.11 Noise and Vibration

The No Action Alternative would enable SNL/NM to operate at current planned levels, which include baseline background noise levels and short-term noise impacts from SNL/NM test activities. Impulse noise-producing test activities would increase an estimated 35 percent over the 1996 number of test activities by 2008.

Projections under the Expanded Operations Alternative indicate a 250 percent increase in the number of impulse noise tests over 1996 levels. This would result in an average of approximately 1 impulse noise event per hour for an 8-hour work day, based on a 261-day work year.

The projected frequency of impulse noise events for the Reduced Operations Alternative would be 65 percent less than the 1996 levels, resulting in an average of 1.5 impulse noise tests per day.

Only a small fraction of these tests would be loud enough to be heard or felt beyond the site boundary. The vast majority of tests would be below background noise levels for locations beyond the KAFB boundary and would be unnoticed in neighborhoods bounding the site. Ground vibrations would remain confined to the immediate test area.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would not affect baseline background noise levels and short-term noise events. Temporary increases in noise levels during construction are expected from operation of heavy construction equipment and vehicle traffic.

3.6.12 Socioeconomics

Direct SNL/NM employment projections range from 7,422 (Reduced Operations Alternative) to 8,417

(Expanded Operations Alternative), in comparison to 7,652 full-time SNL/NM employees in the base year. These employment changes would change regional population, employment, personal income, and other socioeconomic measures in the region by less than 1 percent.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would cost approximately $300 M. The DOE anticipates that the construction of the facility would employ several hundred short-term workers and would probably result in a small temporary increase in total employment within the region. A substantial portion of the dollars spent on materials would flow through the wholesale and retail trade sectors of the regional economy. MESA would be designed for 500 to 550 employees. New employees would be unlikely because the DOE would transfer employees working in existing facilities to the new facilities.

3.6.13 Environmental Justice

Based on the analyses of other impact areas, the DOE would not expect any environmental justice-related impacts from the continued operation of SNL/NM under any of the alternatives. Resource areas of potential concern were evaluated on an individual basis with respect to minority populations and low-income populations. Three resource areas evaluated individually were water resources, cultural resources, and transportation.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would not create any environmental justice-related impacts.

3.6.14 Accidents

At SNL/NM, accidents could occur that would affect workers and the public. Potential accidents with the largest impacts would involve radioactive materials in TA-V facilities and hazardous chemicals in TA-I facilities. In most instances, involved workers (those individuals located in the immediate vicinity of an accident) would incur the largest risk of serious injury or fatality, because, for most accidents, the magnitude of the damaging effects are highest at the point of the accident and diminish with increasing distance. This would apply, for example, to releases of radioactive and chemical materials, explosions, fires, airplane crashes, earthquakes, and similar events. In some situations, however, the mitigating effects of structural barriers, personal protection equipment, and engineered safety features may offer greater protection for close-in workers than for others in the general vicinity of the accident.

In TA-I, under all three alternatives, there could be numerous situations in laboratory rooms where workers could be accidentally exposed to small amounts of dangerous chemicals. The potential also exists in TA-I for a catastrophic accident, such as an airplane crash into a facility or an earthquake, in which multiple dangerous chemicals could be released and expose onsite individuals to harmful or fatal chemical concentrations. Large quantities of hydrogen stored in outside areas of TA-I could also explode as a result of a catastrophic event and cause serious injury or fatality to involved workers and other nearby onsite individuals. The probability of a catastrophic chemical or explosive accident with serious consequences is low (less than once in a thousand years). Should such an accident occur, emergency procedures, mitigating features, and administrative controls would minimize its adverse impacts.

Under the Expanded Operations Alternative, the MDL and the CSRL have two configurations.

First, the MDL and the CSRL would remain in their present configuration. In the event of a catastrophic accident, such as an airplane crash into either facility (but not both), the dominant chemical release would be as much as 106.41 pounds of chlorine from the MDL or as much as 65 pounds of arsine from the CSRL. If one of these accidents were to occur, 141 persons in the vicinity of the MDL or 409 persons in the vicinity of the CSRL could be exposed to Emergency Response Planning Guideline Level 2 (ERPG-2) concentration. In the event of an earthquake, simultaneous release of chemicals is possible and as many as 423 persons could be exposed in TA-I.

In the second configuration, the chemical inventory and operations that were part of the CSRL missions would be performed in the proposed MESA Complex. In the event of a catastrophic accident such as an airplane crash into MESA, the dominant chemical released would be 80 pounds of arsine under the conservative assumption that all the arsine is stored in one location. The catastrophic release of 80 pounds of arsine could result in the exposure of as many as 558 persons, which includes both onsite and offsite people. In the event of an earthquake, the MESA arsine storage facility would remain intact and no arsine would be released. However, other facilities could fail, resulting in the exposure of as many as 306 persons to ERPG-2 concentration.

The potential for accidents would exist in TA-V that would cause the release of radioactive materials, causing injury to workers, onsite individuals, and the public. The magnitudes of impacts for the worst-case accident, an earthquake, would be minimal for all alternatives. If an earthquake occurred, the impacts would range from an approximate 1 in 33 increase in probability of an LCF for a noninvolved worker on the site to 1 in 120,000 for a maximally exposed member of the public. For the entire population residing within 50 mi of SNL/NM, less than one additional LCF would be expected. Involved workers, as in the case of chemical accidents, would incur the largest risk of injury or fatality in the event of almost any accident because of their close proximity to the hazardous conditions.

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CHAPTER 4

Affected Environment

4.1 INTRODUCTION

Understanding the affected environment is necessary for understanding potential impacts from operations at Sandia National Laboratories/New Mexico (SNL/NM). This chapter describes the existing conditions that comprise the physical and natural environment within SNL/NM, the Region of Influence (ROI), and the relationship of people with that environment. Descriptions of the affected environment provide a framework for understanding the direct, indirect, and cumulative effects of each of the three alternatives. The discussion is categorized by resource area to ensure that all relevant issues are included. This chapter is divided into the following 13 resource areas, and also includes other topic areas that support the impact assessment discussed in Chapter 5:

- Land Use and Visual Resources
- Infrastructure
- Geology and Soils
- Water Resources and Hydrology
- Biological and Ecological Resources
- Cultural Resources
- Air Quality
- Human Health and Worker Safety
- Transportation
- Waste Generation
- Noise and Vibration
- Socioeconomics
- Environmental Justice

The information in this chapter comes primarily from the SNL/NM *Environmental Information Document* (SNL/NM 1997a) and from the comprehensive environmental monitoring and surveillance programs that the U.S. Department of Energy (DOE) maintains at SNL/NM. Data for 1996 are presented where available; data for 1992, 1993, 1994, and 1995 are also included where necessary to present trends. Other relevant information is summarized and incorporated by reference.

> **Regions of Influence**
>
> Each ROI—the area that SNL/NM operations may reasonably affect—is delineated by its resource. The ROIs are determined based on characteristics of SNL/NM and the surrounding area. The ROI limits may be natural features (such as the extent of the Albuquerque-Belen Basin aquifer for groundwater) or political boundaries (such as the immediate four-county area for socioeconomics).
>
> Other ROIs are delineated using industry-accepted norms for the resources (such as the 50-mi radius used in radiological air quality).

Each resource and topic area includes a discussion of the ROI—the area that may be affected by SNL/NM operations. The ROI establishes the scope of analysis and focuses the discussion on relevant information. Because resource and topic areas are often interrelated, one section may refer to another.

Materials (including chemicals and radioisotopes) released from SNL/NM can reach the environment and people in a number of ways. The routes that materials follow from SNL/NM to reach the environment and subsequently people are called transport and exposure pathways. SNL/NM conducts environmental monitoring to measure both radioactive and nonradioactive materials released into the environment.

> **Transport and Exposure Pathways**
>
> The routes that released materials follow to reach the environment and subsequently people involve both transport and exposure pathways. A transport pathway is the environmental media, such as groundwater, soil, or air, by which a contaminant is moved (for example, chemicals carried in the air or dissolved in groundwater and moved along by wind or groundwater). An exposure pathway is how a person or other organism comes in contact with the contaminant (for example, breathing, drinking water, or skin contact).

Environmental monitoring assesses the potential for people to come in contact with these materials by any route of exposure. Sampled media include groundwater, storm water runoff, wastewater discharge, vegetation, soil, and air. SNL/NM publishes an annual site environmental report that contains details on these sampling programs (SNL 1994b, 1995c).

4.2 GENERAL LOCATION

SNL/NM is located within Kirtland Air Force Base (KAFB), approximately 7 mi southeast of downtown Albuquerque, New Mexico (Figure 4.2–1). SNL/NM uses approximately 8,800 ac of Federal land on KAFB (SNL/NM 1997a). Albuquerque is located in Bernalillo county, in north-central New Mexico, and is the state's largest city, with a population of approximately 420,000 (Census 1997a). The Sandia Mountains rise steeply immediately north and east of the city, with the Manzanita Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales to the northwest, the Pueblo of Sandia and town of Bernalillo to the north, and the Pueblo of Isleta and towns of Los Lunas and Belen to the south.

4.3 LAND USE AND VISUAL RESOURCES

4.3.1 Land Use

4.3.1.1 Definition of Resource

Land use describes the activities that take place in a particular area. It is a critical element in site operations decision-making. It is especially important as a means to determine if there is sufficient area for site activities and required buffers and to identify conflicts between existing or projected onsite and offsite programs and operations. DOE P 430.1 governs DOE's management of its land and facilities as valuable natural resources, based on the principles of ecosystem management and sustainable development.

4.3.1.2 Region of Influence

The ROI consists of the land SNL/NM uses in and adjacent to KAFB. It represents probable impact areas differentiated by onsite or offsite land resources. Onsite resources are lands used for SNL/NM activities within KAFB. Offsite resources consist of land immediately adjacent to KAFB and include areas belonging to the Pueblo of Isleta, city of Albuquerque, state of New Mexico, and the U.S. Forest Service (USFS).

4.3.1.3 Affected Environment

KAFB is an Air Force Materiel Command Base southeast of Albuquerque, New Mexico. KAFB shares facilities and infrastructure with several associates, including the DOE and its affiliates (for example, SNL/NM). It is comprised of approximately 51,560 ac of land, including portions of Cibola National Forest withdrawn in cooperation with the USFS. It is geographically bounded by the Pueblo of Isleta to the south, the Albuquerque International Sunport and lands held in trust by the state of New Mexico to the west, and the city of Albuquerque to the north. The eastern boundary lies within the Manzanita Mountains (Figure 4.3–1) (SNL/NM 1997a).

Historical Land Use Within KAFB

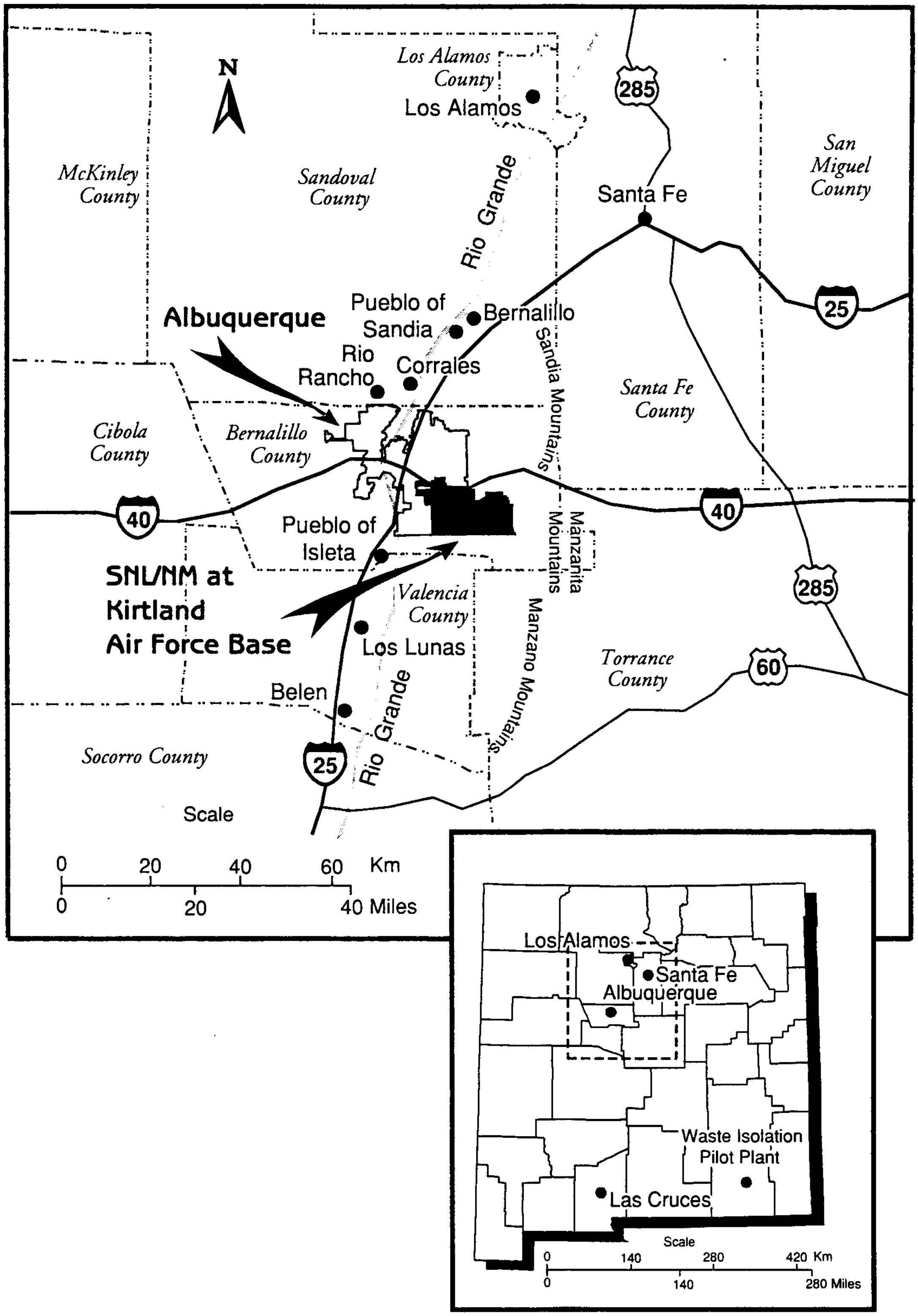
The earliest land use in the KAFB area is attributed to Native Americans and appears to have encompassed hunting, plant gathering, woodcutting, grazing, and possibly ritual activities (Holmes 1996a). No known Spanish land grants have been identified within KAFB. Farming and ranching were the principal activities during the eighteenth and nineteenth centuries. Upon the arrival of the railroad in 1880, mining activity increased and new residents established homesteads. New Mexico became a territory in December 1850 and a state in January 1912.

KAFB's military and civilian history began with the establishment of the city's first airfield in 1928. Beginning in 1942 and throughout World War II, Los Alamos operations, associated with the Manhattan Engineering District, used the area to assist in transportation requirements for the nation's first atomic weapons program (SNL/NM 1997a).

In 1945, jurisdiction over the site that eventually became SNL/NM was transferred to the Manhattan Engineering District, which established the forerunner of SNL/NM. SNL/NM developed and expanded its facilities throughout the Cold War era and to the present. KAFB itself has also continued as a military base and multi-user industrial research and development complex (SNL/NM 1997a).

Land Ownership Within KAFB

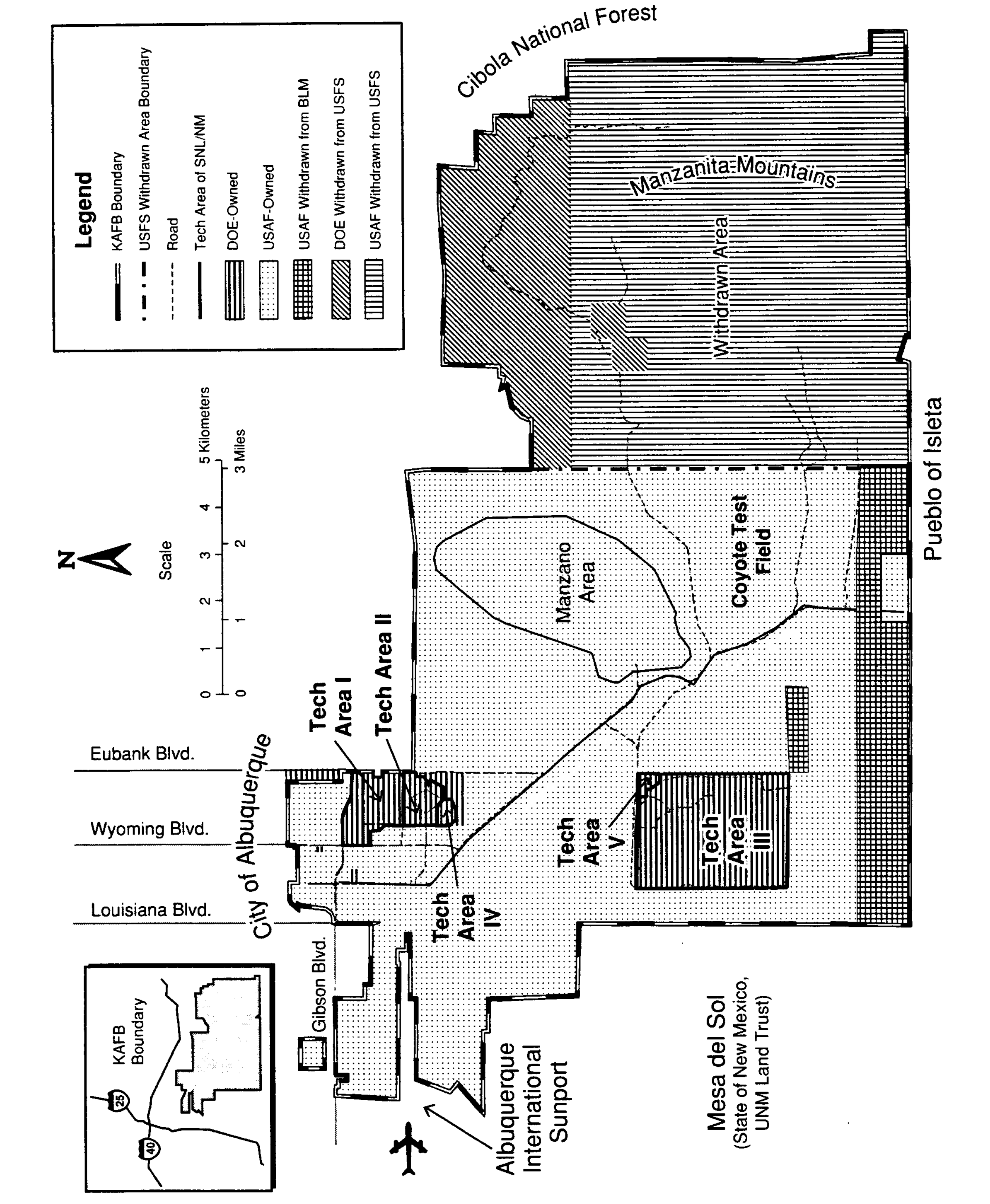
Land ownership on KAFB is divided primarily among the U.S. Air Force (USAF), the DOE, the Bureau of Land Management (BLM), and the USFS (Figure 4.3–1;



Source: SNL/NM 1997j

Figure 4.2–1. General Location of KAFB

KAFB is located southeast of the city of Albuquerque in Bernalillo county.



Source: SNL/NM 1997j

Figure 4.3–1. KAFB Land Ownership

KAFB, occupying approximately 51,560 acres, is primarily owned by the U.S. Air Force, the DOE, the Bureau of Land Management, and the U.S. Forest Service.

Table 4.3–1). The majority of acreage comprising the western half of KAFB is owned by the USAF. The DOE also owns land in this area, which is occupied almost entirely by SNL/NM facilities. Some land in the southwestern half is owned by the BLM and has been withdrawn by the USAF. The eastern portion of KAFB, commonly referred to as the Withdrawn Area, consists of more than 20,480 ac of USFS land within the Cibola National Forest that has been withdrawn by the USAF and the DOE in separate actions.

Table 4.3–1. KAFB Land Ownership

OWNER	ACREAGE	PERCENT OF KAFB
USAF	25,586	49
USFS (Withdrawn by USAF)	15,891	31
USFS (Withdrawn by DOE)	4,595	9
DOE	2,938	6
BLM (Withdrawn by USAF)	2,549	5
TOTAL	**51,559**	**100**

Sources: SNL/NM 1997a, j
BLM: Bureau of Land Management
DOE: U.S. Department of Energy
KAFB: Kirtland Air Force Base
USAF: U.S. Air Force
USFS: U.S. Forest Service

Land Use Within the KAFB

The USAF and the DOE are the principal land users within the KAFB (SNL/NM 1997a) (Table 4.3–2). Land use is established through coordination and planning agreements between these agencies. On matters involving the Withdrawn Area, the USFS is also involved. The USAF operates on much of its own land, as well as on property within its portion of the Withdrawn Area. The DOE owns only a small portion of the land it needs, and is required to conduct many of its activities under permit on land owned or withdrawn by the USAF or within its section of the Withdrawn Area. The DOE also leases land adjacent to KAFB to support SNL/NM activities (see Land Use Adjacent to KAFB). SNL/NM facilities and operations encompass the majority of the DOE's land use requirements on KAFB. Other DOE-funded facilities make up the remainder. Figure 4.3–2 provides a general overview of land use on KAFB.

Table 4.3–2. KAFB Land Use

USER		ACREAGE	PERCENT OF KAFB
USAF		33,338	65
DOE	*SNL/NM*	8,824	17
	Other	6,447	12
Joint USAF/DOE		2,950	6
TOTAL		**51,559**	**100**

Sources: SNL/NM 1997a, j
DOE: U.S. Department of Energy
KAFB: Kirtland Air Force Base
SNL/NM: Sandia National Laboratories/ New Mexico
USAF: U.S. Air Force

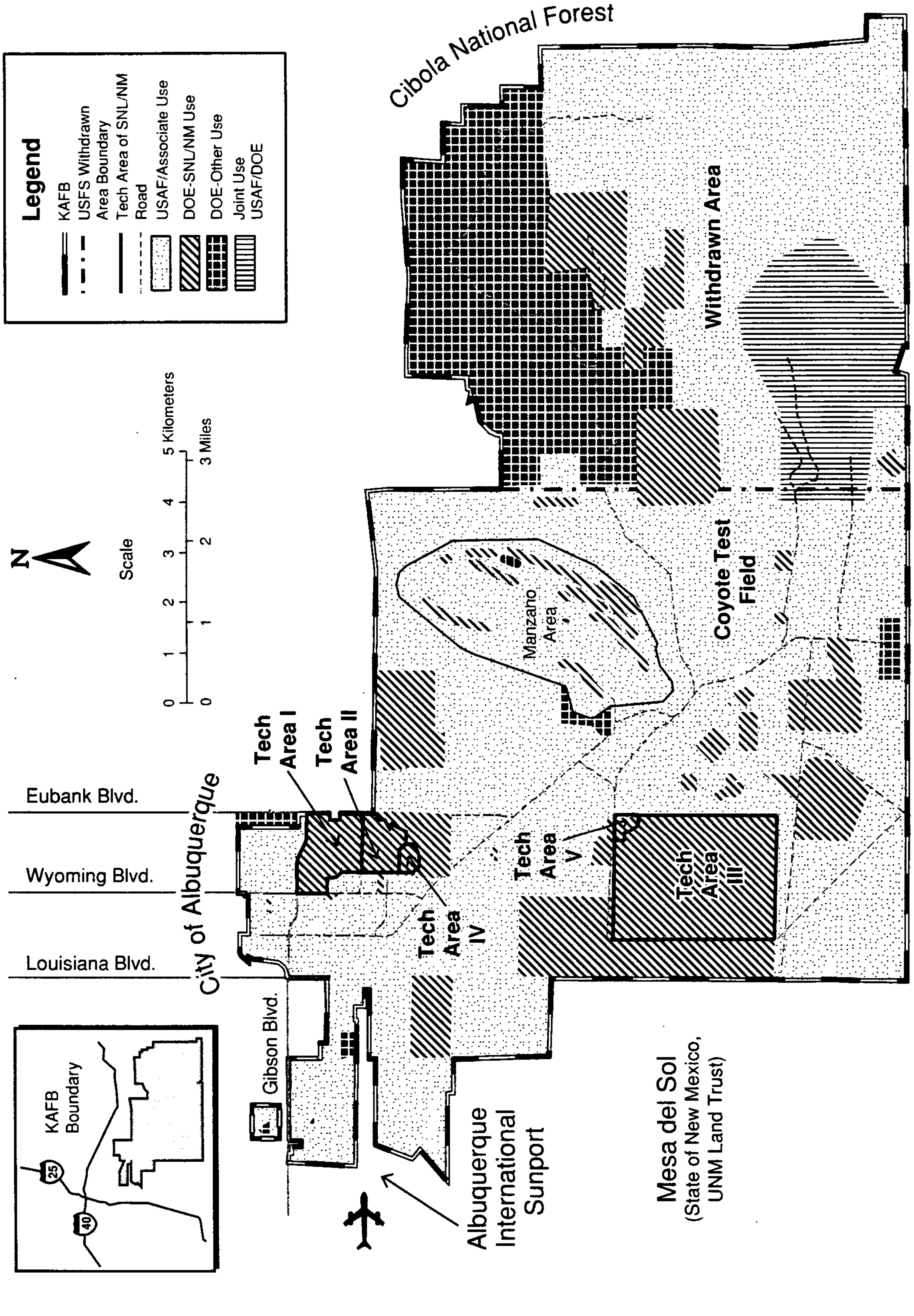
There is no single comprehensive land use plan for KAFB; however, existing land use designations and future planning scenarios are addressed in documents produced by the USAF, USFS, and SNL/NM. These documents include, for example, the *KAFB Comprehensive Plan* (USAF 1998a), *Cibola National Forest Land and Resource Management Plan* (USFS 1985), *SNL Sites Comprehensive Plan* (SNL 1997a), and *SNL Sites Integrated Master Plan* (SNL 1997c).

SNL/NM primary land use fits into a category of industrial/research park uses. This category coincides with the preliminary future use scenarios presented to the Citizens Advisory Board of the Future Use, Logistics, and Support Working Group (SNL 1997a, Keystone 1995) (see Future DOE Land Use on KAFB). Although not all facilities are industrial in nature (for example, administrative and office buildings), factors that contribute to the industrial designation include the following (SNL/NM 1997a):

- activities occurring in locations with limited area for development,
- testing activities occurring in areas near research and development facilities, and
- environmental restoration sites with associated remediation efforts resulting from research and testing activities.

In addition to SNL/NM, other DOE-funded facilities are located on land owned by the USAF and permitted to the DOE. These facilities include the Lovelace Respiratory Research Institute, Nonproliferation and National Security Institute (NNSI), Transportation Safeguards Division (TSD), Federal Manufacturing & Technology/New Mexico (FM&T/NM) (AlliedSignal), Ross Aviation, Inc., the Energy Training Center (ETC), and the DOE/Albuquerque Operations Office (AL).

KAFB land used by the USAF is also designated for industrial use, but includes a broader range of other uses such as residential, recreational, and medical activities that are associated with day-to-day base operations. Additionally, large areas of land within KAFB, particularly in the Withdrawn Area, do not support



Sources: SNL/NM 1997a, 1997j

Figure 4.3–2. KAFB Land Use

The U.S. Air Force and the DOE are the principal land users within KAFB.

specific facilities or programs, but are used as safety zones in association with USAF and DOE testing and training activities (SNL/NM 1997a).

SNL/NM Activities on KAFB

The five SNL/NM technical areas (TAs) cover approximately 2,560 ac (87 percent) of DOE-owned land. Table 4.3–3 lists DOE-owned land on and adjacent to KAFB, lists the total acreage of each SNL/NM TA, and provides a brief description of associated land use. TAs-I, -II, and -IV encompass approximately 645 ac. TAs-III and -V encompass approximately 1,915 ac. The DOE also owns approximately 10 ac that house the DOE/AL and 85 ac on the west side of Eubank Boulevard north of TA-I.

Technical Area I

TA-I comprises approximately 350 ac and is located in the northwest part of KAFB. TA-I is bordered by Wyoming Boulevard to the west and Eubank Boulevard to the east, while F and G Avenues form the northern border and Hardin Boulevard defines the southern boundary (Figure 4.3–3). Approximately 110 ac of TA-I are enclosed behind a security fence. TA-I is the most densely developed and populated of the TAs, with over 6,600 employees and 370 structures (SNL/NM 1997a). The structures within TA-I consist of laboratories, shops, offices, warehouses, and other storage buildings used for administration, site support, technical support, basic research, Defense Programs (DP), component development, microelectronics, energy programs, exploratory systems, technology transfer, and business outreach (SNL/NM 1997b). Large parking lots are also prominent features. Future SNL/NM planning efforts are directed at developing the east side of TA-I along Eubank Boulevard, with additional expansion by private entities into the area outside of the KAFB Eubank Gate (SNL/NM 1996f).

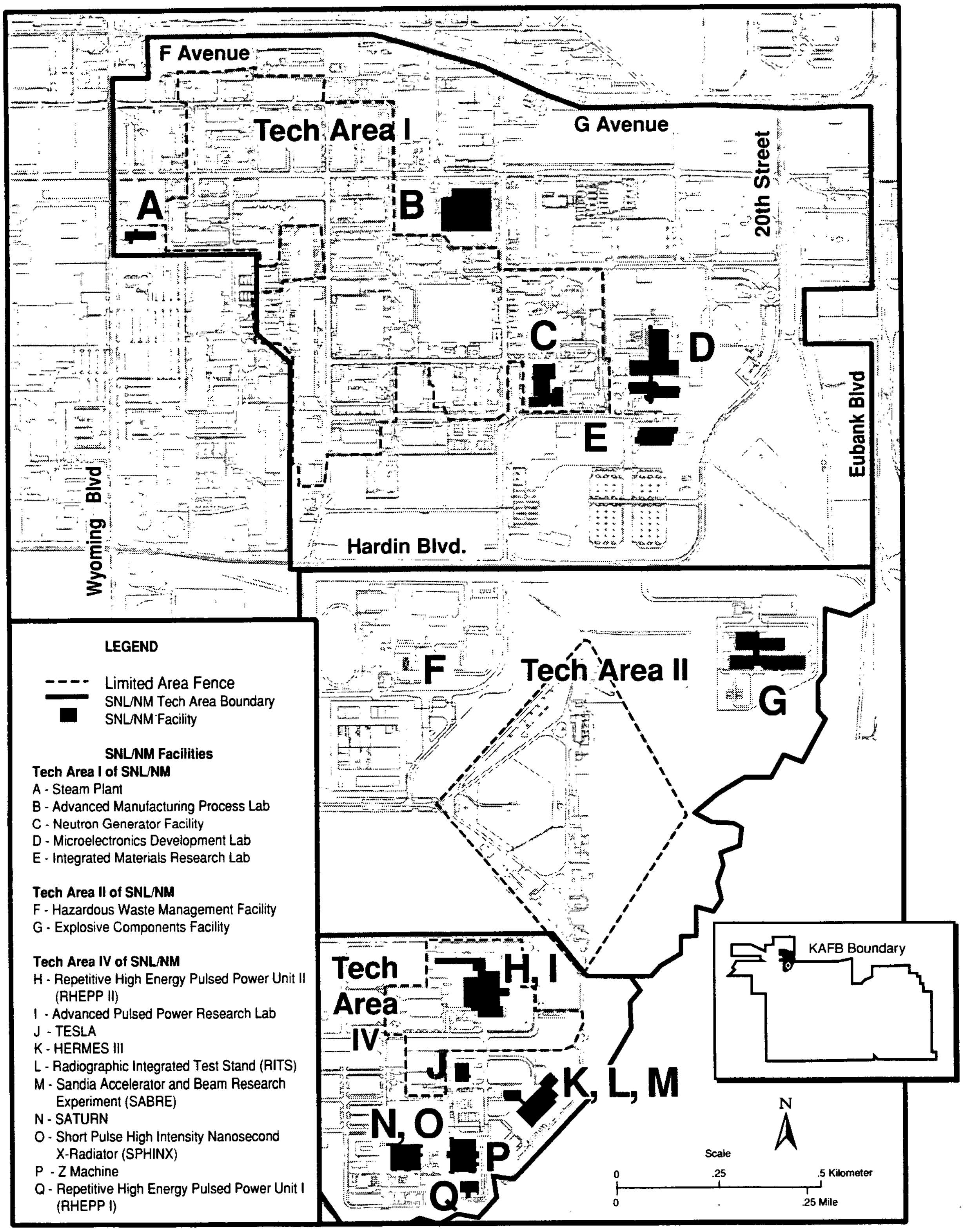
Technical Area II

TA-II is located immediately south of TA-I (Figure 4.3–3). Approximately 440 people work in the 210-ac area. TA-II includes a diamond-shaped fenced area of approximately 45 ac distinguished by a 10-ft-high chain link fence and

Table 4.3–3. DOE-Owned Land on KAFB

AREA	APPROXIMATE ACREAGE	MAJOR LAND USES
TA-I	350	Administrative buildings, laboratories, and offices associated with commercial and light industrial activities
TA-II	210	Storage and warehouse areas, light testing facilities, and maintenance yards
TA-III	1,890	20 test facilities, widely separated by large tracts of open space; a limited number of buildings and mobile office trailers for administrative, office, and light laboratory uses
TA-IV	85	Several major laboratory/research facilities with accompanying office and administrative space
TA-V	25	A small, highly secured area of several primary research facilities, light laboratories, and office space
TOTAL TA ACREAGE	**2,560**	
Tijeras Arroyo Drainage Area (Adjacent to TA-IV)	280	Undeveloped open space
DOE/AL and Coronado Club	10	Administrative buildings and office space
Eubank Boulevard Development Area	85	Undeveloped open space
TOTAL DOE LAND	**2,935**	

Source: SNL/NM 1997a
DOE/AL: Department of Energy/Albuquerque Operations Office
TA: technical area



Source: SNL/NM 1997a

Figure 4.3–3. Technical Areas-I, -II, and –IV

Technical Areas-I, -II, and -IV are located in the northwest section of KAFB.

security gate (SNL/NM 1997a, SNL 1997a). Like TA-I, the area is urbanized but less densely developed. Over 30 structures are within the area, consisting of several laboratories, limited office space, and numerous storage buildings (SNL/NM 1997b). The Explosive Components Facility (ECF), completed in 1995, is used by SNL/NM to perform low-hazard testing on small samples of explosive material. Additional facilities include the safeguards and security building, shipping and receiving, the waste transfer station, and maintenance yards. Other portions of the area have been vacated and are awaiting decommissioning and remediation activities (SNL 1997a). TA-II is fully developed; however, suitable facilities may be reassigned for use as warehouses or for other limited-occupancy uses (SNL/NM 1996f).

Technical Area III

TA-III consists of an area of about 1,890 ac located approximately 5 mi south of TA-I (Figure 4.3–4). Approximately 224 people work in the area, which is composed of 20 test facilities devoted to violent physical testing and simulating a variety of natural and induced environments (SNL/NM 1997a). Over 150 structures are located within TA-III. Most of these structures are grouped together in small units separated by extensive open spaces. These units are organized by testing facility (SNL/NM 1997b). An administrative building and mobile office trailers provide space for administrative, office, and light laboratory functions (SNL/NM 1997a). Although much of the area remains as open space characterized by flat to undulating grassland terrain, TA-III is considered fully developed due to the area required for hazard safety zones (SNL/NM 1997a). For example, testing activities associated with the 10,000-ft Sled Track Facility in the NW corner of TA-III require the leasing of a buffer zone west of the boundaries of KAFB (SNL/NM 1997a, SNL/NM 1997x). Buffer zones are discussed in more detail in the Land Use Adjacent to KAFB subsection.

Technical Area IV

TA-IV is located south of TA-II on approximately 85 ac, 19 of which are behind security fencing (Figure 4.3–3). Like TA-II, TA-IV is urbanized but less densely developed than TA-I. The area is primarily a research site for pulsed-power sciences and particle-beam fusion accelerators, as well as a research and development area. The working population of TA-IV is approximately 546, occupying about 70 structures consisting of main laboratories, mobile offices, and storage (SNL/NM 1997a, 1997b). With the exception of the adjacent 280-ac Tijeras Arroyo drainage area, TA-IV has land available for construction of additional facilities.

Technical Area V

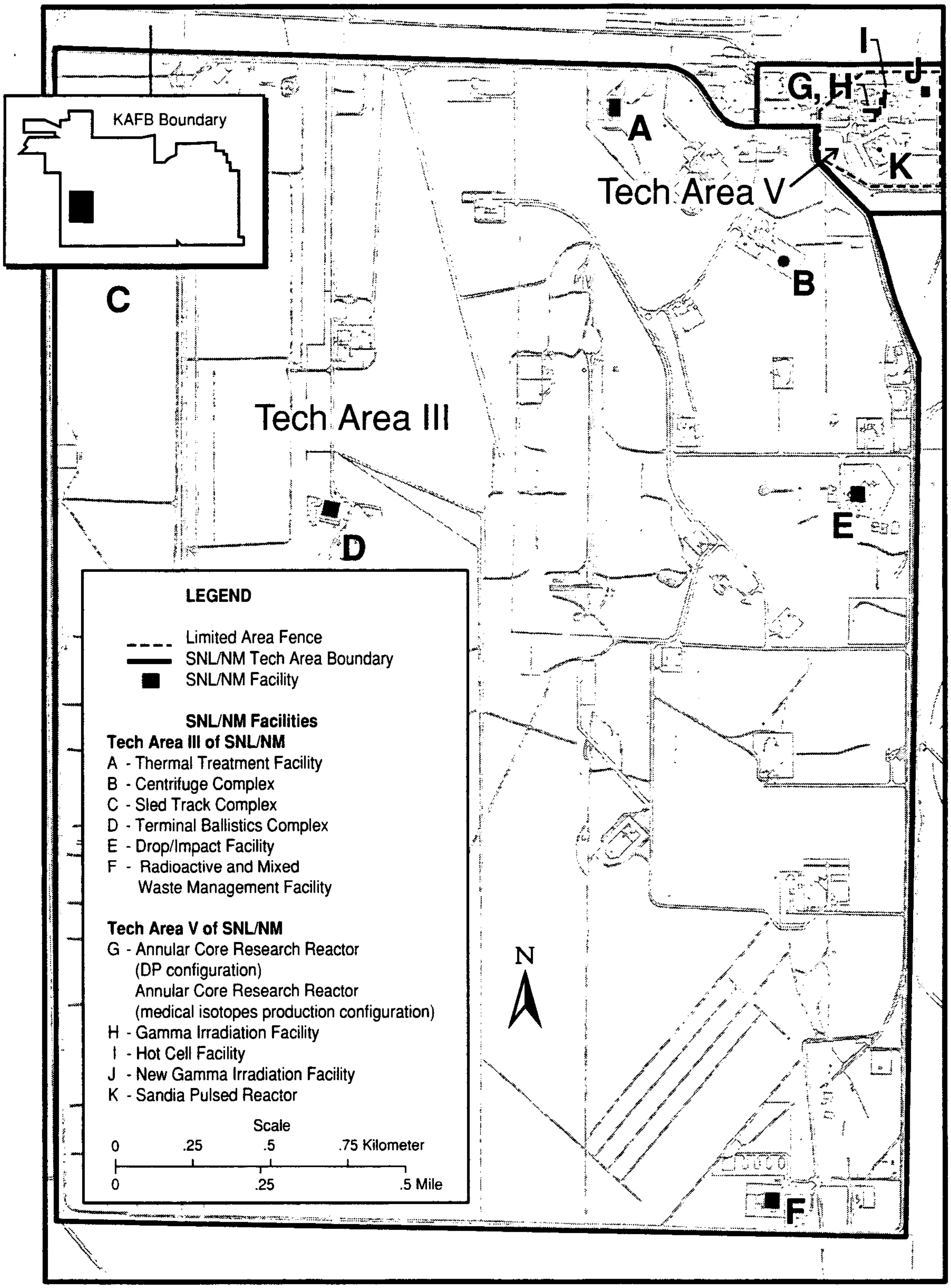
TA-V is located on approximately 25 ac adjacent to the northeast corner of TA-III (Figure 4.3–4). In addition to DOE-owned lands within the boundaries of TA-V, approximately six ac are permitted to the DOE by the USAF to provide additional security (SNL/NM 1997a). TA-V is a relatively small research area consisting of about 35 closely grouped structures where experimental and engineering nuclear reactors are located. Approximately 159 personnel work in the area.

Coyote Test Field

The Coyote Test Field (Figure 4.3–5) is a large area within KAFB that contains a variety of remote testing sites and facilities. The area is comprised of mostly open, flat to undulating, grassland terrain in the west, to more mountainous topography in the east. Approximately 173 structures consisting of laboratory buildings, mobile offices, and numerous storage areas are found widely dispersed throughout the area (SNL/NM 1997b). A number of SNL/NM facilities, such as the Explosives Applications Laboratory (EAL), Containment Technology Test Facility-West, and Thunder Range Complex, operate in this area on land permitted to the DOE by the USAF.

Withdrawn Area

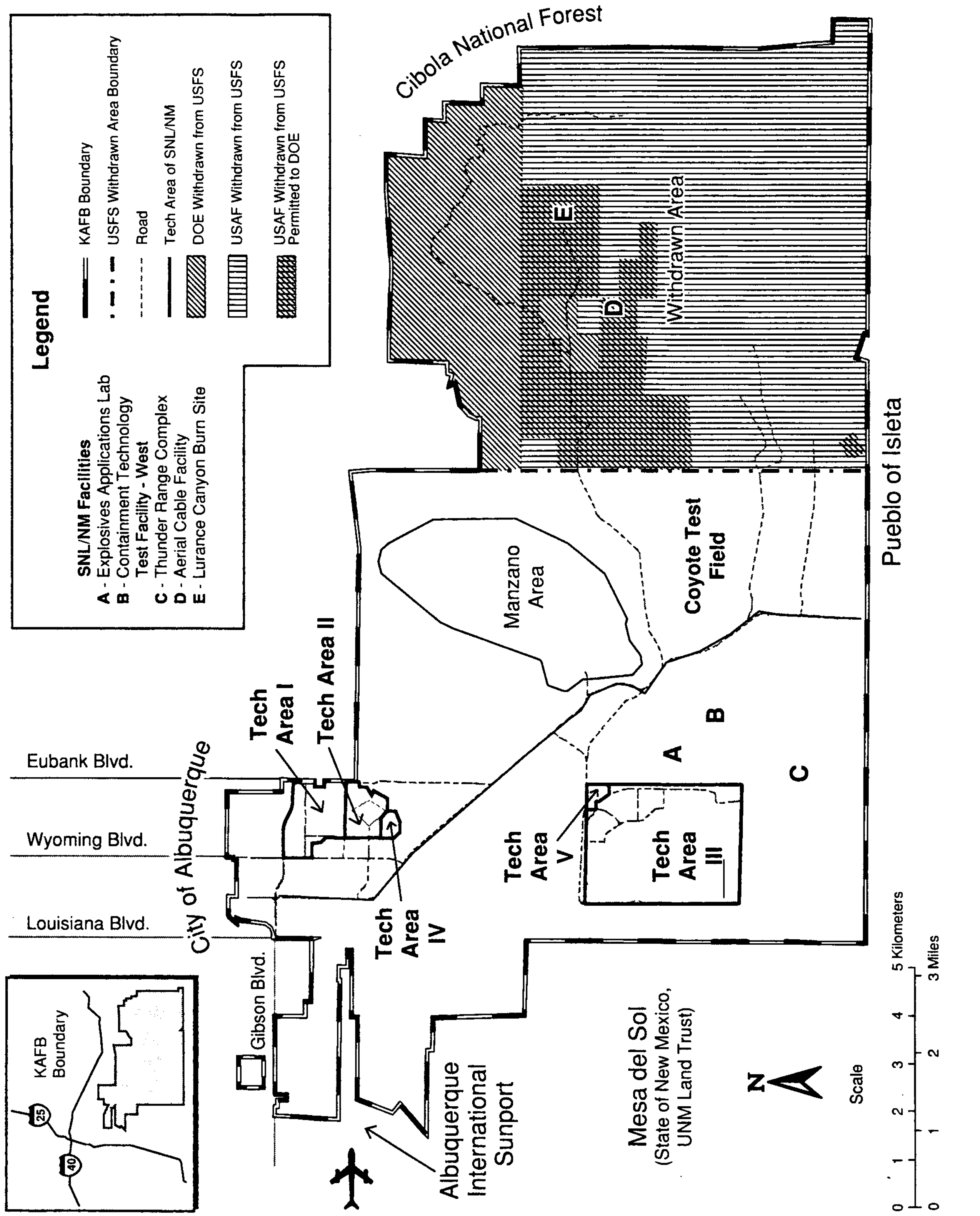
The Withdrawn Area consists of approximately 20,485 ac in the eastern portion of KAFB, including land within the Cibola National Forest that has been withdrawn from public use by the USAF (15,890 ac) and the DOE (4,595 ac) (Figure 4.3–5). SNL/NM operations at the Lurance Canyon Burn Site and the Aerial Cable Facility are conducted on land that has been withdrawn by the USAF and subsequently permitted to the DOE. There are additional SNL/NM activities on USAF-permitted land in the Withdrawn Area as well. Other DOE activities not associated with SNL/NM, such as those associated with the NNSI and the TSD, are also conducted on USAF-permitted land, as well as on that portion withdrawn specifically by the DOE (Figure 4.3–5). The terrain is predominantly mountainous with increasing elevation to the east. Development is limited and characterized by small structures and mobile offices. Large portions of land within the Withdrawn Area do not support specific facilities or programs, but are used as buffer areas for USAF and SNL/NM testing activities (SNL/NM 1997a).



Source: SNL/NM 1997a

Figure 4.3–4. Technical Areas-III and -V

Technical Areas-III and -V are located in the southwest section of KAFB.



Source: SNL/NM 1997j

Figure 4.3–5. Coyote Test Field and the Withdrawn Area

The Coyote Test Field and the Withdrawn Area occupy over 20,000 acres in the eastern portion of KAFB.

Land Use Adjacent to KAFB

Generalized land use adjacent to KAFB is shown in Figure 4.3–6. The city of Albuquerque has the most influence on land use adjacent to the north-northwestern boundary of KAFB. The city has experienced steady growth in these areas characterized by single-family and multi-family residential dwellings, mixed/minor commercial establishments, and light industrial/wholesale operations. Trending east along the northern border of KAFB, limited residential use, as well as some vacant land, is found within the city and surrounding Bernalillo county. The northeast boundary of KAFB is surrounded almost entirely by Cibola National Forest, although some private land, scattered residential dwellings, and industrial operations are present north of the Withdrawn Area. Much residential development, consisting of single-family homes, has occurred just beyond the national forest approximately 1 mi east of the KAFB Withdrawn Area boundary. The southern portion of KAFB borders a wide expanse of open rangeland owned by the Pueblo of Isleta. To the west, adjacent land consists of the Albuquerque International Sunport, some city and county open space, and a large parcel of open space planned for a significant future development known as Mesa del Sol. Mesa del Sol and a number of other planned development projects affecting adjacent land use are discussed in Chapter 6, Cumulative Effects Analysis.

DOE Buffer Zones

The DOE leases approximately 9,100 ac of land adjacent to the western and southwestern boundaries of KAFB as a buffer zone for the operations at the 10,000-ft Sled Track Complex in TA-III (Figure 4.3–7). The Sled Track Complex is an SNL/NM test facility used for simulating high-speed impacts of weapon shapes, substructures, and components to verify design integrity, performance, and fuzing (mechanical or electrical means used to detonate an explosive charge) functions. The facility also subjects weapon parachute systems to aerodynamic loads to verify parachute design integrity and performance (SNL/NM 1998a). The buffer zone ensures that an adequate safety area exists for the physical protection of the public from impact of all sled and payload components. This includes explosive debris and/or shrapnel as well as the maximum range of fly-away rocket motors (SNL/NM 1997x).

The buffer zone is comprised of two distinct areas due to land ownership and the nature of the individual arrangements between the landowners and the DOE (SNL/NM 1997a). The first part of the buffer zone consists of approximately 2,750 ac west of KAFB boundary that the DOE leases from the state of New Mexico. This area is 1 mi wide and encompasses the eastern edge of the proposed Mesa del Sol (state of New Mexico, University of New Mexico [UNM] land trust) development. The lease expired in 1995 and the New Mexico State Land Office (NMSLO) and the DOE are currently discussing its continuation. The second part of the buffer zone consists of approximately 6,345 ac, extending south and west of the southern KAFB boundary. This land is currently used under agreement with the Pueblo of Isleta through the Bureau of Indian Affairs (BIA) (SNL/NM 1997a, 1997j).

For 20 days in 1990, an agreement with the Pueblo of Isleta temporarily established an additional buffer zone of approximately 3,840 ac south of the KAFB boundary. This action was taken during special testing at the Aerial Cable Facility (DOE 1990).

The Mesa del Sol Area

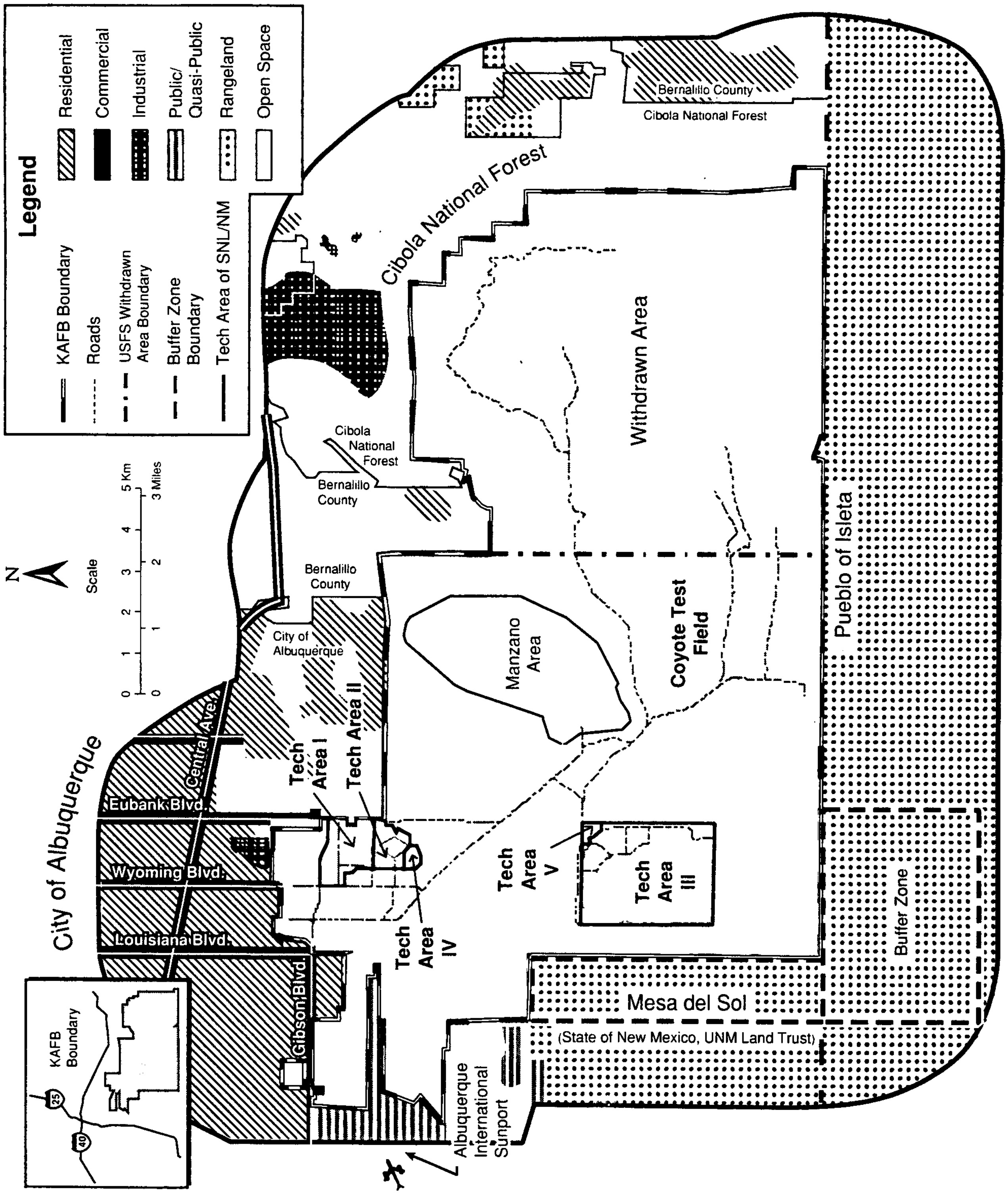
The Mesa del Sol area is a 13,000-acre parcel of vacant land, virtually all of which is held in trust by the New Mexico State Land Office (NMSLO) for the benefit of the University of New Mexico and New Mexico Public Schools. The area was annexed by the city of Albuquerque in 1993 and represents a 20 percent increase in the city's incorporated area. It is anticipated that the area will be home to as many as 40,000 households and be a major impetus for economic development for the city and the region.

Plans for Mesa del Sol call for a mixed-use pedestrian-oriented planned community with a number of districts and activity centers surrounded by large areas of open space. The community will be linked by a regional transportation, open space, and trail network, providing access to the entire metropolitan area.

For additional information, consult the 1997 Mesa del Sol Level A Community Master Plan produced by the NMSLO, Santa Fe, New Mexico (NMSLO 1997).

Future DOE Land Use on KAFB

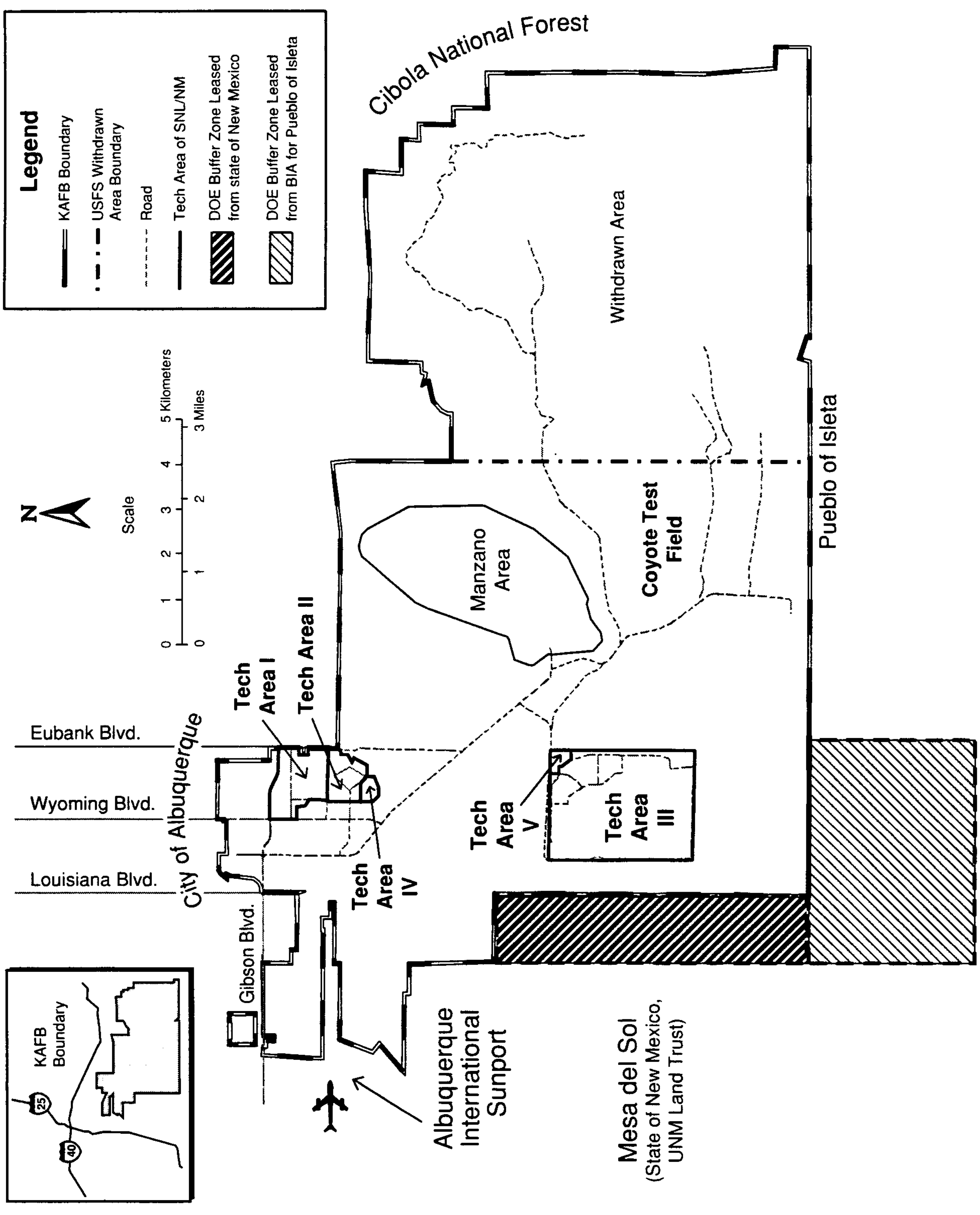
Land use on KAFB is controlled by a complicated series of agreements, permits, and leases among the DOE, the



Sources: DOE 1993c, 1996b; SNL/NM 1997a

Figure 4.3–6. Generalized Land Use Adjacent to KAFB

Land adjacent to KAFB has a wide variety of uses.



Sources: DOE 1993c, 1996b; SNL/NM 1997a

Figure 4.3–7. DOE Leased Buffer Zones

The DOE has leased buffer zones adjacent to the western and southern boundaries of KAFB.

USAF, and the USFS. Since June 1994, a Future Use, Logistics, and Support Working Group has been instrumental in developing future land use recommendations. The working group comprises representatives from the DOE, the U.S. Environmental Protection Agency (EPA), the New Mexico Environment Department (NMED), SNL/NM, the Lovelace Respiratory Research Institute, FM&T/NM, Ross Aviation, Inc., the TSD, the NNSI, the USAF, and the USFS.

The DOE and SNL/NM Citizens Advisory Board (CAB) was identified by the working group as the appropriate vehicle for public participation. The CAB receives information from the DOE and SNL/NM relevant to future land use issues. The CAB held its first future land use meeting in June 1995 and is currently in the process of reviewing site baseline data and preliminary future land use information. The Pueblo of Isleta and the Bernalillo County Commission have been apprised of future land use planning activities at SNL/NM and are provided with all pertinent communications and publications (SNL 1997a).

The Future Use, Logistics, and Support Working Group developed preliminary recommendations for KAFB and recognized the high probability of continued Federal use of the complex. Under these recommendations, the Federal government will maintain institutional control of the site and restrict access to it. Interim future land use recommendations by the working group include industrial/commercial and recreational uses as they relate to general cleanup levels. Refer to Section 4.5.3.3, for a discussion of the cleanup level designations. SNL/NM's primary land uses fit into a category of industrial/research park uses. These uses are consistent with the preliminary future land use scenarios presented to the CAB for DOE-owned properties (SNL 1997a, Keystone 1995).

Although SNL/NM land use will not change significantly in the foreseeable future, the DOE is negotiating two real estate transactions on behalf of SNL/NM. The first involves acquiring from the city of Albuquerque approximately 4 ac along Eubank Boulevard south of H Street in exchange for a right-of-way for the city to improve Eubank Boulevard south of Central Avenue (SNL 1997a). The other possible transaction involves renewing the lease arrangement with the NMSLO for the buffer zone west of TA-III and the KAFB boundary. The DOE and the NMSLO are establishing an arrangement that supports their mutual concerns for public safety while maintaining current testing capabilities (SNL 1997a, NMSLO 1997).

For a discussion of general future land use projects and developments in and adjacent to KAFB, see Chapter 6, Cumulative Effects Analysis.

4.3.2 Visual Resources

4.3.2.1 Definition of Resource

Visual resources encompass those aspects of an area that pertain to its appearance and to the manner in which it is viewed by people. This resource area provides a means to review the aesthetic qualities of natural landscapes and their modifications, associated perceptions and concerns of people, and the physical or visual relationships that influence the visibility of any proposed landscape modifications.

4.3.2.2 Region of Influence

The ROI is similar to that for land use (4.3.1.2). It consists of the geographic areas in and adjacent to KAFB where SNL/NM operations may influence the surrounding landscape and associated visual characteristics.

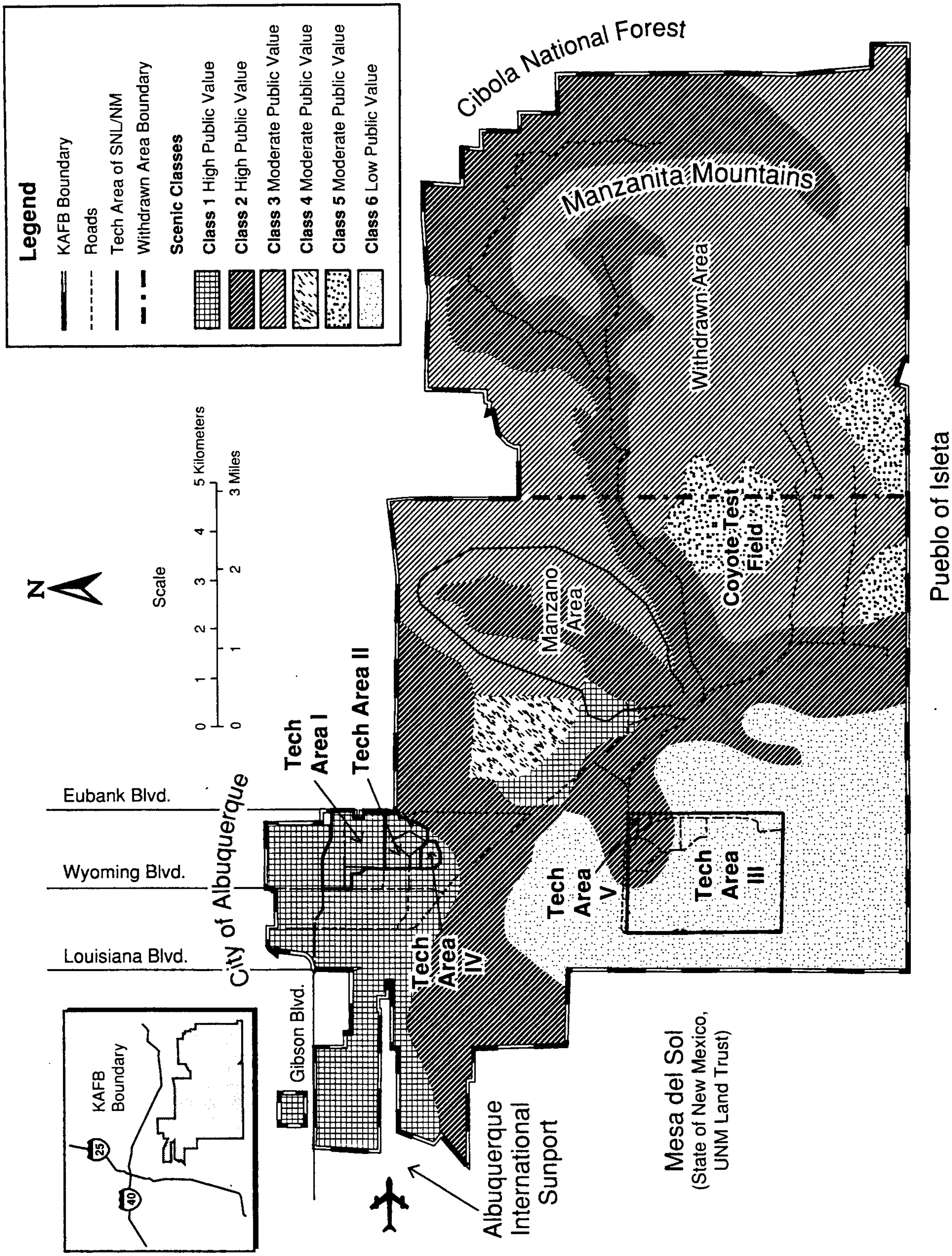
4.3.2.3 Affected Environment

The surrounding visual characteristics of SNL/NM consist of mostly flat, gently sloping grassland to the west and mountainous terrain to the east. Key landforms that dominate views in the general area include the Four Hills formation, the Manzanita Mountains, and the Manzano Mountains further south. From areas of Albuquerque nearest KAFB, views to the east and southeast are limited by the Four Hills formation and surrounding foothills of the Manzano Area. Views to the south partially consist of KAFB facilities, the Albuquerque International Sunport, and open rangeland. In general, the terrain features associated with the western portion of KAFB are not particularly distinctive. The eastern half, however, exhibits greater visual variety due to its mountain and canyon topography (SNL/NM 1997a). Most SNL/NM facilities are well within the KAFB boundary and away from public view. Because of their location and the surrounding terrain characteristics, most facilities are not visible from roads and areas with public access. Distant views of TA-I are possible from eastbound Interstate 40, but they are brief and show limited detail. Views from Interstate 25 consist of background landscapes only (SNL/NM 1997a).

Development is the most apparent modern alteration of the natural environment on KAFB affecting visual resources. Much of this activity is striking in nature and characterized by an urban setting with large buildings, extensive roadways, utility structures, parking lots, and other developed areas. The northwestern portion of KAFB, which includes SNL/NM TAs-I, -II and -IV, is the most populated and densely developed area that exemplifies these conditions. TAs-III and -V have a more limited and scattered development pattern, but similarly exhibit a variety of man-made modifications that affect the visual environment. The Coyote Test Field and particularly the Withdrawn Area are more sparsely developed. While early construction efforts throughout KAFB may not have specifically considered surrounding visual aesthetics, resulting in discordant assemblies of buildings and associated structures, recent development by both the USAF and the DOE includes facilities with designs and materials that are more visually compatible with the natural environment. In support of goals established to improve visual resources, SNL/NM has initiated Campus Design Guidelines, which contain a set of principles and detailed design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. They include guidance for building massing, facades, color palettes, building orientation and entries, circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. All new and modified facilities will be brought into compliance with these guidelines over time. These efforts have been endorsed by SNL/NM senior management and are administered through the Corporate Projects Department, the Sites Planning Department, and the Campus Development Committee (SNL 1997a).

Visual resource value ratings for aesthetics, called "scenic classes," have been developed for KAFB using the USFS Scenery Management System (Figure 4.3–8) (USFS 1995, SNL/NM 1997a). These scenic classes are based on evaluating landscape character and scenic attractiveness, as well as on the number of observers/users in the area. The latter generate concern levels that measure the degree of public importance on landscapes viewed from travelways and use areas. For the KAFB visual resource analysis, viewer input was obtained from SNL/NM personnel working throughout the area, as well as from public comments solicited during preparation of the Cibola National Forest environmental analysis (USFS 1996). The scenic classes are rated from 1 to 6, corresponding to a gradual range from highest public value (1) to lowest public value (6). The higher the public value, the more important it is to maintain the highest scenic value. This evaluation provides baseline information for assessing potential effects on scenery from proposed projects or other proposed landscape changes.

As shown in Figure 4.3–8, the majority of SNL/NM TAs and other facilities are in areas where the scenic class indicates high public value (scenic class 1 or 2). Although these locations represent areas where the landscape is not particularly distinctive and has been extensively modified by development, the scenic class is elevated by the large number of observers and users present who generate high levels of concern for scenery. On a practical level, this means that future development at SNL/NM should continue to include efforts, such as the Campus Design Guidelines described above, to improve visual resources. Remote facility locations, particularly in the southwestern corner of KAFB and most of TA-III, are in areas of lower scenic value due to a combination of reduced observer/user sensitivity levels, indistinct landscape features, and extensive development. Other areas of SNL/NM activity, such as the Coyote Test Field and the Withdrawn Area, are generally within scenic classes representing high-to-moderate public value due to the inherently distinctive, less developed, and attractive nature of the area.



Source: SNL/NM 1997a

Figure 4.3–8. KAFB Scenic Classes

The scenic classes on KAFB range from the highest public value (scenic class 1) to low public value (scenic class 6).

4.4 INFRASTRUCTURE

4.4.1 Definition of Resource

Infrastructure consists of buildings, services, maintenance, utilities, material storage, and transportation systems and corridors that support the operations of a facility. Specifically, SNL/NM's infrastructure consists of water, sanitary sewer, storm drain, steam, fossil fuels, chilled water, electrical transmission, electrical distribution, communications, roads, and parking that support TAs-I, -II, -III, -IV, and -V and other DOE facilities at KAFB (SNL 1997a). For a discussion of land use, see Section 4.3.

4.4.2 Region of Influence

The ROI for infrastructure mainly consists of assets used by SNL/NM within KAFB. KAFB includes the physical area that encompasses KAFB, lands owned by the DOE, lands owned by the USAF, and portions of the Cibola National Forest withdrawn from public entry by the USAF and the DOE.

SNL/NM relies primarily on KAFB for infrastructure support, including base security, roads, electrical distribution, water supply, and sewage. Table 4.4–1 presents information on the type of utilities and amounts used by SNL/NM and KAFB. Table 4.4–1 also identifies utility capacities.

4.4.3 Affected Environment

4.4.3.1 SNL/NM Buildings

Buildings within SNL/NM are listed by type and square footage in Table 4.4–2. Physical attributes such as construction type, gross square feet, and usage distinguish primary buildings.

4.4.3.2 SNL/NM Services and Maintenance

SNL/NM's management and operations (M&O) contractor is Lockheed Martin Corporation. Under the office of SNL/NM's President and Laboratory Director, the complex is organized into 11 divisions: Physical Sciences and Components; Weapon Systems; Human Resources; Laboratory Development; National Security Programs; Energy, Environment, and Information Technology; Laboratory Services; California Laboratory; Systems, Science, and Technology; Business, Management, and Chief Financial Officer; and Defense Programs Products and Services. Extensive descriptions of key programs and services are provided in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a).

SNL/NM has a maintenance program supported by appropriate *National Environmental Policy Act* (NEPA) review. Routine maintenance and upgrades currently underway or planned include the following:

Table 4.4–1. Utility Capacities and Quantities Used by SNL/NM and KAFB

UTILITY	USAGE				KAFB CAPACITY
	SNL/NM (1996)	% OF CAPACITY	OTHER KAFB (1996)	% OF CAPACITY	
Water	440 M gal	22.0	710 M gal	35.5	2 B gal
Wastewater	280 M gal	32.9	256 M gal	30.1	850 M gal
Electricity	197,000 MWh	18.0	307,000 MWh	28.0	1.1 M MWh[a]
Natural Gas[b]	580 M ft^3[c]	26.5	680 M ft^3	31.1	2.3 B ft^3
Fuel Oil	15,000 gal[c]	NA	Not reported	NA	Not limited by infrastructure
Propane	370,000 gal[c]	NA	Not reported	NA	Not limited by infrastructure

Sources: DOE 1997k, SNL 1997a, SNL/NM 1997b
B: billion
ft^3: cubic foot
gal: gallon
KAFB: Kirtland Air Force Base
M: million
MWh: megawatt-hour
NA: not applicable
SNL/NM: Sandia National Laboratories/New Mexico
[a] Based on 125-megawatt (MW) rating
[b] Estimate based on 60 pounds per square inch (psi)
[c] Quantities were not typical due to several factors including weather and boiler tests at the steam plant, and were not used as baseline quantities in Chapter 3 on Table 3.6–2 and Chapter 5 on Table 5.3.2–1.

Table 4.4–2. Summary of SNL/NM Buildings and Their Square Footage

SNL/NM BUILDING TYPES	NUMBER OF BUILDINGS	GROSS SQUARE FT (GSF)	% OF GSF	PARAMETERS
Primary Buildings	125	4,441,636	88	Buildings > 3,000 GSF Permanent, semi-permanent, or wood/steel construction; not leased space
Other Buildings	304	268,319	6	Nonprimary buildings < 3,000 GSF
Mobile Offices	180	200,530	4	Mobile offices < 3,000 GSF
Transportable Buildings	65	109,529	2	Transportable buildings < 3,000 GSF
TOTAL	**674**	**5,020,014**	**100**	

Source: SNL 1997a
<: less than
>: greater than
SNL/NM: Sandia National Laboratories/New Mexico

- cleaning, painting, repairing, renovating, and servicing buildings, equipment, vehicles, and utility infrastructure;
- maintaining and extending onsite roads, parking areas, and access control structures;
- replacing, upgrading, and maintaining equipment, tools, and components, such as computers, valves, pumps, filters, monitors, and equipment controls to preserve, improve, and extend the life of the infrastructure; and
- maintaining, replacing, and upgrading environment, safety, and health equipment, controls, and monitoring capabilities.

4.4.3.1 Roadways and Transportation Access

The general road network in KAFB is shown in Figure 4.4–1. Key roads include Interstates 25 and 40. Interstate 25 runs north-south and is approximately 1.5 mi west of the KAFB boundary at its nearest approach. Interstate 40 runs east-west through Albuquerque and is approximately 1 mi north of the KAFB boundary at its nearest approach.

Access to KAFB and SNL/NM consists of an urban road network maintained by the city of Albuquerque, the gates and roadways of KAFB, and SNL/NM-maintained roads. Traffic enters SNL/NM through three principal gates: Wyoming, Gibson, and Eubank. Most commercial traffic enters through the Eubank gate because it provides direct access to the SNL/NM shipping and receiving facilities located in TA-II. An additional entrance to KAFB, the Truman gate, serves KAFB's western areas.

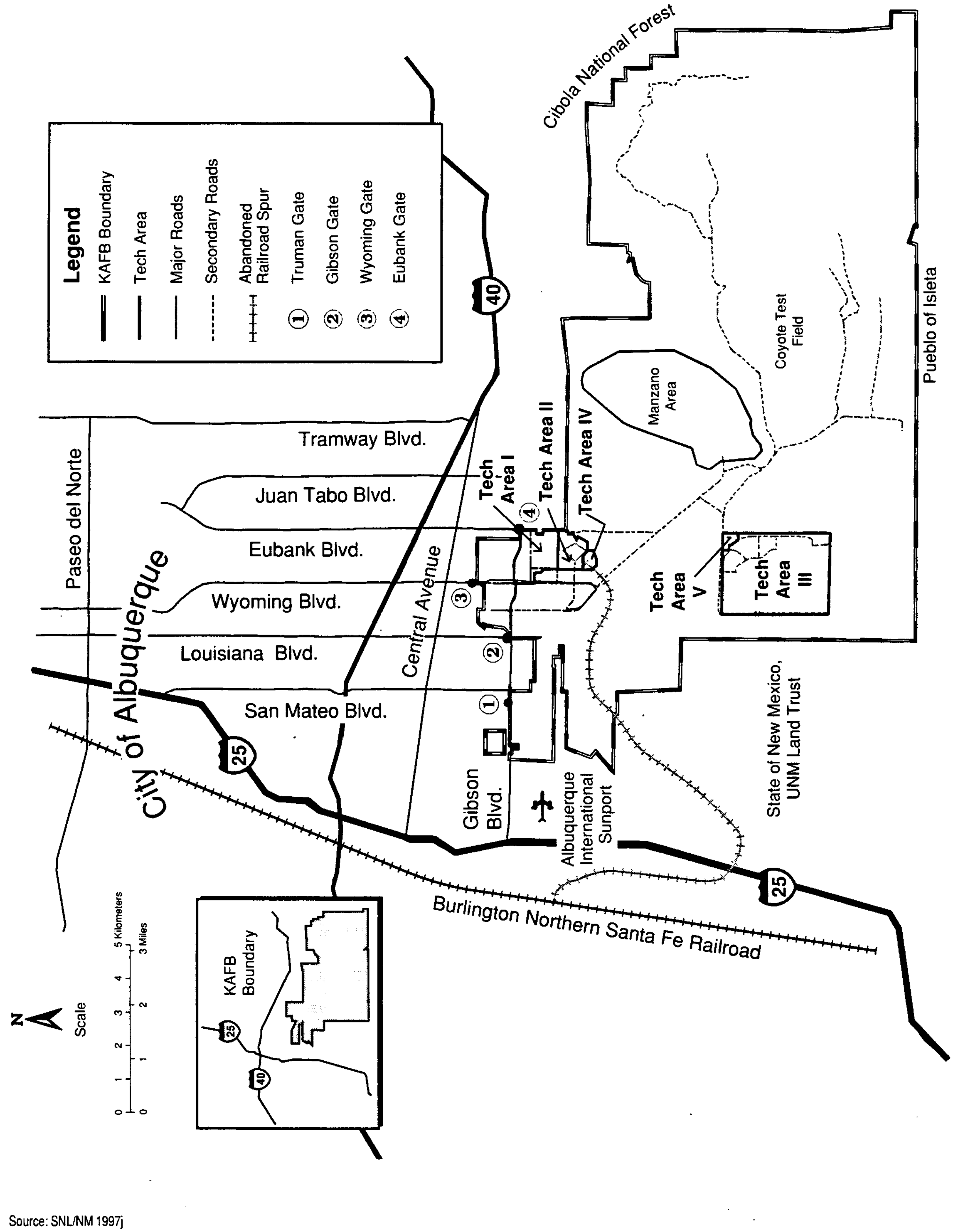
SNL/NM maintains approximately 20 mi of paved roads, 25 mi of unpaved roads, approximately 80 ac of paved service areas, and approximately 80 ac of paved parking (SNL 1997a). The roads near SNL/NM experience heavy traffic in the early morning and late afternoon. The principal contributors are SNL/NM staff and other civilian and military personnel commuting to and from KAFB. Survey estimates of employee-related traffic entering KAFB are between 10,000 to 13,500 SNL/NM and DOE commuters per day (SNL/NM 1997a). SNL/NM and DOE commuters represent approximately 36 percent of commuter traffic on KAFB (SNL 1997a). For a discussion of transportation-related issues such as traffic, see Section 4.11.

Rail facilities are not available on KAFB. The Burlington Northern & Santa Fe railroad discontinued its spur into KAFB in 1994. Land within KAFB, permitted to the DOE for the railroad right-of-way, has been returned to the USAF and demolition of the spur has begun.

Primary air service is provided for the entire region by the Albuquerque International Sunport, located immediately northwest of KAFB. Runways and other flight facilities are shared with KAFB.

4.4.3.2 Water

The water supply system consists of 85 mi of piping that, in 1996, provided 440 M gal of water (22 percent of KAFB capacity) for fire protection, industrial support of



Source: SNL/NM 1997j

Figure 4.4–1. General Area Road Network in KAFB

Access to SNL/NM consists of key roads, Interstates 25 and 40, and an urban road network maintained by the city of Albuquerque.

SNL/NM's research programs, and sanitary use (Table 4.4–1). The highest volume user is the Microelectronics Development Laboratory (MDL), which uses approximately 44 M gal of water per year for its activities. The second largest individual user (14.3 M gal per year) is the steam plant, supplying steam to SNL/NM and KAFB for space heating and laboratory processes (SNL 1998a).

KAFB owns and operates the water supply and distribution system, which includes the main booster pump station, storage reservoirs, and wells. Neither the existing water service from KAFB to SNL/NM, nor most major SNL/NM facilities are metered. The minimum pipeline size is dictated by the need for fire protection; sanitary and industrial use determine the size of service lines to specific facilities. For a discussion of water resources, see Section 4.6.

4.4.3.3 Sanitary Sewer

In 1996, the sewer system consisted of a 40-mi underground pipe network that discharged approximately 280 M gal per year (32.9 percent of KAFB capacity) of industrial and domestic wastewater (Table 4.4–1). Wastewater has leaked from underground sewer lines. Possible soil contamination associated with these leaks is being investigated and cleaned up as part of the SNL/NM Environmental Restoration (ER) Project. Sections 4.5 and 4.6 discuss ER Project activities.

4.4.3.4 Storm Drain

As part of its storm drain system, SNL/NM maintains approximately 15 mi of pipe and 2 mi of channel. KAFB experiences periodic thunderstorms accompanied by brief periods of intense rainfall. Approximately one-half of the system is designed to provide a means of storm water control to protect buildings, roads, and equipment from a 100-year storm event. The remaining half, which does not meet the current standard, has been assessed and upgrades, modifications, and repairs are currently underway in order to effectively control storm water throughout the facility and meet the 100-year storm event criteria. Existing drainage channels require continuous maintenance to correct erosion problems and remove weeds, sediment, and debris that inhibit proper flow (SNL 1997a).

4.4.3.5 Electrical Transmission and Distribution

SNL/NM maintains approximately 115 mi of electrical transmission/distribution lines. The electrical transmission system is a high-voltage (46-kV) overhead transmission system from the Public Service Company of New Mexico (PNM) to the various substations within SNL/NM. SNL/NM maintains the 26 master unit substations that distribute all its electrical power. The estimated monthly electric bill for the DOE, KAFB, and SNL/NM is $1.6 M. PNM provides power to SNL/NM through the Eubank substation, located east of SNL/NM. A second source of power from PNM is currently under construction south of TA-IV (SNL 1997a).

South of Tijeras Arroyo, KAFB owns and maintains the transmission lines that support SNL/NM facilities. The system has experienced outages to facilities in TAs-III, -IV, and -V and the Coyote Test Field. Improvements to the system are anticipated pending completion of an upgrade project (SNL 1997a). In 1996, SNL/NM used 197,000 MWh (18 percent of KAFB capacity) (Table 4.4–1).

4.4.3.6 Natural Gas

SNL/NM maintains 4.5 mi of gas line. Natural gas supplied by PNM is the primary heating fuel used at the steam plant. It is also supplied to self-contained boilers at facilities in TAs -I, -II, and -IV, which are not on the steam distribution system. Laboratories also use natural gas in many of the buildings for heating and experiments. SNL/NM uses approximately 580 M ft^3 per year (26.5 percent of system capacity). Diesel fuel is used as an emergency backup during natural gas pressure interruptions. SNL/NM uses 370,000 gal of propane per year in TAs-III and -V and in other remote locations (SNL 1997a). Natural gas and propane use in 1996 was not considered typical due to several factors, including weather and tests associated with the steam plant. However, the recent completion of a natural gas line into the area is expected to significantly reduce the demand for propane, while increasing use of natural gas.

The source of natural gas to KAFB and the SNL/NM central steam plant is a high-pressure line that enters KAFB near the intersection of Pennsylvania Avenue and Gibson Boulevard. The reliability of the line may be questionable, since it has been damaged in the past. Two low-pressure gas isolation valves allow restoration of service if the primary distribution line becomes damaged. The internal low-pressure gas system is a dual loop throughout the TAs that provides a backup source if a portion of the line becomes temporarily disabled. This distribution system is made of steel pipe and requires protection to prevent corrosion. Recent projects have upgraded the steel pipelines, replaced building gas valves, and replaced many of the steel lines with polyethylene pipe, thus eliminating the need for previously required protection measures (SNL 1997a).

4.4.3.7 Steam/Chilled Water

The purpose of the steam system is to provide heat for buildings and hot water for sanitary use. It is also used to provide humidity in a limited number of buildings and chilled water through absorption chillers. The steam plant supplies an average of 1.5 M lbs per day of saturated steam for space heating in TA-I and the eastern portion of KAFB (SNL/NM 1997b). SNL/NM maintains 14 mi of piping for steam and 1 mi of piping for chilled water.

4.4.3.8 Communications

SNL/NM maintains 2,900 mi of communication lines. Surveys indicate that the system may be nearing capacity; however, system upgrades are meeting the current demand for data links (SNL 1997a).

4.4.3.9 Selected Infrastructure Facilities

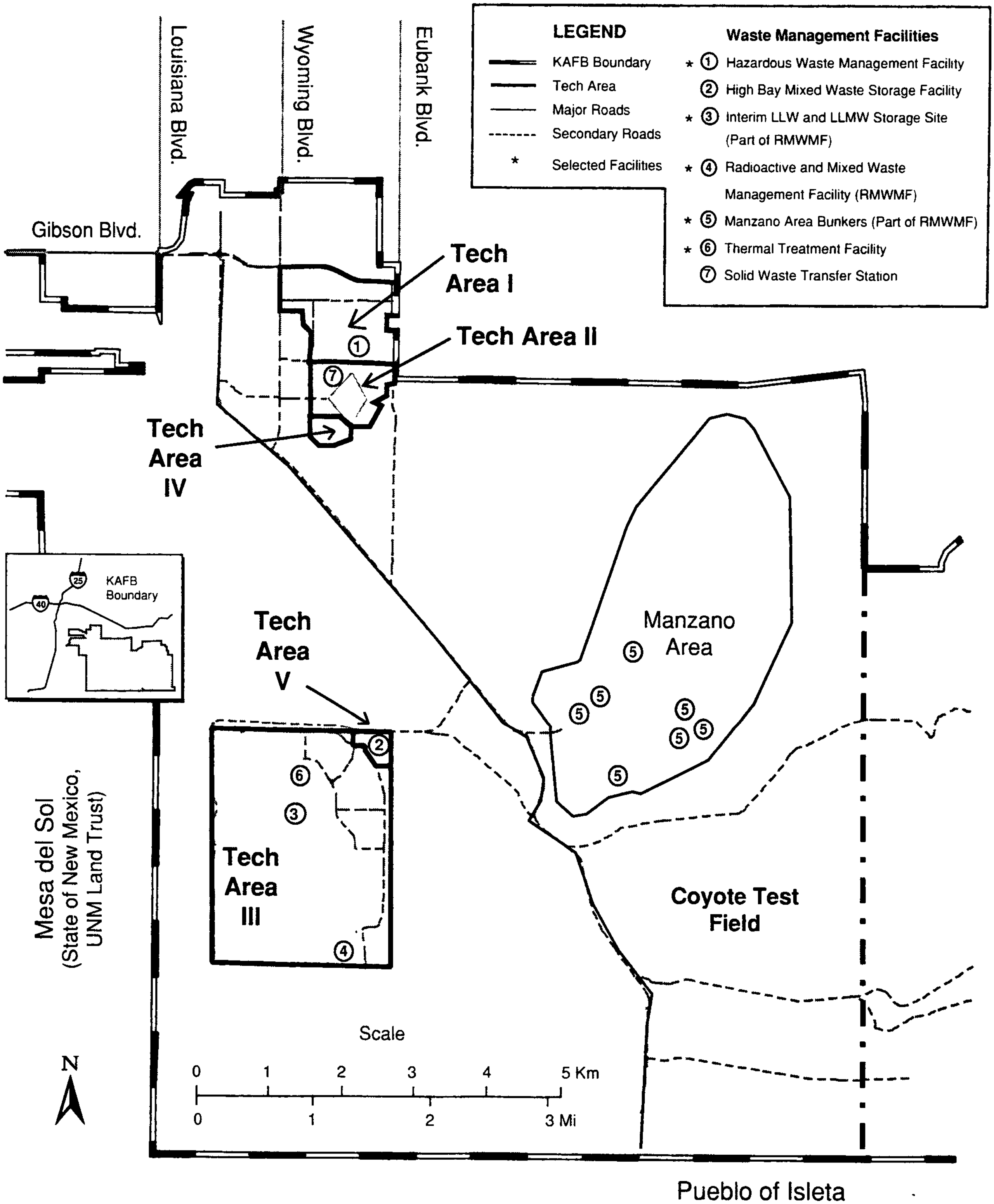
The steam plant, Radioactive and Mixed Waste Management Facility (RMWMF), Thermal Treatment Facility (TTF), and Hazardous Waste Management Facility (HWMF) were identified as representative facilities that provide infrastructure support services. For a discussion of the facility screening process, see Section 2.3. Steam plant functions are discussed in the Facility Descriptions that follow Chapter 2.

The three remaining facilities are waste management facilities. The facilities vary in size, capacity, and scope of operation, depending on the waste type for which they are designed. SNL/NM manages low-level waste (LLW,) low-level mixed waste (LLMW), transuranic (TRU) waste, mixed transuranic (MTRU) waste, and hazardous waste. Descriptions of these wastes and associated management facilities are provided in Section 4.12. Figure 4.4–2 shows the locations of the three selected waste management facilities and four additional waste management facilities on SNL/NM.

4.4.3.10 Material Storage and Inventory

SNL/NM stores and manages a wide variety of hazardous and nonhazardous materials. Hazardous materials include radioactive materials; chemicals including solvents, acids, bases, and specialty gases; explosives and explosive containing materials; and fuels. Nonhazardous materials include plastics, metals, certain solvents, certain oils like mineral oil, and simple office materials like paper. For a detailed discussion of SNL/NM material management see *SNL/NM Environmental Information Document* (SNL/NM 1997a).

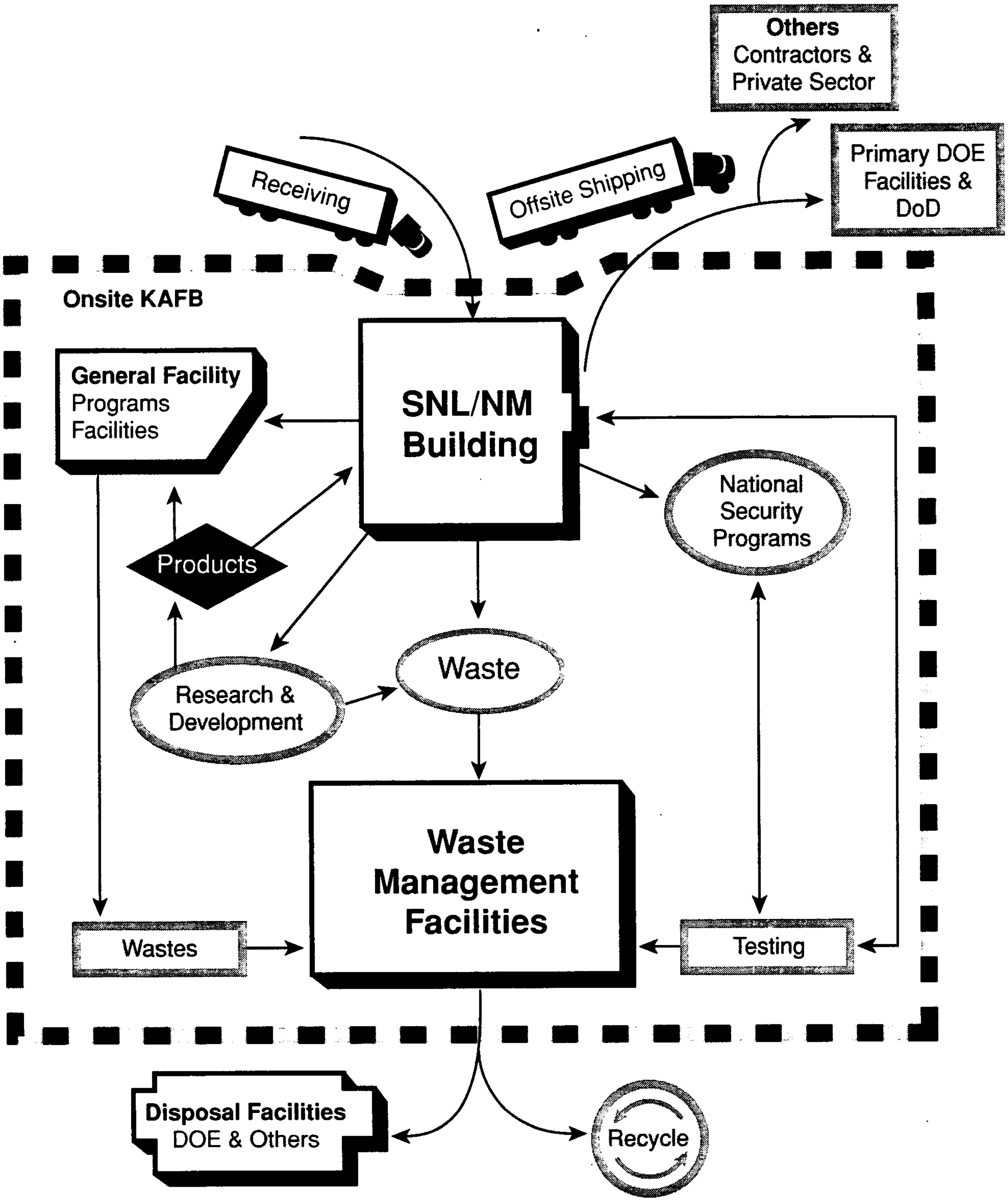
Figure 4.4–3 illustrates conceptually how materials move at SNL/NM. For details regarding material inventories used for analysis in the SWEIS, see Appendix A. The material inventories and SNL/NM databases were used to analyze potential air quality impacts, human health impacts including accidents, and transportation requirements (see Sections 4.9, 4.10, and 4.11, respectively).



Source: SNL/NM 1997j, 1998ee

Figure 4.4–2. Waste Management Facilities

SNL/NM manages a variety of waste through seven facilities located throughout SNL/NM.



Source: SNL/NM 1997j

Figure 4.4-3. Conceptual Illustration of Material Movement at SNL/NM

SNL/NM receives materials that are then distributed to testing, research and development, and other facilities.

4.5 GEOLOGY AND SOILS

4.5.1 Definition of Resource

The discussion of geology and soils includes seismology, slope stability, and soil contamination. Seismology refers to the geology below the soil layer that is relevant to the occurrence, frequency, and magnitude of earthquakes. Slope stability generally focuses on the stability of the soil layer. For the purpose of this SWEIS, soils include natural material at the ground surface extending to a depth that construction activities could reasonably disturb (20 to 30 ft).

4.5.2 Region of Influence

The main concern of seismic activity and slope stability is their effect on onsite facilities, specifically, whether damage from earthquakes or slope failures could result in a contaminant release. The ROI would, therefore, be the extent of environmental or human health effects from such a release. Offsite impacts from these and other accidental releases are addressed in Sections 5.3.8.2, 5.4.8.2, and 5.5.8.2.

Potential soil contamination effects would result from exposure at or near the contaminated area. Thus, the ROI is limited to KAFB. Potential migration of soil contaminants into groundwater or surface water is addressed in Sections 4.6.1.3 and 4.6.2.3.

4.5.3 Affected Environment

4.5.3.1 Seismology

SNL/NM straddles the eastern boundary of the 30-mi-wide Albuquerque-Belen Basin, about midway along its north-south trending length of about 90 mi (Figure 4.5–1). The city of Albuquerque is in a region expected to experience moderate earthquakes that could result in damage to buildings, depending on the quality of construction (SNL/NM 1997a). Since 1966, New Mexico has experienced four moderate earthquakes, all approximately 5.0 on the Richter scale. Two of these were in Dulce (near the Colorado border in north-central New Mexico), one was in Gallup (near the Arizona border in west-central New Mexico), and one was in Eunice (extreme southeast corner of New Mexico, near the Texas border). The Dulce and Gallup earthquakes were the closest to SNL/NM, all approximately 125 mi away. The largest shock predicted in New Mexico in a 100-year period would have a magnitude of 6.0 on the Richter scale (SNL/NM 1997a). The Richter scale does not measure damage. Damage is dependent upon several factors, including duration of the event, type of movement, facility design, and construction materials and practices.

A number of regional faults (Sandia, West Sandia, Manzano, Hubbell Springs, Tijeras, and Coyote) intersect within KAFB (Figure 4.5–2). There is no evidence of movement along these faults over the last 10,000 years (SNL/NM 1997a).

In the Albuquerque area, the largest magnitude earthquake of the century, a recorded magnitude 4.7 on the Richter scale, occurred on January 4, 1971. SNL/NM buildings did not receive any appreciable damage. A survey after the event noted cracks in some SNL/NM buildings, but the cracks could have predated the earthquake (SNL/NM 1997a).

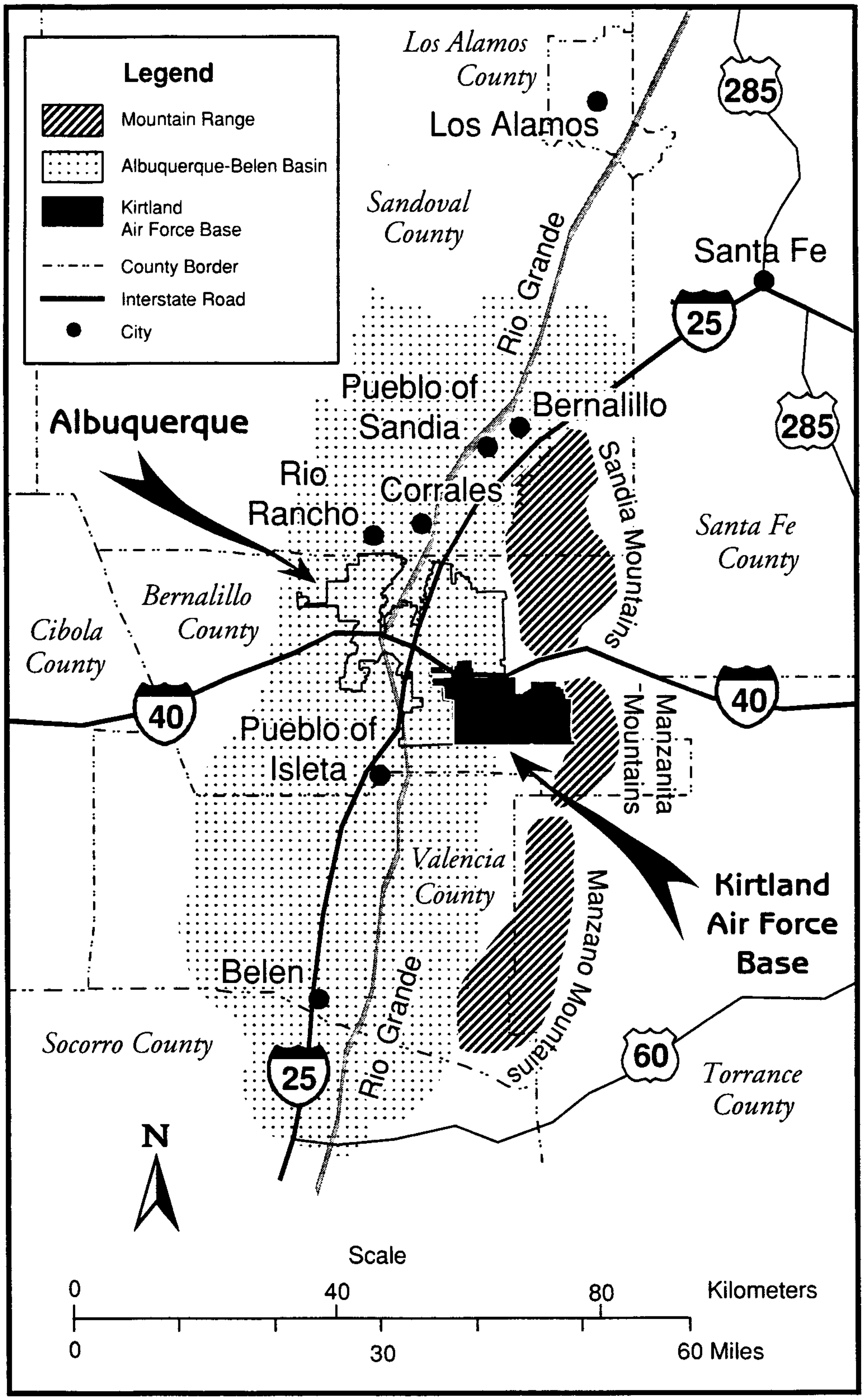
4.5.3.2 Slope Stability

Most SNL/NM facilities are constructed on level ground or gentle slopes. These areas are composed of alluvial fan sediments that slope westward toward the Rio Grande. Steeper slopes occur along the arroyos (particularly where channel erosion occurs during periods of storm runoff) and in the Manzanita Mountains. Facilities near slopes are those that border the Tijeras Arroyo at the southern edge of TA-IV, including Building 970 and parking areas, and the ECF, Building 905, in TA-II. Similarly, there are only two SNL/NM facilities in the Manzanita Mountains—the Lurance Canyon Burn Site and the Aerial Cable Facility. The Manzanita Mountains are predominantly Precambrian crystalline and Paleozoic marine carbonate bedrock and are not prone to landslides. To date, no SNL/NM facility has been affected by slope instability.

4.5.3.3 Soil Contamination

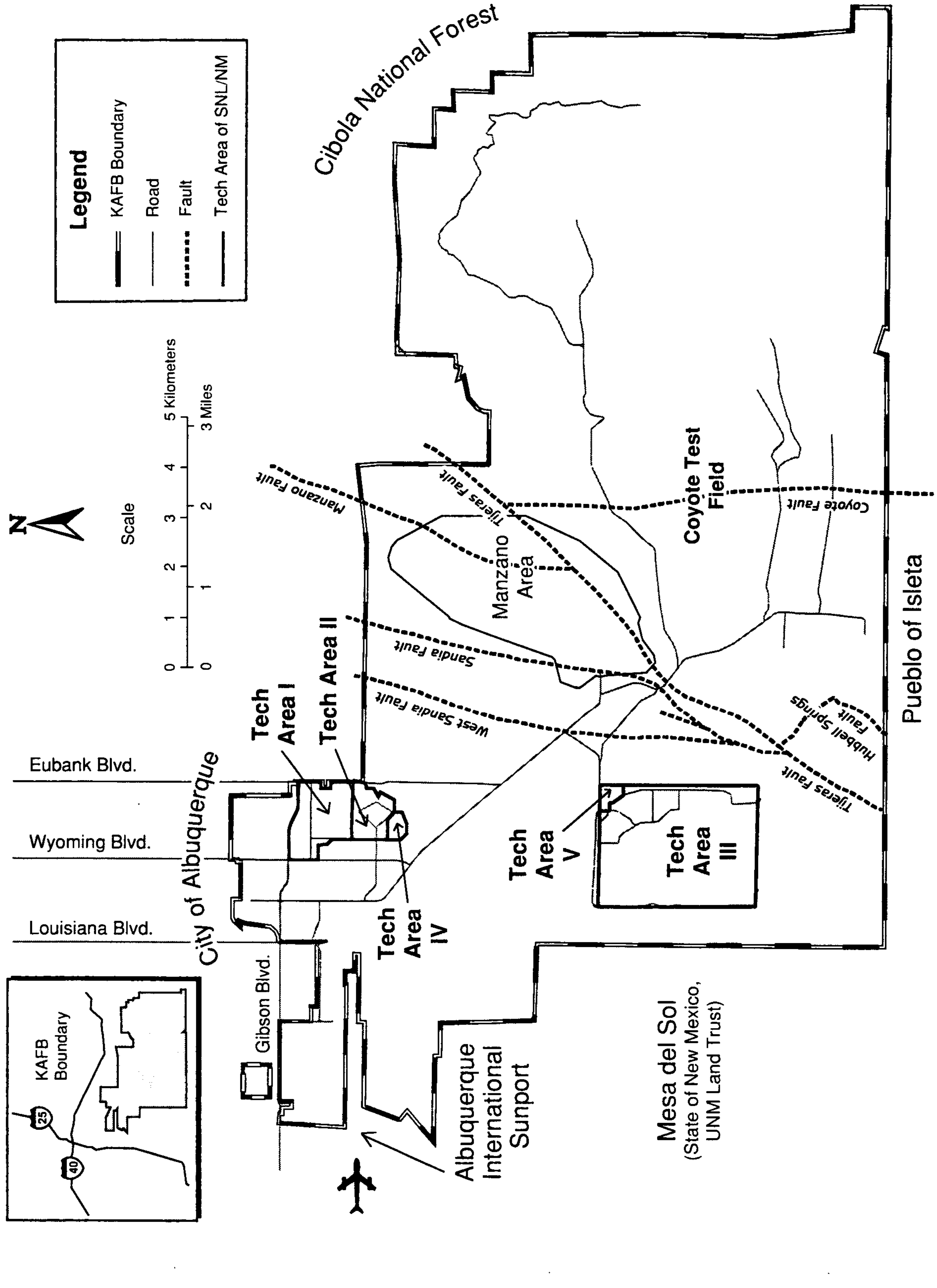
Soils at SNL/NM are derived primarily from eroded bedrock in the Manzanita Mountains that was transported downslope by water. Soil layers formed by these sediments tend to be discontinuous. The chemical composition of these soils reflect the composition of the source bedrock, and soils at SNL/NM frequently have high naturally occurring (background) concentrations of the metals arsenic, beryllium, and manganese (SNL/NM 1996e).

As a result of past SNL/NM activities, soil contamination exists or may exist at a number of locations at KAFB, although most sites are less than 1 ac in size



Sources: SNL/NM 1997j, USGS 1995

Figure 4.5–1. Location and Extent of the Albuquerque-Belen Basin
SNL/NM is located along the eastern edge of the Albuquerque-Belen Basin.



Sources: SNL/NM 1997a, 1997j

Figure 4.5–2. Regional Faults at KAFB

Six regional faults intersect KAFB.

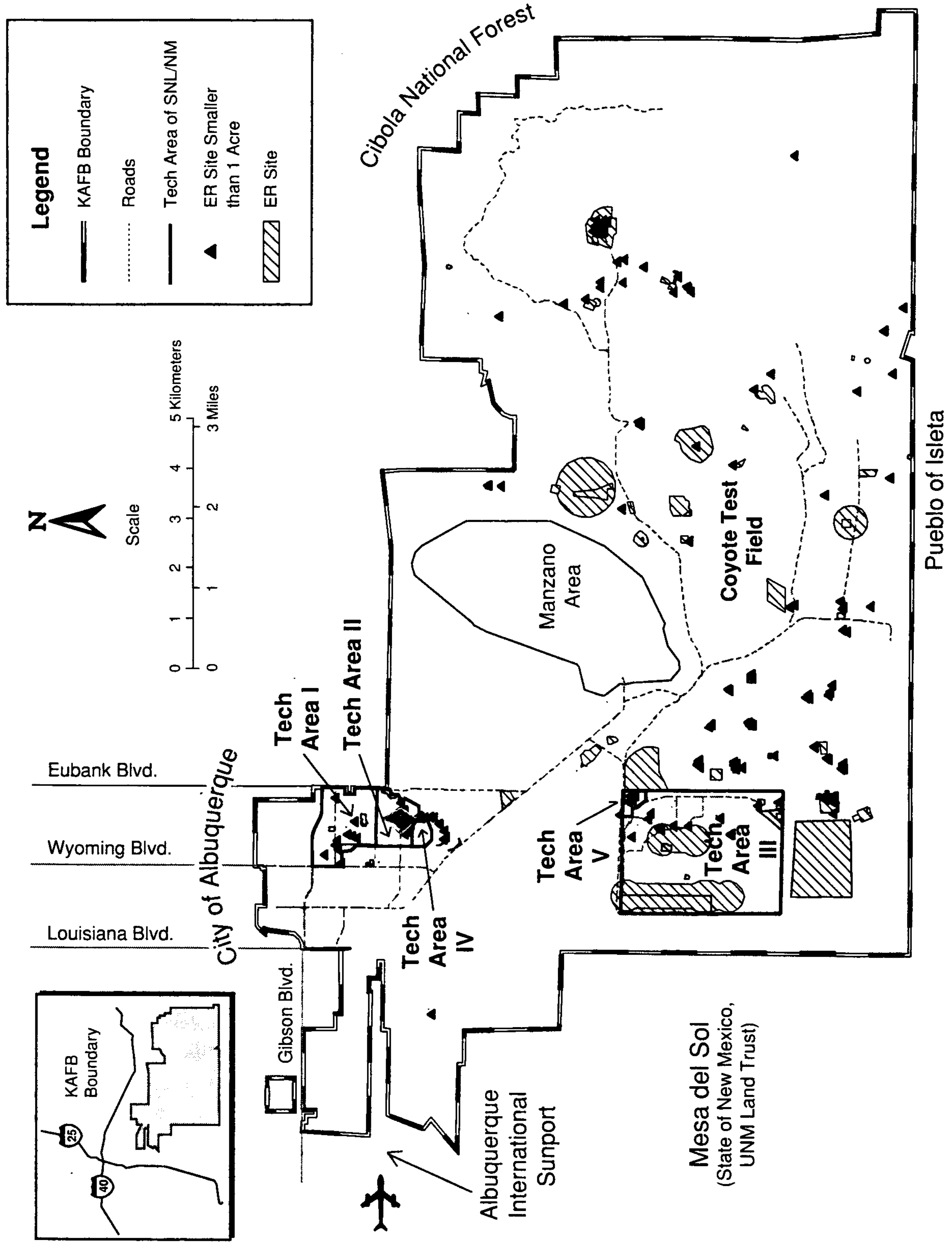
(Figure 4.5–3). Cleanup of these contaminated sites is regulated under RCRA. SNL/NM investigates and remediates these sites through the ER Project. Under the ER Project, potentially contaminated sites go through an investigative process that includes identification, sampling, and, if necessary, remediation. SNL/NM proposes no further action at sites that do not have contamination or that have concentrations of contaminants that pose no appreciable risk to human health or the environment. The state of New Mexico has the authority to approve or reject "no further action" proposals. As of August 1998, 182 sites had been identified, with 122 proposed as "no further action" to the NMED

Further, of the 182 sites identified under the ER Project, 47 are within 0.5 mi of a major surface water drainage, either Tijeras Arroyo or Arroyo del Coyote (DOE 1996c). Of these, 39 were proposed by SNL/NM for no further action, either because confirmatory soil sampling failed to show the presence of contamination or contaminants in soil were present in low concentrations.

Sites that pose a potential risk to human health and the environment will undergo some type of remediation, often the removal of contaminated soil. Some residual contamination may remain at these sites, but at concentrations presenting little or no human-health risk. Immediate risks to human health are addressed through short-term measures, such as restricting site access or covering contaminated soil with tarps or commercially available dust suppression products that reduce the chance of airborne soil particles (DOE 1996c). Monitoring near ER Project sites indicates that exposure to dust particles is not a significant transport pathway for radioisotopes (Section 4.1) (SNL 1996a). The ER Project is scheduled for completion between Fiscal Year (FY) 2003 and FY 2005.

Soil contamination also exists at some active SNL/NM outdoor test facilities. In the past decade, environmental controls on testing have reduced the concentrations or extent of additional soil contamination. The ER Project addresses soil contamination resulting from past testing (DOE 1996c). Most of the soil contamination at these active sites is shallow surface contamination stemming from the explosion, destruction, or burning of tested devices containing hazardous material. The primary contaminants at these active sites are depleted uranium (DU) and lead.

SNL/NM actively performs environmental soil monitoring on and near KAFB to confirm the effectiveness of control systems in place at the various TAs. Soil samples are collected twice annually from 50 locations: 31 onsite, 13 at the site perimeter, and 6 offsite (SNL 1997d). Samples are analyzed for common radionuclides and metals, with analytical results compared to naturally occurring concentrations. For 1996, most soil monitoring results showed no difference from naturally occurring concentrations. However, three onsite locations had higher-than-background soil concentrations of tritium (averaging 20.13 pCi/ml versus 0.24 pCi/ml offsite), which were associated with identified ER Project sites in controlled areas (SNL 1996a, 1997d). Excluding these three locations, onsite tritium concentrations averaged 0.72 pCi/ml (SNL 1997d).



Source: SNL/NM 1997j

Figure 4.5–3. Locations of SNL/NM Environmental Restoration Sites

One hundred eighty-two sites have been identified for investigation and potential remediation under the SNL/NM Environmental Restoration Project.

4.6 WATER RESOURCES AND HYDROLOGY

4.6.1 Groundwater

4.6.1.1 Definition of Resource

Groundwater in the KAFB area occurs within saturated unconsolidated geologic material and fractured and porous bedrock. Aquifers are subsurface layers of rock or unconsolidated material that are capable of yielding usable amounts of water to wells or springs.

4.6.1.2 Region of Influence

The groundwater beneath the western portion of KAFB is part of an interconnected series of water-bearing geologic units within the Albuquerque Basin that form the Albuquerque-Belen Basin aquifer (Figure 4.5–1). Groundwater beneath the eastern portion of KAFB occurs in limited quantities in fractured bedrock. The Albuquerque-Belen Basin aquifer and the bedrock aquifer in the eastern portion of KAFB define the ROI.

4.6.1.3 Affected Environment

The principal sedimentary fill of the Albuquerque-Belen Basin is the Santa Fe Group, consisting of gravels, sands, silts, and clays (Figure 4.6–1). The local (SNL/NM area) groundwater system has three hydrogeologic regions (HRs), which are delineated by their locations in relation to the geologic fault system that bisects KAFB (Figure 4.6–2).

HR-1, within which the SNL/NM TAs are located, is to the west of the fault system. It consists of thick unconsolidated sedimentary deposits overlying bedrock. The Albuquerque-Belen Basin aquifer occurs in this unit of unconsolidated sediments and is the source of Albuquerque's municipal water. Groundwater flow is generally north to northwest in the northwestern portion of KAFB where TAs-I, -II, and -IV are located (Figure 4.6–2). Hydraulic conductivities range from less than 0.1 ft to more than 100 ft per day. The depth of the unsaturated zone, from ground surface to the aquifer, increases toward the west and is approximately 500 ft at the western edge of KAFB.

HR-2 straddles the Sandia/Tijeras/Hubbell Springs fault system. This region is a transition between the unconsolidated sedimentary character of HR-1 and the bedrock-dominated character of HR-3. Hydraulic conductivities are highly variable, ranging from 0.003 ft per day in bedrock to near 150 ft per day in alluvial material. Depth to groundwater is also highly variable, ranging from 500 ft near the southeast corner of TA-III to near zero ft along the Arroyo del Coyote south of the Manzano Area (Figure 4.6–2). The eastern portion of KAFB, which includes the Coyote Test Field and the Withdrawn Area, is within HR-2 and HR-3.

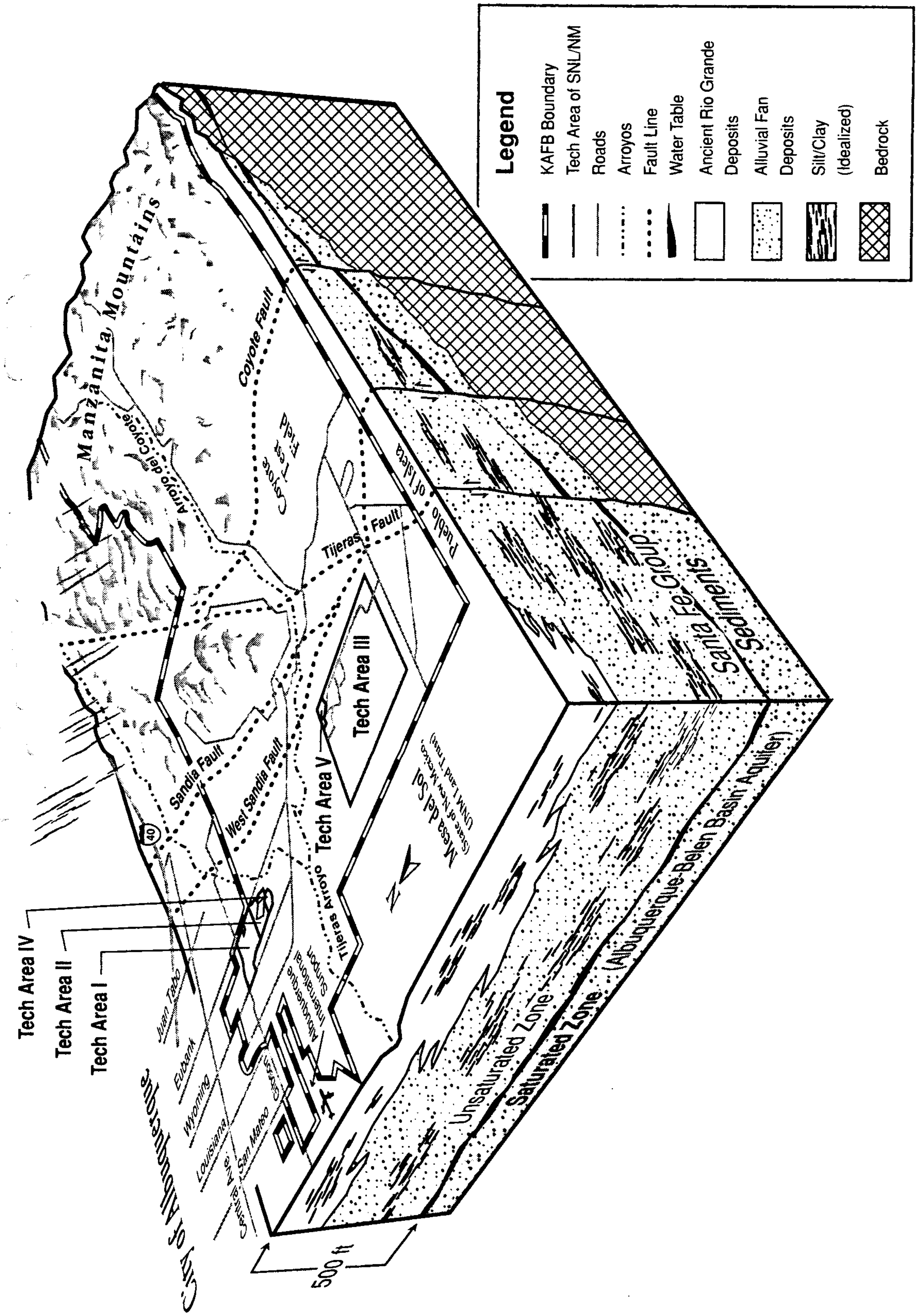
HR-3 is characterized by its bedrock aquifers, although in some places a thin layer of groundwater-containing alluvial material overlies the bedrock. Depth to groundwater in HR-3 varies from 150 ft near the Hubbell Springs Fault to near zero ft along portions of Arroyo del Coyote (SNL/NM 1997a). The depth to groundwater may exceed 150 ft in mountainous areas, but data are limited.

Groundwater Quality

A network of monitoring wells is used to collect samples for characterizing baseline water chemistry and groundwater contamination (Figure 4.6–3). This network is part of an active environmental monitoring program covering groundwater, surface water, and air (SNL 1995c, 1996a).

The groundwater beneath SNL/NM and adjacent areas is the source of drinking water for SNL/NM, KAFB, and adjacent portions of the city of Albuquerque and the Pueblo of Isleta. The local groundwater is also used for irrigation and industry. Federal and state water quality standards are based on the type of water use (for example, drinking, irrigation, or recreation). Maximum contaminant levels (MCLs) are based on the National Primary Drinking Water Regulations. The New Mexico Water Quality Control Commission (NMWQCC) has established maximum allowable concentrations for some substances for which no Federal MCLs have been established (NMWQCC 1994).

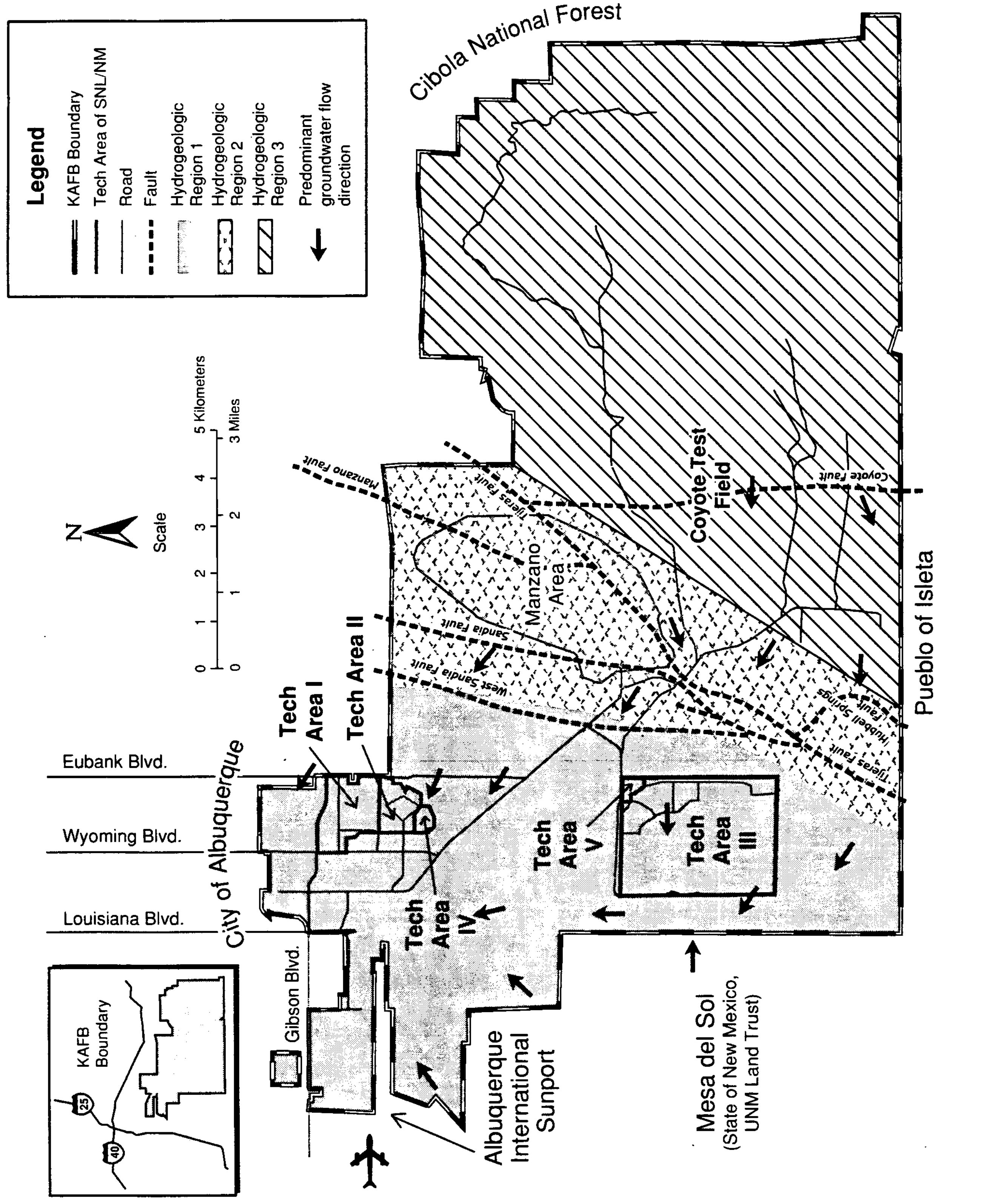
Groundwater quality can be influenced by the presence of contaminants in the soil column above the groundwater, as well as in the groundwater itself. These influences are of major concern to the SNL/NM ER Project, which is investigating the nature and extent of groundwater contamination from past activities at SNL/NM sites. All known groundwater contamination is the result of past waste management activities that occurred before the enactment of such laws as the *Resource Conservation and Recovery Act* (RCRA), the *Toxic Substances Control Act* (TSCA), and the *Clean Water Act* (CWA).



Source: Original

Figure 4.6–1. Conceptual Diagram of Groundwater System Underlying KAFB

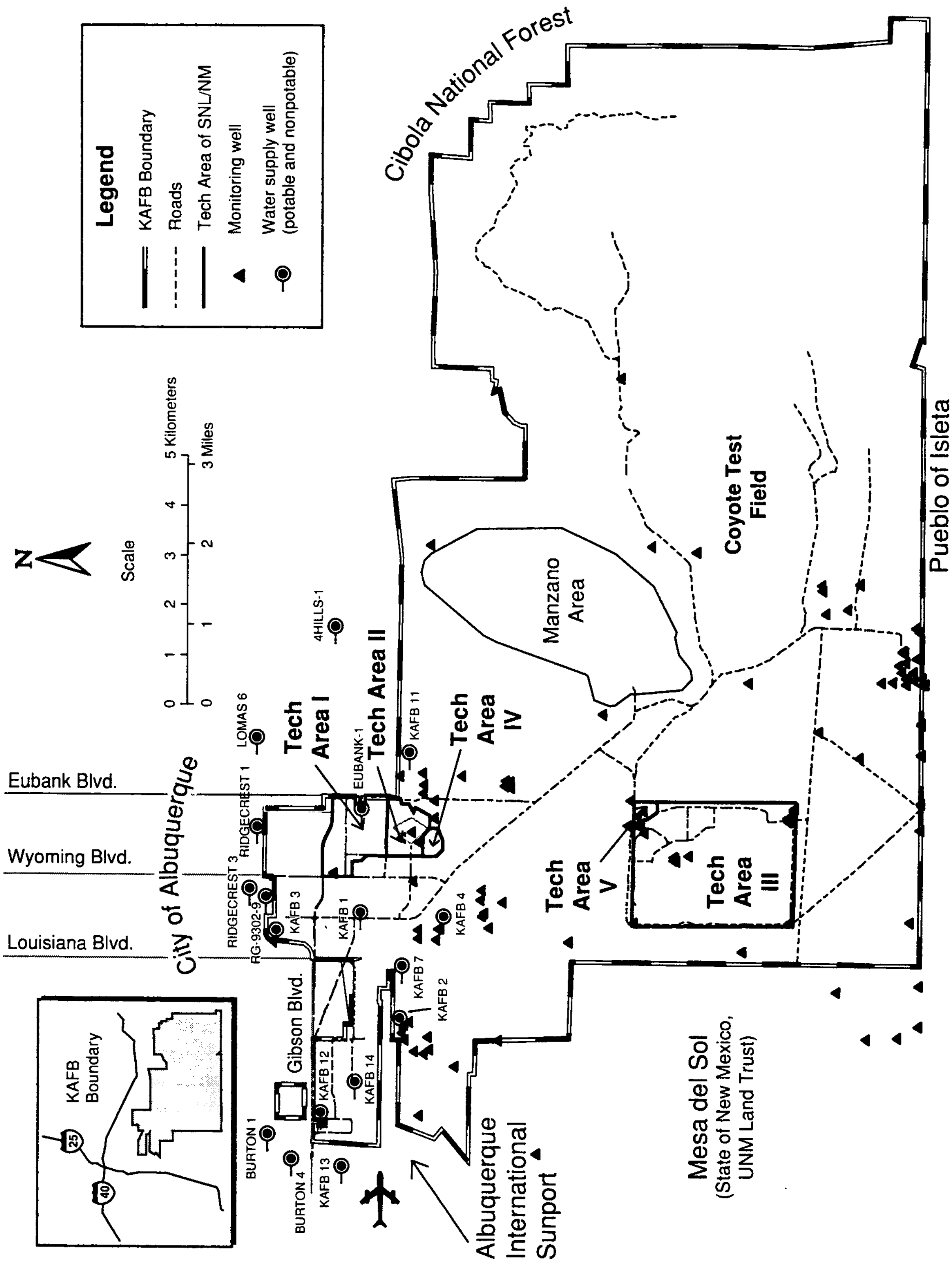
Santa Fe Group alluvial sediments and groundwater underlie KAFB.



Source: SNL/NM 1997j

Figure 4.6–2. Locations of Hydrogeologic Regions at KAFB

The SNL/NM area groundwater system has three hydrogeologic regions.



Source: SNL/NM 1997j

Figure 4.6–3. Locations of Groundwater Monitoring and Supply Wells

A network of monitoring wells is used to collect samples for environmental monitoring.

Locations of Potential or Known Groundwater Contamination

Sites with potential or known groundwater contamination at SNL/NM are Sandia North (an ER Project designation for groundwater investigations of sites in TA-I and TA-II), the Mixed Waste Landfill (MWL), locations in TA-V, Lurance Canyon Burn Site, and the Chemical Waste Landfill (CWL) (SNL 1997d) (Figure 4.6–4). Measurements indicate that some contaminants at some of these sites exceed MCLs (40 *Code of Federal Regulations* [CFR] Part 141) (Table 4.6–1). Investigation or remediation of these sites is ongoing as part of the ER Project.

Sandia North

Sandia North is a 1.2-mi^2 area located in the northern part of KAFB. It encompasses TA-I and TA-II and includes approximately 40 environmental restoration sites. Underlying the Sandia North area are shallow, perched (not connected with the regional Albuquerque-Belen Basin aquifer) water-bearing zones, with a gradient toward the southeast, and deep regional groundwater (approximately 500 ft deep) that flows generally to the northwest and north. Some city of Albuquerque and KAFB production wells are located within 1 mi of the Sandia North area. Trichloroethene (TCE) and nitrates have been detected in both the deep and shallow groundwater beneath the Sandia North area. Since 1993, six shallow and three deep wells have been used to monitor groundwater in the Sandia North area. TCE and nitrates have been detected repeatedly in some of these wells. TCE has been detected at nearly three times the MCL in a deep aquifer monitoring well; nitrate has been detected at nearly three times the MCL in a shallow monitoring well (Table 4.6–1).

An investigation plan is being implemented to characterize the sources and site hydrogeology (SNL/NM 1998bb). The sources of the TCE and nitrate have not been determined. Possible explanations include multiple sources among the SNL/NM environmental restoration sites located in this area or nearby private landfills not associated with SNL/NM.

Mixed Waste Landfill

The MWL was established in 1959 for the disposal of radioactive and mixed wastes. The landfill, inactive since 1988, is located in the north-central part of TA-III and encompasses approximately 2.6 ac. Uranium, thorium, transuranics, fission products, and tritium were disposed of in the landfill. Tritium has been detected in soils below and outside the perimeter of the MWL.

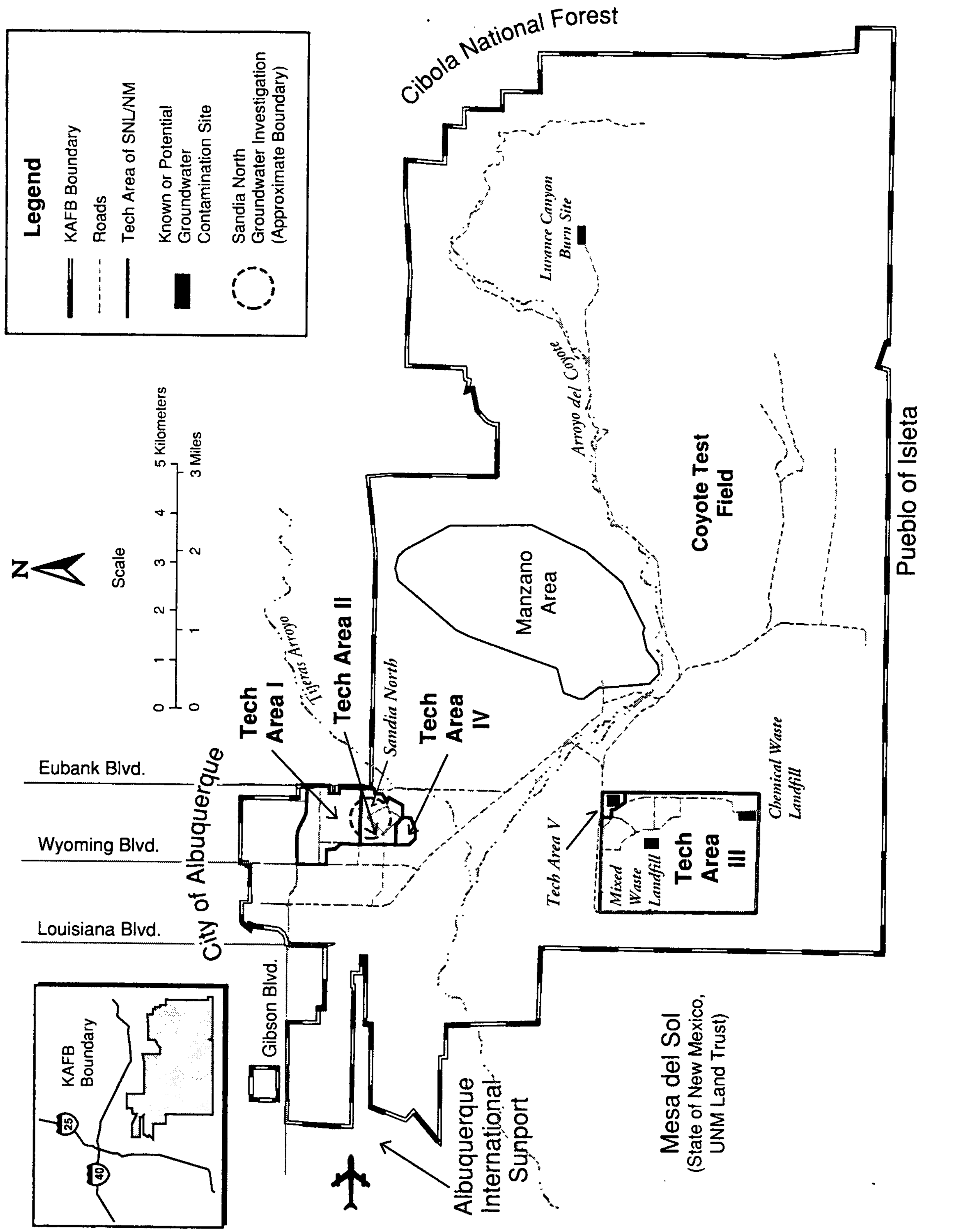
The regional water table at the MWL occurs at a depth of approximately 460 ft. No evidence of groundwater contamination has been detected at the landfill since September 1990 in 21 rounds of sampling. Nickel has been measured in one monitoring well at a concentration (0.145 mg/L) above the 0.1-mg/L MCL. The concentrations of nickel in groundwater samples at this well are attributed to dissolution of the stainless-steel well screen (SNL 1997d). Such dissolution is a well-known phenomenon (Hewitt 1992, Oakley and Korte 1996), with these concentrations confined to water within or immediately surrounding the well (not characteristic of concentrations in the aquifer). Monitoring of nickel concentrations continues at this location. SNL/NM has removed broken and subsided concrete caps at the MWL to reduce the possibility of ponding water infiltrating underlying wastes. The waste pits where the concrete caps were removed were backfilled with soil to ground surface to promote precipitation runoff. Site remediation is projected to be completed in 2001.

TA-V

The TA-V area contains nine monitoring wells, including those that monitor the Liquid Waste Disposal System (LWDS) site. During 1996, TCE was present at levels of about 3 to 4 times the 0.005-mg/L MCL at one LWDS well. TCE has been detected in several wells at concentrations below the MCL. It is believed that the TCE is reaching groundwater via aqueous phase transport. The likely source of the TCE is approximately 6.4 M gal of wastewater released to the LWDS drainfield from 1963 to 1967. In 1996, nitrate concentrations as high as 12 mg/L (versus an MCL of 10 mg/L) were found in samples at two wells, including the LWDS well (SNL 1997d). The probable sources of the nitrates are septic tanks and leachfields; these systems have been closed and waste and contamination from these sites have been removed.

Lurance Canyon Burn Site

The Lurance Canyon Burn Site is located in the eastern part of KAFB in a canyon in the Manzanita Mountains. This site was used in the 1970s for testing high explosives. Today it is used to test the effects of fire on weapons components and equipment. Nitrates have been consistently found in a production well used to supply fire-control water to the Burn Site, at concentrations



Sources: SNL 1997d, SNL/NM 1997j

Figure 4.6–4. SNL/NM Known or Potential Groundwater Contamination Sites

Sites with potential for or that have known groundwater contamination are located at TAs-I, -II, -III, and -V and the Coyote Test Field.

Table 4.6–1. Maximum Recorded Levels of Suspected Groundwater Contamination at SNL/NM

SITE	CONTAMINANTS	MAX MEASURED CONCENTRATIONS	MCL
Sandia North (TA-I and TA-II)	TCE	0.014 mg/L	0.005 mg/L
	Nitrate[a]	29 mg/L	10 mg/L
TA-V	TCE	0.023 mg/L	0.005 mg/L
	Nitrate[a]	13.1 mg/L	10 mg/L
Chemical Waste Landfill	TCE	0.026 mg/L	0.005 mg/L
Lurance Canyon Burn Site	Ethylbenzene	0.0037 mg/L	0.750 mg/L
	Toluene	0.055 mg/L	0.750 mg/L
	Xylenes (total)	0.019 mg/L	0.620 mg/L

Sources: 40 CFR Part 141; DOE 1996c; SNL 1997d; SNL/NM 1996z, 1998hh
MCL: maximum contaminant level
mg/L: milligram per liter
TA: technical area
TCE: trichloroethene
[a] All nitrate concentrations are as nitrogen.

ranging from 8 to 27 mg/L, near or above the 10-mg/L MCL (SNL 1997d). A recently installed downgradient monitoring well shows the presence of nitrates and low levels (below MCLs) of toluene, ethylbenzene, and xylenes, which are components of petroleum hydrocarbons. An ongoing investigation will identify the sources of nitrates and other contaminants.

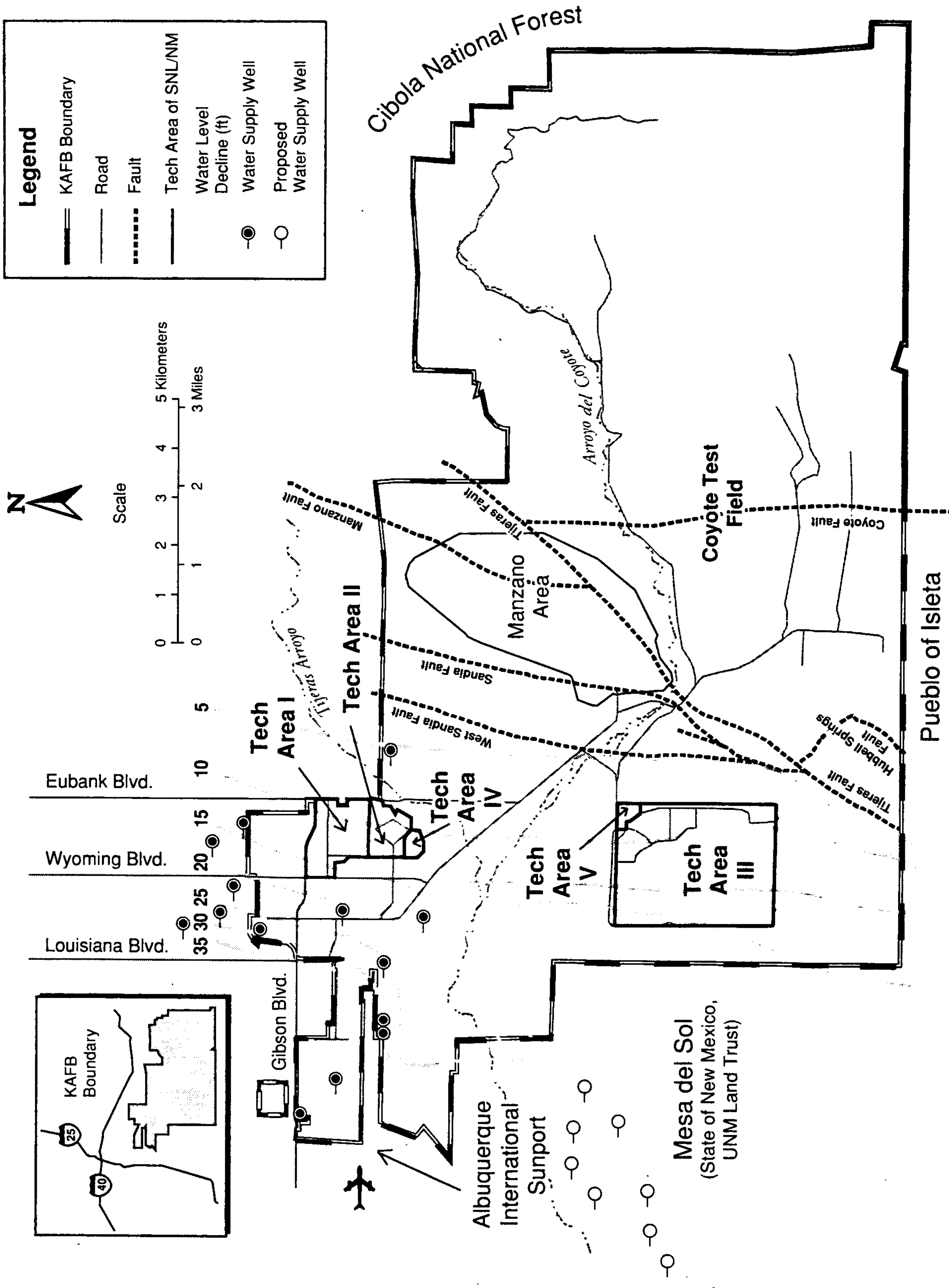
Chemical Waste Landfill

The CWL, located in TA-III, is currently managed in accordance with the *Chemical Waste Landfill Closure Plan* (DOE 1992d) that was approved in 1993 by the NMED. Although cleanup is underway at the CWL, there is no plan to remove the entire source (DOE 1996c). The primary inorganic and organic contaminants of concern at the CWL are hexavalent chromium (disposed of as chromic acid) and TCE, respectively (DOE 1992d). TCE has been discovered in the groundwater beneath the site at levels above the EPA's drinking water standard of 0.005 mg/L (SNL 1997d). The released chromium has not reached the water table, although chromium is found in groundwater samples as a result of stainless-steel corrosion from the monitoring wells that were installed in 1988 (SNL/NM 1995d). Such dissolution is a well-known phenomenon (Hewitt 1992, Oakley and Korte 1996). Furthermore, if the chromium in the aquifer were a result of vertical transport of the CWL contamination, chromium contamination would be continuously seen in the vadose zone down to the water table. Chromium contamination is not found in the lower 410 ft of the vadose zone.

Groundwater Quantity

Little moisture is available for groundwater recharge from direct precipitation on the site. Recharge estimates range from 0.004 to 0.1 inch per year. Local groundwater recharge is associated primarily with infiltration of arroyo water during short-term storm events. Water supply wells (in the Santa Fe Group) for the city of Albuquerque and KAFB are near the northern boundary of KAFB (Figure 4.6–3). Pumping from these wells and others throughout the Albuquerque-Belen Basin results in groundwater withdrawal exceeding recharge. The 1996 KAFB withdrawal was 1.16 B gal; some of the nearby city well fields pump considerably more than this amount (SNL/NM 1997a).

An excess of withdrawal over recharge results in a continuing decline in groundwater levels beneath the site. In HR-1, groundwater levels have been declining at rates of 0.2 to 3.0 ft per year. During the 12-year period from 1985 through 1996, water levels declined by more than 35 ft in the extreme northwestern portion of KAFB (Figure 4.6–5). At KAFB, the rates of drawdown are greatest westward from the fault zone and northward near the water-supply wells. Water levels in HR-2 and HR-3 have not been affected by water supply production in HR-1 (SNL/NM 1997a).



Sources: SNL/NM 1997a, 1997j; NMSLO 1997

Figure 4.6–5. Decline in Water Levels from 1985 through 1996

During the period from 1985 through 1996, groundwater levels in parts of KAFB declined by more than 35 ft.

A shallow groundwater system underlies TA-II and TA-IV at approximately 300 ft below the ground surface. Groundwater within this system perches on a relatively impermeable layer of sediments above the Albuquerque-Belen Basin aquifer. Relatively shallow groundwater also underlies the Tijeras Arroyo Golf Course, about 1.5 mi east of TA-II. Water levels in this area are rising at a rate of 2 ft per year, most likely because of golf course watering. Existing information is insufficient to determine whether this shallow zone is connected to the regional Albuquerque-Belen Basin aquifer (SNL/NM 1997a).

Water level declines in the Albuquerque-Belen Basin as a whole mirror those in HR-1. Estimates of basin-wide declines range from 20 to 160 ft since the 1960s, when significant increases in groundwater withdrawal began (SNL/NM 1997a).

4.6.2 Surface Water

4.6.2.1 Definition of Resource

The surface water system on KAFB is a reflection of the dry high-desert climate of the area. Surface water flows through several major and many small unnamed arroyos, primarily during summer thunderstorms (July through September). With the exception of flow from two springs, there are no perennial streams or other surface water bodies at KAFB. As an example of how infrequently water flows in the arroyos, flow was detected at the lowermost Tijeras Arroyo monitoring station on only 28 days during the 4-year period from 1992 through 1995. Floodplains occur next to the major arroyos; however, their areas are small in comparison to the size of KAFB (Figure 4.6–6). Wetlands are present only in the immediate vicinity of several springs in the Manzanita Mountains.

4.6.2.2 Region of Influence

The ROI for surface water is onsite arroyos and the watershed downstream from KAFB, which consists of Tijeras Arroyo, extending from the western KAFB boundary to the Rio Grande, and the Rio Grande downstream from Tijeras Arroyo. Surface water flowing in arroyos and subject to SNL/NM influences can affect KAFB and downstream resources and users. Surface water in Tijeras Arroyo flows through public and private lands west of KAFB before discharging into the Rio Grande.

4.6.2.3 Affected Environment

Major Arroyos

The major surface drainages at SNL/NM are Tijeras Arroyo and Arroyo del Coyote (Figure 4.6–6). With the exception of two short sections of channel with intermittent flow (fed by springs), these drainages flow only during storm events.

Tijeras Arroyo is the primary drainage feature on KAFB. Above the point where Tijeras Arroyo enters KAFB, it drains approximately 80 mi^2; at the point where it exits, the drainage area encompasses approximately 122 mi^2. Tijeras Arroyo is the only substantial outlet for surface water exiting KAFB; this arroyo joins the Rio Grande 4.7 mi downstream of the KAFB boundary.

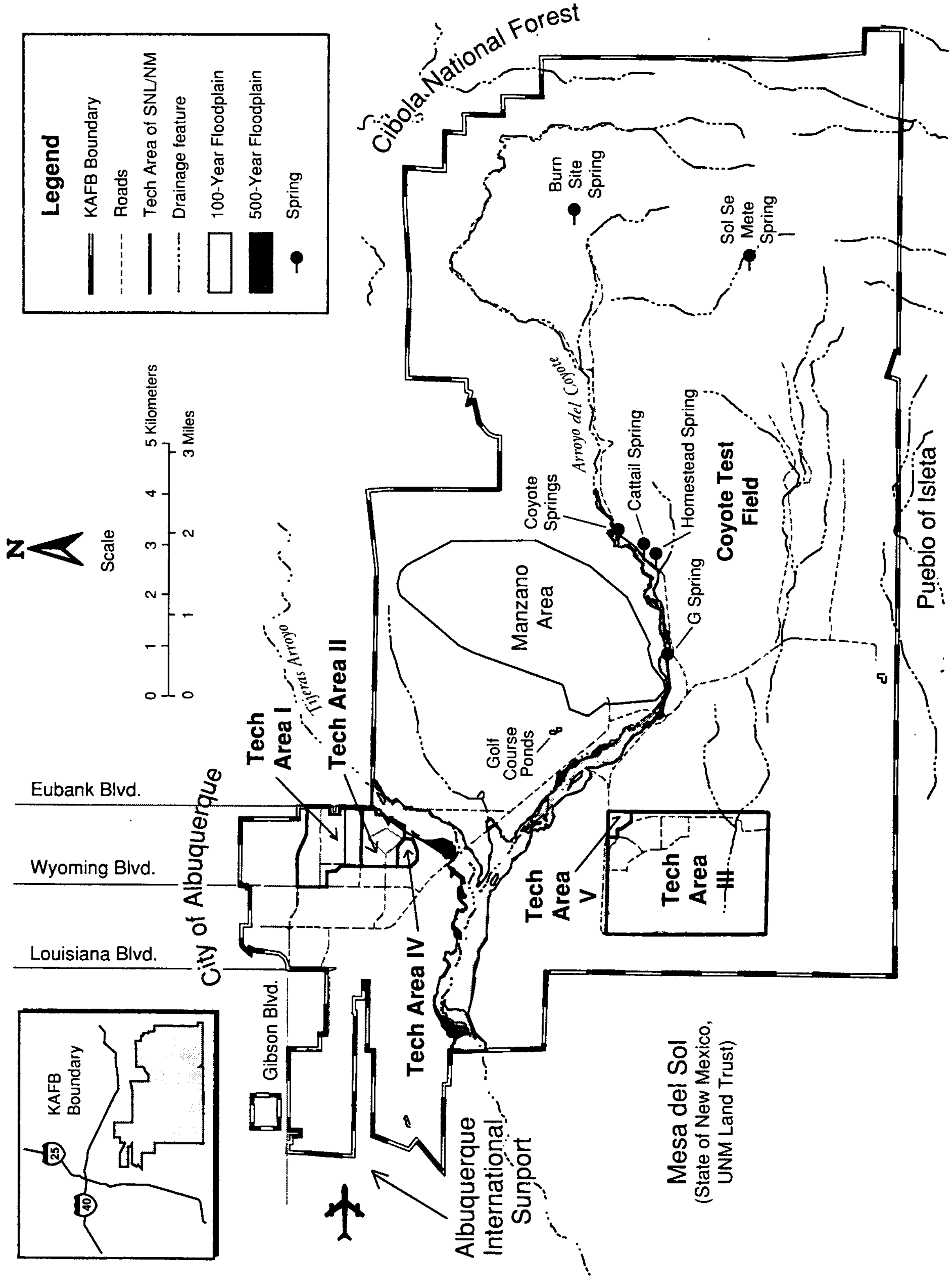
Arroyo del Coyote joins Tijeras Arroyo approximately 2 mi upstream of where Tijeras Arroyo leaves KAFB, and drains approximately 39 mi^2.

Several unnamed arroyos and drainages to the south of Arroyo del Coyote dissipate as the topographic relief decreases to the west. Storm water in this area either evaporates or infiltrates into the soil; therefore, there is no hydrologic surface connection from these areas to Tijeras Arroyo or the Rio Grande.

Floodplains and Wetlands

Floods and runoff occur most commonly during the summer thunderstorm season (July through September) when approximately 50 percent of the average annual rainfall occurs. Snow in the Manzanita Mountains can produce local runoff that rarely reaches the lower portions of the arroyos or the Rio Grande. Figure 4.6–6 shows the 100- and 500-year floodplains. Note that 100-year floodplains identified in TA-I (DOE 1996c) are not shown on Figure 4.6–6. These are narrow floodplains confined to existing drainage channels and several low-lying streets and vacant areas.

Wetlands on KAFB are associated with several springs, all within the Arroyo del Coyote drainage (Figure 4.6–6). Two of these springs, Coyote Springs and Sol Se Mete Spring, flow year-round. G-Spring, Burn Site Spring, Cattail Spring, and Homestead Spring are intermittent (SNL 1997d). The water originating at springs on KAFB travels only a short distance before infiltrating the soil. Associated wetlands (if any) are smaller than 1 ac (Section 4.7.3.2). Only the Burn Site Spring is under SNL/NM control.



Source: SNL/NM 1997j

Figure 4.6–6. Arroyos, Floodplains, and Springs at KAFB

Surface water flows through several major and many small unnamed arroyos, primarily during summer thunderstorms.

No floodplain/wetlands impacts were identified for the SWEIS for which a floodplain/wetlands assessment is required under 10 CFR Part 1022.

Surface Water Quality – Storm Water Runoff

Water flowing in arroyos is subject to the quality standards listed in 20 New Mexico Administrative Code (NMAC) 6.1, *State of New Mexico Standards for Interstate and Intrastate Streams* (NMWQCC 1994). This regulation includes a set of general standards, applicable to all surface water in the state (including ephemeral streams) and additional or more stringent standards for designated bodies of water. They include criteria within the KAFB boundary for stream bottom deposits; floating solids, oil, and grease; color; odor and taste of fish; plant nutrients; toxic substances; radioactivity; pathogens; temperature; turbidity; salinity; and dissolved gases. For "nonclassified" waters, such as the arroyos on KAFB, livestock watering and wildlife habitat standards apply. Livestock watering standards are generally the most stringent, with numeric standards for 12 metals, radium-226/-228, tritium, and gross alpha.

New Mexico standards also apply to the Rio Grande from the Alameda Bridge (14 mi upstream of the Albuquerque sewage treatment plant) to the headwaters of Elephant Butte Reservoir (120 mi downstream of Tijeras Arroyo). The designated uses of this water are irrigation, limited warm water fishery, livestock watering, wildlife habitat, and secondary contact. Additional water quality criteria cover pH, temperature, fecal coliform bacteria, total dissolved solids, sulfate, and chloride.

The Rio Grande flows through the Pueblo of Isleta, beginning 6 mi downstream from the confluence with Tijeras Arroyo. The Pueblo of Isleta has designated surface water quality standards (Isleta Pueblo 1992) that parallel the New Mexico standards for many quality indicators. However, Pueblo of Isleta standards are generally more specific (quantitative measures rather than qualitative criteria for oil and grease, color, plant nutrients, and turbidity) and stricter (for example, a fecal coliform limit of 100 colonies/100 ml versus 1,000 colonies/100 ml). The stricter criteria stem from additional designated uses of the Rio Grande, which are "primary contact" and "primary contact-ceremonial."

SNL/NM's discharge to arroyos is limited to runoff during storm events. Storm water from TAs-I, -II, and -IV is collected in storm sewer systems that discharge to Tijeras Arroyo. There is no discharge from TAs-III and -V because of evaporation and infiltration of storm water into the air and ground.

Potential Sources of Runoff Contamination

Environmental Restoration Project Sites

A few ER sites are located adjacent to arroyos. In July 1997, a heavy storm washed DU into the soil outside the boundary of an ER site. (This event was documented in the Occurrence Reporting and Processing System [ORPS] Report number ALO-KO-SNL-6000-1997-0006 and reported to the state [SNL 1997a].) However, past sampling activities have not shown clear evidence of contamination in local surface runoff water. Samples taken from SNL/NM operational sites in the upper Arroyo del Coyote showed higher levels of aluminum, magnesium, and copper compared to samples taken upstream of the sites, but none of these constituents has been associated with SNL/NM activities or ER sites in the area (SNL 1995c).

Permitted Storm Water Discharge

SNL/NM monitors storm water runoff from TAs-I, -II, and -IV for compliance with National Pollutant Discharge Elimination System (NPDES) permits. Sampling conducted in 1995 and 1996 show four exceedances of the New Mexico Maximum Allowable Concentrations (MACs). Manganese was detected above the 0.2-mg/L MAC on three occasions (twice at 0.24 mg/L, and once at 0.57 mg/L). Barium was detected above the 1.0-mg/L MAC on one occasion (1.1 mg/L); this concentration may be naturally occurring. No exceedances of radionuclides, organics, or other metals were detected. The concentrations of manganese noted are likely the result of high natural concentrations in KAFB soils (SNL/NM 1996e).

Storm water monitoring results from 1997 show exceedances of iron and zinc at both NPDES monitoring stations (SNL 1998e). Iron was detected at 23.7 and 12.9 mg/L, which exceeds the 1.0 mg/L MAC. Zinc was detected at 0.191 and 0.271 mg/L, which exceeds the 0.065 MAC. Total suspended solids also exceeded the permit limit of 100 mg/L, with detected concentrations of 1,660 and 1,170 mg/L. An inspection of the areas monitored by these NPDES stations found no potential sources of iron or zinc (SNL 1998e). Low flow at the NPDES monitoring stations requires placement of the sample intake tube on the bottom of the drainage channel. This likely has caused introduction of a greater amount of suspended solids than is representative of the runoff. During laboratory analysis of these samples, minerals naturally present in the suspended solids, such as iron and zinc, may appear at higher concentrations as well. SNL/NM continues to monitor runoff at these stations in accordance with permit requirements, with results reported to regulatory authorities.

Outdoor Testing Facilities

Radioactive materials could be released to the ground during outdoor testing activities conducted in TA-III and the Coyote Test Field (SNL/NM 1998a). Only facilities in the Coyote Test Field have a defined surface water drainage path to Tijeras Arroyo. SNL/NM sampling in Tijeras Arroyo has shown only trace amounts of the sampled radionuclides, uranium-233/234, -235, and -238; thorium-228, -230, and -232; and strontium-90 (Appendix B). These concentrations are consistent with estimates of background levels for surface water (SNL/NM 1996g).

Surface Water Monitoring Data

During storm events in 1994 and 1995, SNL/NM collected 32 surface water samples from onsite arroyos (Figure 4.6–7, Table 4.6–2). Not all samples were analyzed for all constituents. Most constituents of concern, which include dissolved metals, explosives, and radionuclides, were found only at trace concentrations (SNL/NM 1996g). Only aluminum was detected above applicable standards in any of the samples (5 of 29 samples analyzed). Three of these samples, including the sample with the highest aluminum concentration (41.4 mg/L), were collected from tributaries of the Arroyo del Coyote in the Withdrawn Area. These sampling locations are upstream of SNL/NM facilities, indicating that aluminum at these concentrations is naturally occurring.

Surface Water Quality - Wastewater

SNL/NM discharges both sanitary and industrial effluents into the Albuquerque sanitary sewer system. Sanitary effluents include wastewater from restrooms and cafeterias and from other domestic activities. Industrial discharges originate from laboratory processes, general manufacturing, and experimental activities. SNL/NM actively monitors compliance with discharge permits (see Section 7.3.4.1) and policies that allow no direct disposal of hazardous chemicals or radioactive materials into the sewer system.

As part of the wastewater management program, SNL/NM also maintains a small number of septic systems (at remote facilities) that are periodically pumped and discharged by certified pumping contractors. Contents are sampled before pumping to ensure that the sewage meets regulatory criteria. SNL/NM submits wastewater permit applications, which detail potential pollutant sources and the raw materials used in industrial processes, to the city of Albuquerque. To ensure compliance with the discharge limits stated on each city permit, SNL/NM conducts monthly sampling at each general outfall monitoring station and continuous monitoring of pH and water flow at all permitted stations.

During 1996, SNL/NM reported two permit violations for all wastewater discharges (both pH exceedances lasted a total of 4.5 hrs). No violations were reported for 1995 (SNL 1996a).

Surface Water Quantity

The quantity of surface water flow depends on the nature of both the drainage area (soil characteristics, slope, and vegetation) and the storm event (intensity and duration). Flow data for the arroyos is limited; only one stream gauge was in place before 1994.

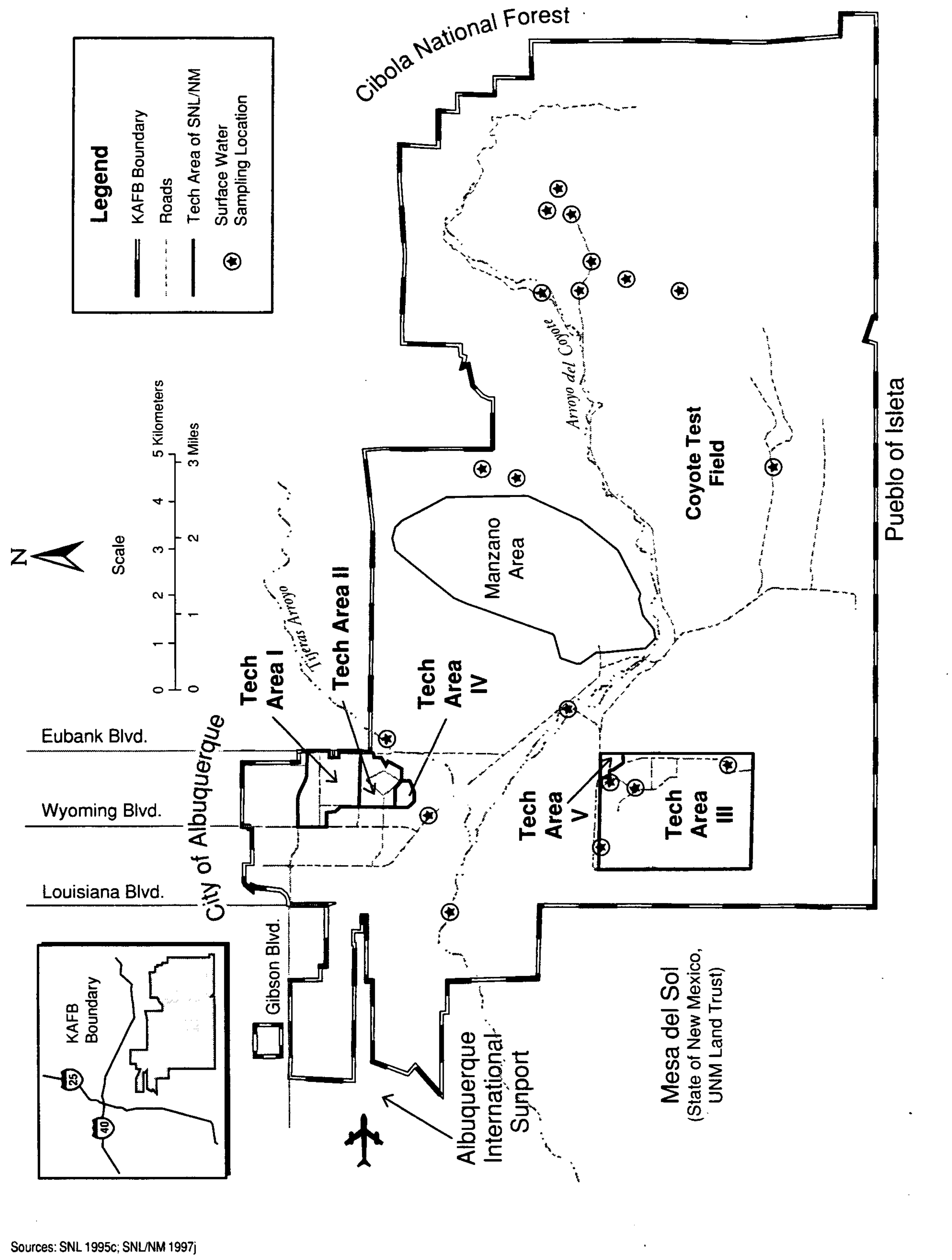
SNL/NM activities affect surface water quantity in two ways: storm water runoff from SNL/NM facilities and discharge of process and sanitary water to the Albuquerque sewage treatment plant.

Storm Water Runoff

Parking lots, buildings, and other activities that have altered the natural vegetation or topography have affected the quantity of storm water runoff. Increases in the amount of storm water runoff from SNL/NM activities are due to the replacement of natural surfaces (soil and desert vegetation) with more impervious surfaces (primarily buildings and parking lots). Runoff to arroyos is more likely to occur from impervious surfaces, either directly or through storm sewers. The greatest areal extent of paved surfaces and buildings is in TA-I, which contains the densest population of SNL/NM employees.

Discharge to Sanitary Sewer

SNL/NM discharges approximately 770,000 gal of water per day to the sanitary sewer, the result of manufacturing activities and sanitary water used in SNL/NM facilities (SNL/NM 1997a). This water flows to the Albuquerque sewage treatment plant, where it is treated along with other sewage from the city. The treated water is discharged to the Rio Grande, about 0.7 mi north of Tijeras Arroyo. The discharged water must meet Federal and state quality standards.



Sources: SNL 1995c; SNL/NM 1997j

Figure 4.6–7. Locations of Surface Water Samples Collected During 1994 and 1995

Thirty-two surface water samples were collected from nineteen locations at KAFB during 1994 and 1995.

Table 4.6–2. Summary of Surface Water Quality Data Collected by the Site-Wide Hydrogeologic Characterization Project (1994 and 1995)

ANALYTE	SAMPLES ANALYZED	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	MEAN DETECT	MEDIAN DETECT	STANDARD[a]
METALS (mg/L)							
Silver	29	2	ND	0.0061	0.00485	0.00485	NA
Aluminum	29	21	ND	41.4	4.93	1.7	5.0
Arsenic	29	1	ND	0.016	0.016	0.016	0.2
Barium	29	20	ND	3.9	0.53	0.22	NA
Beryllium	29	3	ND	0.0091	0.0062	0.0056	NA
Calcium	29	18	ND	1,690	205	51.65	NA
Cadmium	29	1	ND	0.0056	0.0056	0.0056	0.05
Cobalt	29	8	ND	0.021	0.0096	0.0084	1.0
Chromium	29	0	NA	NA	NA	NA	1.0
Copper	29	16	ND	0.096	0.022	0.0135	0.5
Iron	29	19	ND	23.2	2.21	0.82	NA
Mercury	29	3	ND	0.0003	0.00019	0.00016	0.01
Potassium	18	17	ND	14.9	4.94	4.3	NA
Magnesium	29	26	ND	20.4	4.44	3.5	NA
Manganese	29	18	ND	2.6	0.54	0.27	NA
Sodium	19	10	ND	11.3	3.28	2.6	NA
Nickel	29	10	ND	0.054	0.019	0.00965	NA
Lead	29	15	ND	0.04	0.015	0.011	0.1
Antimony	29	0	NA	NA	NA	NA	NA
Selenium	29	3	ND	0.012	0.0076	0.0057	0.05
Tin	10	0	NA	NA	NA	NA	NA
Thallium	29	3	ND	0.011	0.0086	0.011	NA
Vanadium	29	19	ND	0.081	0.024	0.016	0.1
Zinc	28	18	ND	0.24	0.087	0.059	25.0
EXPLOSIVES (µg/L)							
1, 3-DNB	16	0	ND	ND	NA	NA	NA
HMX	16	0	ND	ND	NA	NA	NA
Nitrobenzene	16	0	ND	ND	NA	NA	NA
RDX	16	0	ND	ND	NA	NA	NA

Table 4.6–2. Summary of Surface Water Quality Data Collected by the Site-Wide Hydrogeologic Characterization Project (1994 and 1995) (concluded)

ANALYTE	SAMPLES ANALYZED	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	MEAN DETECT	MEDIAN DETECT	STANDARD[a]
EXPLOSIVES ($\mu g/L$)							
Tetryl	16	2	ND	1.9	1.25	1.25	NA
2,6-DNT	16	0	NA	NA	NA	NA	NA
2,4-DNT	15	0	NA	NA	NA	NA	NA
2,4,6-TNT	16	2	ND	0.11	0.087	0.087	NA
2-Amino-4,6-DNT	16	5	ND	0.28	0.091	0.038	NA
4-Amino-2,6-DNT	16	0	NA	NA	NA	NA	NA
1,3,5-TNB	16	0	NA	NA	NA	NA	NA
RADIONUCLIDES (pCi/L)							
Uranium-233/234	26	26	0.17	22	4.38	1.415	NA
Uranium-235	26	19	ND	0.98	0.25	0.13	NA
Uranium-238	26	25	ND	42	4.77	1.1	NA
Thorium-228	10	6	ND	4.81	1.61	1.46	NA
Thorium-230	26	25	ND	27	5.04	1.2	NA
Thorium-232	26	18	ND	24	5.73	2.6	NA
Strontium-90	23	23	0.26	19	3.12	1.7	NA

Sources: SNL 1995c, SNL/NM 1996g
µg/L: micrograms per liter
DNB: Dinitrobenzene
DNT: Dinitrotoluene
HMX: High Melt Explosive
mg/L: milligrams per liter
NA: not applicable
ND: not detected
pCi/L: picocuries per liter
RDX: Research Development Explosive
TNB: Trinitrobenzene
TNT: Trinitrotoluene
[a] Most stringent standard for designated use from 20 NMAC 6.1 (NMWQCC 1994)

4.7 BIOLOGICAL AND ECOLOGICAL RESOURCES

4.7.1 Definition of Resource

Biological resources are the plants and animals that live on or otherwise rely on lands at KAFB and contiguous lands for their continued existence. Biological resources include the habitats where plant and animal species live, as well as the plants, animals, and ecosystems that the Federal and state governments and agencies specifically address as protected or deserving of special consideration in planning and management activities.

4.7.2 Region of Influence

The ROI consists of KAFB, the Withdrawn Area, and the DOE buffer zones adjacent to the southwest corner of KAFB. In addition, it includes the adjacent lands to which animals regularly travel.

4.7.3 Affected Environment

4.7.3.1 Overview

KAFB is located at the juncture of four major North American biological provinces: Great Basin, Rocky Mountains, Great Plains, and Chihuahuan Desert (Brown 1982). Each province influences the existing biological communities. KAFB contains a diversity of biological resources due, in part, to these influences and an elevation change from a low point of approximately 5,200 ft in Tijeras Arroyo to a high point of 7,715 ft at Mt. Washington in the Manzanita Mountains.

Early biological data at KAFB have been collected primarily for specific projects (Biggs 1991; IT Corp. 1995; SNL 1994a). Broad-scale studies include sensitive species surveys on KAFB (New Mexico Natural Heritage Program [USAF 1995d]), and wetland surveys (USACE 1995). More recently, plant and vertebrate animal inventories have been completed for portions of KAFB (SNL/NM 1997a, USAF 1997b, and SNL/NM 1997u).

4.7.3.2 Biodiversity

At least 267 plant species and 195 animal species occur on KAFB (SNL/NM 1997a). This diversity is due, in part, to the variety of habitats, which include cliff faces, caves, abandoned mines, and drainages, as well as the four major vegetation associations, which are grassland, woodland, riparian, and altered. Restricted access and limited planned development have benefited biological resources at KAFB.

The exclusion of livestock for the past 50 years on KAFB appears to have had a beneficial effect on the vegetation in that the USAF policy of grazing curtailment has allowed the grassland sites to recover somewhat from the heavy grazing pressures of the previous three centuries (Parmenter & Chavez 1995). The presence of grama grass cactus may be due to this lack of grazing. The state of New Mexico delisted grama grass cactus as endangered in 1995, partially as a result of the populations found during surveys on KAFB (SNL/NM 1997a).

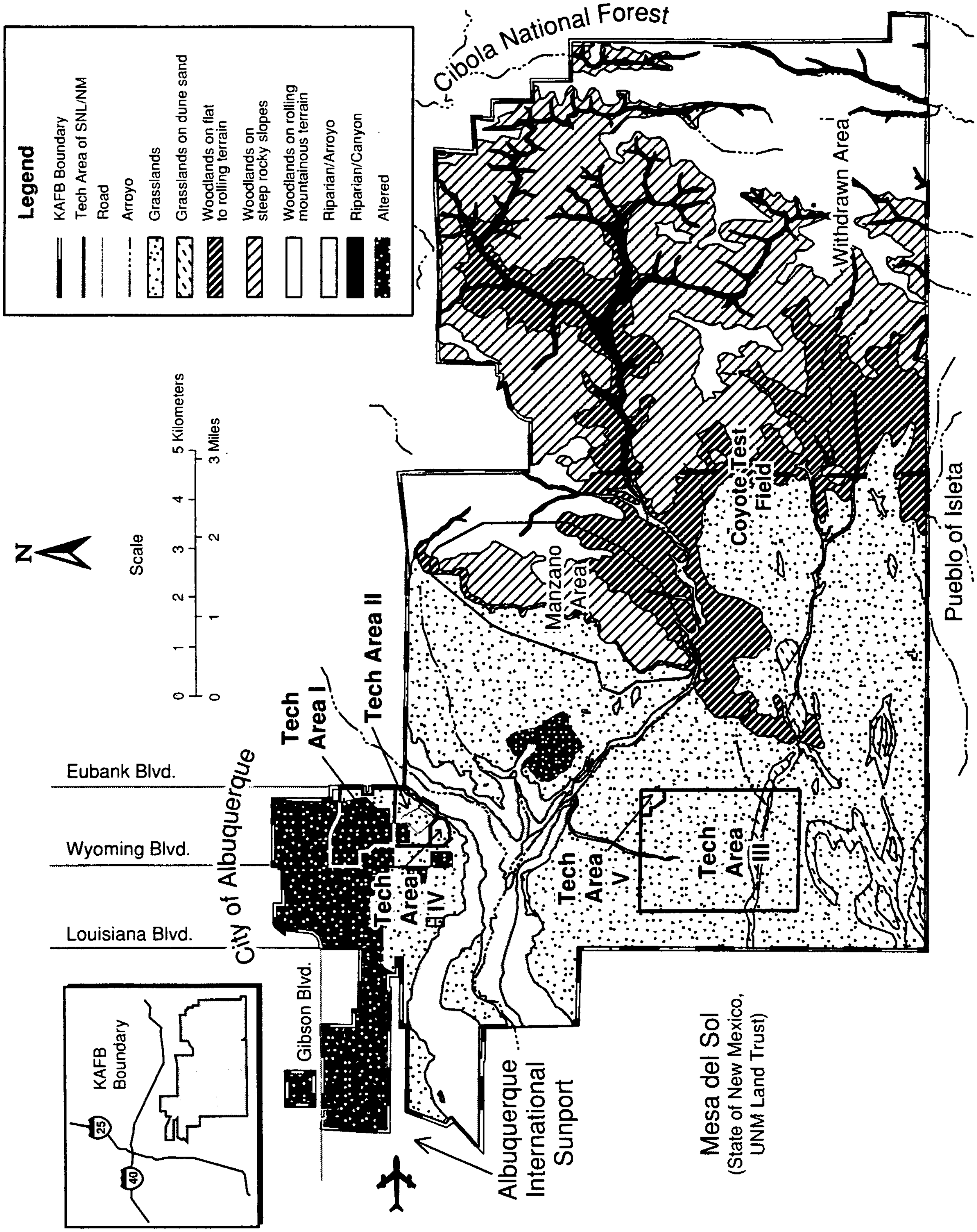
Plants

The four major vegetation associations at KAFB, grassland, woodland, riparian, and altered, are distinct in the form and composition of their vegetation (USAF 1996). Figure 4.7–1 shows the areal extent and location of the major natural vegetation associations on KAFB.

The grassland association occupies the lower alluvial slopes and terrace surfaces of the Rio Grande valley near the city of Albuquerque. It is the dominant vegetation association on KAFB, west of the Withdrawn Area. Coyote Test Field and TAs-I, -II, -III, -IV, and -V are on grasslands. Selected plant species common in the grasslands are listed in Table 4.7–1.

Woodland vegetation occurs primarily on the upper alluvial slopes and mountainous areas of the Withdrawn Area. Species generally found in the 6,000- to 6,200-ft elevation range include one-seed juniper with a groundcover that includes blue grama. Pinyon pine-juniper woodland, at an elevation of 6,200 to 6,500 ft, is characterized by an even mix of pinyon pine and one-seed juniper. The numbers of ponderosa pine have declined since 1850 due to fire suppression practices and climate change (Baisan & Swetnam 1994). Many areas of the woodlands are becoming progressively choked with deadwood and dense thickets of young trees (Baisan & Swetnam 1994).

Isolated, narrow bands of riparian vegetation occur along the surface drainages of KAFB. These drainages are predominantly ephemeral and contain flow only after large rainfall events. Riparian vegetation constitutes less than 5 percent of the area of KAFB. The riparian woodland vegetation is limited primarily to the upper reaches of Arroyo del Coyote and associated drainages. Common riparian plant species are listed in Table 4.7–1. The sites contain dense stands of trees where the water table is close to land surface, such as at G Spring and Coyote Springs. The riparian woodland vegetation is dominated by exotic species, principally salt cedar, which



Source: SNL/NM 1997j

Figure 4.7–1. Major Vegetation Associations at KAFB

The diversity of plant and animal species on KAFB is due, in part, to the presence of four major vegetation associations.

Table 4.7–1. Selected Plant Species Common in the Vegetation Associations Occurring on KAFB

COMMON NAME	SCIENTIFIC NAME	VEGETATION ASSOCIATION
Black Grama	*Bouteloua eriopoda*	Grasslands
Blue Grama	*Bouteloua gracilis*	Grasslands
Fourwing Saltbush	*Atriplex canescens*	Grasslands
Galleta	*Hilaria jamesii*	Grasslands
Sand Sagebrush	*Artemisia filifolia*	Grasslands
Apache Plume	*Fallugia paradoxa*	Riparian
Fremont Cottonwood	*Populus fremontii*	Riparian
Salt-Cedar	*Tamarix pentandra*	Riparian
Siberian Elm	*Ulmus pumila*	Riparian
Tree-of-Heaven	*Ailanthus altissima*	Riparian
Gambel Oak	*Quercus gambellii*	Woodlands
Mountain Mahogany	*Cercocarpus montanus*	Woodlands
Pinyon Pine	*Pinus edulis*	Woodlands
Ponderosa Pine	*Pinus ponderosa*	Woodlands
One-Seed Juniper	*Juniperus monosperma*	Woodlands
Wavy-Leaf Oak	*Quercus undulata*	Woodlands
Cattail	*Typha latifolia*	Wetlands
Three-square	*Scirpus americanus*	Wetlands
Torrey Rush	*Juncus torreya*	Wetlands
Wire Rush	*Juncus balticus*	Wetlands
Poplar	*Populus spp.*	Altered
Russian Thistle	*Salsola kali*	Altered
Summer Cypress	*Cupressus arizonica*	Altered

Sources: Parmenter & Chavez 1995; SNL 1997a, 1994a; SNL/NM 1974; USACE 1995

is widespread in the arroyos on KAFB (SNL/NM 1997a). They form dense stands on Arroyo del Coyote at G Spring and near Coyote Springs. Large, mature native Fremont cottonwood trees occur where there is a sufficient subsurface water supply.

Human development and activities have created altered vegetation associations at KAFB. This vegetation ranges from no vegetative cover to manicured landscapes, such as the golf course. Most of this vegetation consists of nonnative species. Common plant species in altered vegetation are listed in Table 4.7–1.

Aquatic Habitat

Natural spring-fed wetlands form a minor component of the riparian habitat on KAFB and are cumulatively less than 1 acre in size. KAFB has six wetlands, all associated with springs (USACE 1995) (Figure 4.6–6). These wetlands are designated as jurisdictional wetlands under Section 404 of the CWA, because they have the soils, hydrology, and vegetation that meet standard criteria (USACE 1995). The largest wetland is Coyote Springs in Arroyo del Coyote. Two of the wetlands, Sol se Mete and Burn Site Springs, are in the canyons of the Withdrawn Area. Species characteristic of these wetlands include wire rush, three-square, Torrey rush, and cattail (USACE 1995). Only the Burn Site Spring is on land used by SNL/NM. The USFS manages a tank that collects water for wildlife at this spring and Sol se Mete Spring. The USAF administers constructed ponds on KAFB Tijeras Arroyo Golf Course and a constructed lake, Christian Lake, in the southern part of KAFB.

Animals

Each of KAFB's vegetation associations support a distinct assemblage of animal species, which include amphibians, reptiles, birds, and mammals. Each species exhibits specific habitat requirements for food, water, and cover, as well as behaviorally controlled requirements, such as travel corridors (areas through which animals habitually move), breeding site preferences, and sensitivity to human activity. Because of their mobility, bird communities are particularly dynamic. Although some bird species at KAFB are resident throughout the year, many are migratory. They are only present seasonally, breeding, wintering, or traveling between their breeding and wintering grounds.

The most important ecological factor that controls wildlife communities on KAFB is the limited availability of surface water (USAF 1996). Selected common animal species and habitats on KAFB are listed in Table 4.7–2.

Large predators in the woodlands include the mountain lion and the black bear. The mule deer is the only large herbivore known to use KAFB and is also the principal game animal. Grassland-juniper vegetation in the foothills surrounding Lurance Canyon and Sol se Mete Canyon is an important winter range for mule deer (Biggs 1991).

Table 4.7–2. Selected Common Animal Species and Habitats on KAFB

COMMON NAME	SCIENTIFIC NAME	HABITAT TYPE
American Kestrel	*Falco sparvertius*	Grasslands
Coyote	*Canis latrans*	Grasslands
Deer Mouse	*Peromyscus maniculatus*	Grasslands
Desert Cottontail	*Sylvilagus auduboni*	Grasslands
Red-Tailed Hawk	*Buteo jamaicensis*	Grasslands
Whiptail Lizard	*Cnemidophorus spp.*	Grasslands
Ash-Throated Flycatcher	*Myiarchus cinerascens*	Woodlands
Cooper's Hawk	*Accipiter cooperii*	Woodlands
Mule Deer	*Odocoileus hemionus*	Woodlands
Northern Flicker	*Colaptes auratus*	Woodlands
Rock Squirrel	*Spermophilus variegatus*	Woodlands
Scrub Jay	*Aphelocoma coerulescens*	Woodlands
Lark Sparrow	*Chondestes grammacus*	Riparian
Gray Fox	*Urocyon cinereoargenteus*	Riparian
Red-Spotted Toad	*Bufo puntatus*	Riparian
Violet-Green Swallow	*Tachycineta thalassina*	Riparian
Barn Swallow	*Hirundo rustica*	Altered
European Starling	*Sturnus vulgaris*	Altered
House Sparrow	*Passer domesticus*	Altered

Sources: Parmenter & Chavez 1995, SNL 1994a, SNL/NM 1997u, USAF 1995d

Drainages provide a focal point for animals due to greater availability of food, water, and cover generally found along their courses. Diversity is, therefore, generally higher in the riparian habitat, especially where surface water is available. Most large mammal species of the area inhabit the canyons and arroyos. Coyote Springs, for example, attracts mule deer and a large number of bird species.

Drainages and their associated riparian vegetation serve as important wildlife corridors. In the Withdrawn Area, the Madera and Bonita Canyons and ridgelines contain travel corridors. On a regional scale, the Manzanita Mountains are an important migratory bird corridor for neotropical migrants, including several raptor species (SNL/NM 1997a).

Many species favor habitats that are disturbed, altered, or close to human activities. Colonies of Gunnison's prairie dogs (a state sensitive species) occur in the margins of developed areas including roads, housing, runways, and the golf course. On DOE lands, the colonies are limited to TA-I. The burrows in these colonies provide nesting sites for the burrowing owl, a species protected under the *Migratory Bird Treaty Act* (16 U.S.C. §703). The grass, ponds, and variety of trees at KAFB golf course provide a particularly rich haven for animals, including waterfowl and shorebirds.

Exposed cliffs on the west side of the Manzano Mountains provide potential nesting or roosting sites for a wide variety of birds, including raptors such as the golden eagle and peregrine falcon. Both species have been observed in that area; however, no nesting activity for either of these species has been documented. Several abandoned mines in the Manzanita Mountains provide habitat for bats.

4.7.3.3 Threatened, Endangered, and Sensitive Species

There are four agencies that have the authority to designate threatened, endangered, and sensitive species occurring in New Mexico. The agencies are the U.S. Fish and Wildlife Service (USFWS), the New Mexico Game and Fish Department (NMGFD), the New Mexico Forestry and Resource Conservation Division (NMFRCD), and the USFS. The state of New Mexico separates the regulatory authority for plants and animals between the NMFRCD and the NMGFD, respectively. The USFS lists species for special management consideration on USFS lands. The USFWS protects species under the authority of the *Endangered Species Act of 1973* and the *Migratory Bird Treaty Act*, which contains a list of migratory nongame birds for which information exists indicating declining populations. The levels of protection afforded threatened, endangered, and sensitive species on KAFB are defined in Table 4.7–3.

The Pueblo of Isleta recognizes and applies all state and Federal designations of endangered, threatened, and sensitive species to populations that occur on pueblo lands (SNL/NM 1997a). In addition, the Pueblo of Isleta considers all species occurring on pueblo lands to be of cultural importance and, therefore, protected (SNL/NM 1997a).

Plants

Table 4.7–3 lists the threatened, endangered, and sensitive species and habitats on KAFB. One state-listed sensitive plant species, the Santa Fe milkvetch, occurs on the low hills in the southwestern part of KAFB (SNL 1994a). The Strong prickly pear, found near the northern boundary of KAFB, is on the state of New Mexico Rare Plant Review List (Ferguson 1998). One USFS-listed species, the grama grass cactus, is found in areas of the grasslands.

Animals

The peregrine falcon was the only Federally listed threatened or endangered species that may frequent KAFB. A probable sighting near Mt. Washington was likely a migrant (USAF 1995d). No nesting activity of this species has been observed and KAFB contains only marginal nesting habitat (USAF 1995d). In 1997, the USAF conducted a raptor survey of KAFB and did not observe any listed raptor species (USAF 1997b).

On August 25, 1999, the USFWS delisted the American peregrine falcon from the Federal list of endangered and threatened wildlife. The USFWS has determined that this species has recovered following restrictions on the use of organochlorine pesticides (such as, dichloro-diphenyl-trichloroethane [DDT]) in the U.S. and Canada, following the implementation of successful management activities (64 FR 46541).

On February 16, 1999, the USFWS designated the mountain plover as a proposed threatened species (64 FR 7587). Although KAFB could contain potential habitat for the mountain plover, numerous avian surveys of the Withdrawn Area and KAFB in general have not documented its presence (SNL, 1997u; USAF, 1997b).

No Federally proposed or candidate species occur on KAFB. In 1993, a colony of state-listed threatened gray vireos was discovered in the western foothills of the Withdrawn Area on land controlled by the USAF. This is

Table 4.7–3. Threatened, Endangered, and Sensitive Species and their Habitats on KAFB

COMMON NAME	SCIENTIFIC NAME	STATUS	HABITAT
ANIMALS			
Baird's Sparrow	*Ammodramus bairdii*	SC, ST, FSS	Grasslands and moist meadows
Bell's Vireo	*Vireo bellii arizonae*	ST, FSS	Canyons
Black Swift	*Cyseloides niger borealis*	SS	Higher elevations
Desert Massasauga	*Sistrurus catenatus edwardsii*	FSS	Grasslands and arroyos
Ferruginous Hawk	*Buteo regalis*	SC, FSS	Grasslands and open shrublands
Gunnison's Prairie Dog	*Cynomys gunnisoni*	SS	Grasslands
Gray Vireo	*Vireo vicinior*	ST, FSS	Juniper woodlands & shrublands
Loggerhead Shrike	*Lanius ludovicianus*	SC	Shrublands & shrubby grasslands
Mountain Plover	*Charadrius montanos*	FE	Dry short-grass prairie
Pale Townsend's Big-Eared Bat	*Plecotus townsendii pallescens*	SC, SS, FSS	Caves, mines, and rock shelters
American Peregrine Falcon	*Falco peregrinus aratum*	FE, ST, FSS	Cliffs, woodlands, and streams
Small-Footed Myotis	*Myotis ciliolabrum*	SC, SS	Caves, rock crevices, and grasslands
Swainson's Hawk	*Buteo swainsonii*	FSS	Grasslands and lower slopes
Texas Horned Lizard	*Phrynosoma cornutum*	SC, FSS	Grasslands and open deserts
Texas Longnose Snake	*Rhinocheilus lecontei*	FSS	Grasslands and arroyos
Western Spotted Skunk	*Spilogale gracilis*	SS	Arroyos, canyons, and rocky slopes
Western Burrowing Owl	*Athene cunicularia hypugea*	SC	Grasslands and open shrublands
White-Faced Ibis	*Plegadis chihi*	SC, FSS	Marshes, ponds, & riparian areas
PLANTS			
Grama Grass Cactus	*Pediocactus papyracanthus*	FSS	Grasslands
Santa Fe Milkvetch	*Astragalus feenis*	NML2 FSS	Limestone hills in grasslands
Strong Prickly Pear	*Opuntia valida*	NML3	Lower elevation hills

Sources: NMDGF 1997; SNL 1994a, b; SNL/NM 1997a; USAF 1995d; USFS 1994; USFWS 1998

FE: Federal Endangered: "... Any species that is in danger of extinction throughout all or a significant portion of its range" (16 U.S.C. § 35).

SC: Federal species of concern: Species for which further biological research and field study are needed to resolve their conservation status (USFS-listed species).

FSS: USFS Sensitive Species: Species for which population viability is a concern based on current or predicted numbers, density, distribution, or habitat capability.

NML2: New Mexico List 2: Official listing of plant species that are vulnerable to extinction or extirpation within the state due to rarity or restricted distribution, but are not protected under the *New Mexico Endangered Plant Species Act*.

NML3: New Mexico List 3: Official Listing of plant species that are on the New Mexico Rare Plant Review List as species for which more information is needed, but are not protected under the *New Mexico Endangered Plant Species Act*.

ST: State Threatened: New Mexico-listed species protected as threatened under the *Wildlife Conservation Act*.

SS: State Sensitive: New Mexico-listed species: Taxa that, in the opinion of a qualified New Mexico Game and Fish Department biologist, deserve special consideration in management and planning, and are not listed threatened or endangered by the state of New Mexico. These can include taxa that are listed as threatened, endangered, or sensitive by other agencies; taxa with limited protection; and taxa without legal protection. The intent of this category is to alert land managers of the need for management where these taxa could be affected.

USFS: U.S. Forest Service

the largest known concentration of gray vireos in the state of New Mexico (USAF 1995d).

Eight species of concern have been observed on KAFB, in addition to thirteen migratory nongame birds of management concern for the USFWS, Region 2 (Table 4.7–3). These species are protected under the *Migratory Bird Treaty Act* (16 U.S.C. §703).

Four state-listed threatened animal species occur on KAFB (Table 4.7–3). Eleven USFS-listed sensitive animal species have also been observed on KAFB (Table 4.7–3). One of the state-listed sensitive species, Pale Towsend's big-eared bat, has been observed hibernating in two caves (Altenbach 1997).

4.7.3.4 Biomonitoring

Ecological monitoring of selected biota, including small mammals, birds, reptiles, amphibians, and vegetation, is conducted annually by SNL/NM. Baseline measurements are collected on potential contaminant loads in species as well species density and composition. In 1997, data were collected at two sites: TA-II and a site at the southeastern end of the perimeter fence separating the Pueblo of Isleta and KAFB. Analysis of samples of seven small mammals from these sites did not show any significant radionuclide or metal contamination (SNL/NM 1997u).

SNL/NM recently completed an ecological risk assessment validation study (SNL/NM 1999d). This study was conducted for the SNL/NM ER project to provide site-specific data in support of the ecological risk assessment currently being used to evaluate potential risks to natural populations at contaminated sites. The field work for this study included both biomonitoring and quantitative surveys of key populations at potential ecological risk. Biomonitoring consisted of the collection of soil, plant, invertebrate, and small mammal samples from four ER Project sites and the analysis of these samples to determine the concentrations of 18 selected inorganic analytes. No significant effects to small mammal communities were found at any of the sites. A report presenting the results of these studies is currently in preparation. The study objectives recommended by the U.S. Department of Interior will be considered in ongoing study objectives.

4.7.3.5 Ecosystems Management

KAFB is bordered by Cibola National Forest and the Pueblo of Isleta. Sensitive species and other wildlife travel across the management boundaries of the Pueblo of Isleta and the national forest, where biological resources are valued and actively used for recreational, cultural, and aesthetic purposes. Many of the sensitive biological resources on KAFB are on the lands the DOE and the USAF have withdrawn from the USFS (Cibola National Forest). SNL/NM conducts activities on these DOE and USAF lands, but the USFS retains management responsibilities for their natural resources. Management measures are delineated in the *Ecosystem Management Plan for National Forest Lands in and Adjacent to the Military Withdrawal, Sandia Ranger District, Cibola National Forest, Bernalillo County, New Mexico* (USFS 1996) and the 1985 *Cibola National Forest Land and Resource Management Plan,* as amended (USFS 1985). The USFS's emphasis in the Withdrawn Area is to improve wildlife diversity and decrease the threat of an escaped wildfire. USFS fire management practices include thinning vegetation, constructing fuel breaks, and prescribed burning. The USFS has stated that the desired condition for the Withdrawn Area is one in which the public feels that the area is a "special wildlife haven" over which it has stewardship (USFS 1995).

On KAFB, the USAF manages wildlife resources, wetlands, land resources, and outdoor recreation through guidance outlined in several documents. The *Integrated Natural Resources Management Plan* (INRMP), *Kirtland Air Force Base, New Mexico* was developed to provide interdisciplinary strategic guidance for natural resource management (USAF 1995a). As a result of the INRMP, two additional plans were developed to aid in natural resources management. The *Kirtland Air Force Base Fish and Wildlife Plan* (FWP) addressed the protection and management of the naturally occurring populations of vertebrate wildlife species on KAFB (USAF 1996). The *Kirtland Air Force Base 1997 Raptor Survey and Management Strategies*, following the suggested guidance of the INRMP and the FWP, identified existing species and numbers of raptors, presented suggestions on habitat improvement, and gathered information on raptor preservation (USAF 1997b).

4.8 CULTURAL RESOURCES

4.8.1 Definition of Resource

Cultural resources are prehistoric or historic sites, buildings, structures, districts, or other places or objects considered to be important to a culture, subculture, or community for scientific, traditional, or religious purposes, or for any other reason. Cultural resources primarily addressed in the SWEIS are those that have been recommended as or determined to be eligible or potentially eligible for inclusion in the National Register of Historic Places (NRHP) and those that are Traditional Cultural Properties (TCPs). TCPs are places or objects that have religious, sacred, or cultural value for a particular cultural group. In order to be included in the NRHP, a resource must meet one or more of the following criteria (36 CFR Part 60):

- Criterion A—Associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B—Associated with the lives of persons significant in our past.
- Criterion C—Embodies the distinctive characteristics of a type, period, or method of construction.
- Criterion D—Yielded or may be likely to yield information important in prehistory or history.

The resource must also retain most, if not all, of seven aspects of integrity: location, design, setting, workmanship, material, feeling, and association.

Cultural resources considered in the SWEIS are divided into three categories. The first is prehistoric archaeological sites, which in the Albuquerque area date to before A.D. 1540, when Francisco Vasquez de Coronado and his expedition arrived in the middle Rio Grande valley and initiated Spanish exploration of the area. The second category, historic sites, includes archaeological sites as well as buildings and structures dating from A.D. 1540 to 1948. Based on the standards of the National Park Service (NPS), the cutoff date for being categorized as a historic resource is 50 years in age, which provides the historical perspective necessary to evaluate significance. However, this category also includes younger resources (post-1948) that have been recommended as *exceptionally significant* within one of the criteria. The third category consists of TCPs. TCPs can include resources that fall within the previous two categories.

4.8.2 Region of Influence

The ROI includes KAFB and the DOE buffer zones adjacent to the southwest corner of KAFB. The resources include those already identified, as well as those that have not yet been identified, such as buried archeological sites, TCPs, and unassessed resources. The ROI is further refined into areas of potential effect to cultural resources for the various activities performed at SNL/NM use areas.

4.8.3 Affected Environment

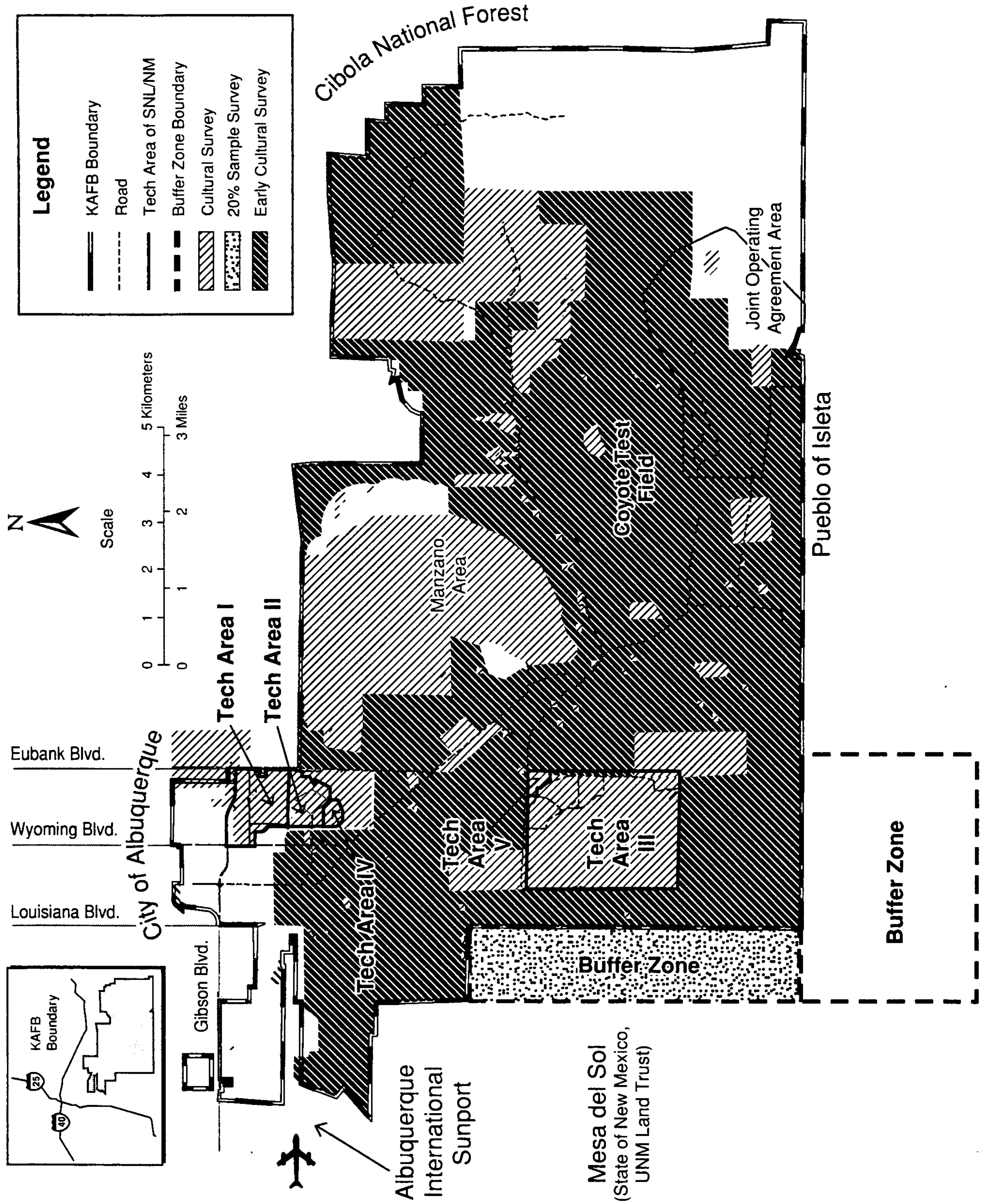
4.8.3.1 Overview of Cultural Resource Inventories and Sites

SNL/NM is located along the middle Rio Grande valley. The valley has been consistently inhabited for thousands of years, and contains present-day Puebloan cultural groups who have ancestral ties to the area. Archaeological resources and TCPs hold important roles within the traditional cultures of these groups and of groups that are farther away. These resources are not just contained in the groups' traditions and oral histories, but play an active part in continuing a way of life that has been in existence since the groups' origins. Cultural resources are also important to the scientific community and to the general public as a key to understanding the vast prehistory and history of this region.

Since the first documented survey in 1936, well before the establishment of KAFB, both KAFB and the DOE buffer zones have been the subject of cultural resource studies (Figure 4.8–1). Over 160 cultural resource investigations, reports, and studies have been conducted, most in the last 10 years. While many of these studies are extremely limited in scope, others are broad and apply to the entire KAFB. Approximately 75 percent of the ROI has been studied for cultural resources (Trierweiler 1998, SNL/NM 1997a).

Within the boundaries of KAFB and the DOE buffer zone, 284 prehistoric and historic archaeological sites have been recorded, of which 192 have been recommended as eligible or potentially eligible for the NRHP. The resources range from prehistoric Native American campsites to historic Euro-American placer mining pits. Of the prehistoric archaeological sites, campsites are the most common, followed by sites of limited activity (such as stone tool production), then habitations. Of the historic sites, mining sites are the most common, followed by habitations, then sites related to agriculture and ranching, then small, isolated trash scatters (Trierweiler 1998).

Five hundred seventy-nine architectural properties have been recorded and assessed for NRHP eligibility within KAFB boundaries, of which nine individual properties have been recommended as eligible or potentially eligible for the NRHP (Trierweiler 1998; USAF 1998a; Tuttle 1998). Most of them were recorded by the 377th Air Base Wing of KAFB, under the auspices of the U.S. Department of Defense (DoD) Legacy Program, and are on KAFB lands. Few of these properties predate World War II, and most were constructed during the 1940s and 1950s (Trierweiler 1998). In addition, the architectural properties in TA-II, as a group, are eligible to the NRHP as



Source: SNL/NM 1997j

Figure 4.8–1. Areas Inventoried for Cultural Resources in KAFB and the DOE Buffer Zones

Over 160 cultural resource studies have been conducted on KAFB and the DOE Buffer Zones.

a district. A more detailed discussion of the cultural resources at KAFB is provided in Appendix C.

Unidentified Sites

Despite the large number of cultural resource inventories conducted on KAFB, cultural resources probably exist that have not yet been identified or recorded. Even in areas that have been inventoried, data collected on resource locations could be incomplete due to human error or conditions such as heavy vegetation cover, which can seriously affect the ability to see sites on the ground. In addition, archaeological sites may be buried (Frederick 1992, Frederick & Williamson 1997, Larson et al. 1998, Abbott et al. 1997, Doleman 1989).

Settlement Patterns

Previous archaeological research on KAFB indicates definite patterns in the location and densities of cultural resources on KAFB (Figure 4.8–2). These patterns can be used to predict if sites are likely to exist in an area and, if so, their probable density. Known archaeological sites on KAFB are primarily concentrated in four areas. Two areas along Arroyo del Coyote contain the largest concentrations of sites: one in the area southeast of the Manzano Area and the other in the Withdrawn Area near the headwaters of Arroyo del Coyote, where tributaries from the mountains flow into Coyote Canyon. A third concentration of sites is in the southwest corner of the Withdrawn Area in the upper elevations. Finally, a smaller concentration of sites is found along Tijeras Arroyo in the northwest portion of KAFB.

4.8.3.2 Cultural Resource Protection in the ROI

Because activities within KAFB are conducted by Federal agencies, contractors to Federal agencies, and private entities under agreement with Federal agencies, there are a number of laws, regulations, and executive orders applicable to Federal agencies that protect cultural resources and access to resources that are sacred or ceremonial sites on KAFB (see Chapter 7). Each of the agencies in the ROI (DOE, USAF, and USFS) has implementing policies and procedures that follow these regulations. In addition, there are personnel assigned within each agency with responsibility for overseeing compliance with the policies and procedures implemented by their respective agencies. Proposed undertakings in the ROI undergo review by the responsible Federal agency to determine if eligible cultural resources could be effected by the undertaking. Consultations between the agencies and the New Mexico State Historic Preservation Officer (SHPO) take place as required. Agencies and the SHPO consult on measures that can be implemented to mitigate or avoid any potential adverse effects.

4.8.3.3 Cultural Resources by Land Use Type

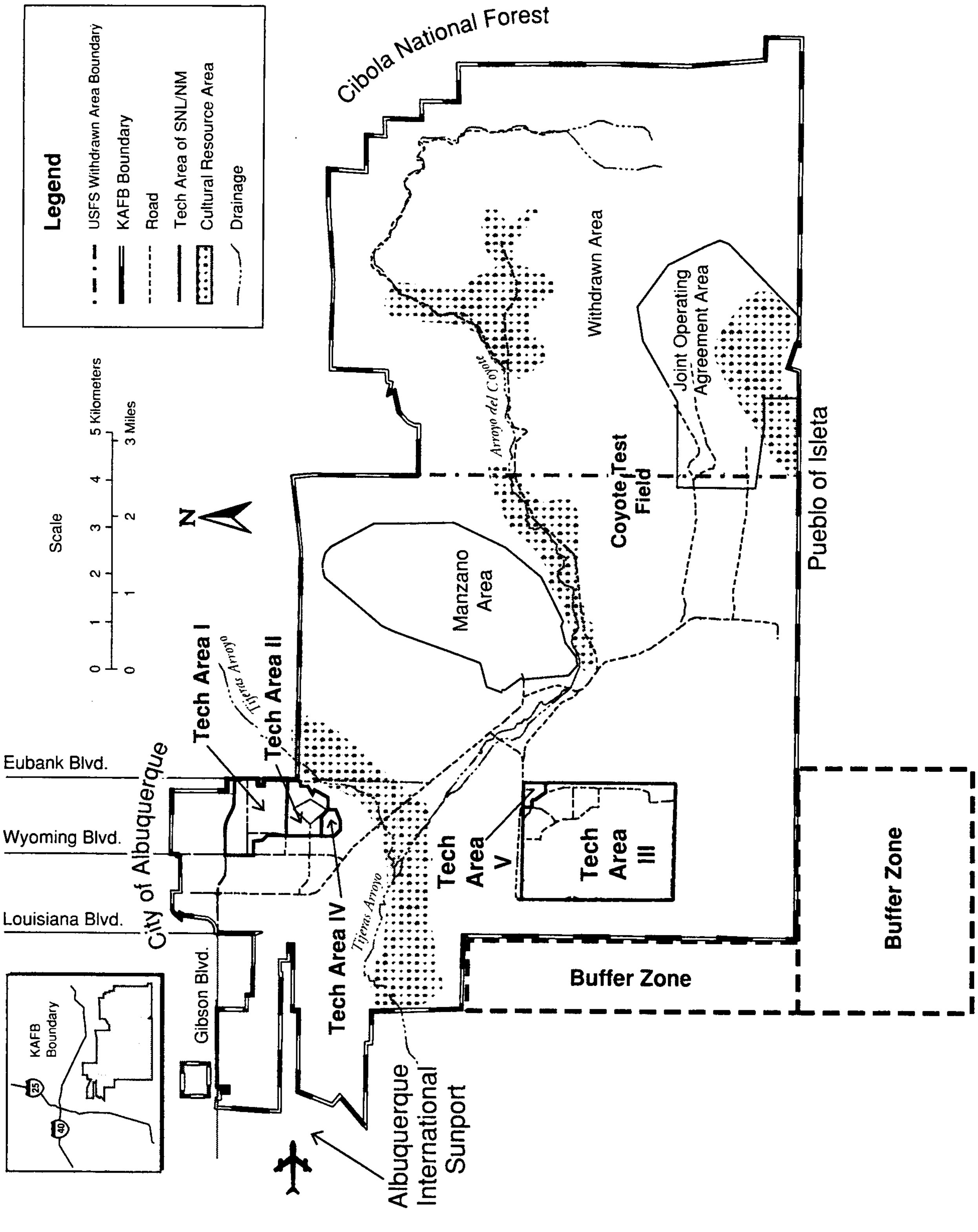
KAFB Lands Owned by the DOE and Used by SNL/NM

TAs-I through -V have been completely inventoried for archaeological sites (both prehistoric and historic) (Hoagland 1990 a,b,c,d,e; Lord 1990). Although TAs-II and -IV are in an area that likely contains sites (adjacent to Tijeras Arroyo), aside from isolated occurrences of artifacts, no prehistoric or historic archaeological sites have been identified there. The vast majority of buildings and structures used by SNL/NM are less than 50 years old, and thus have not been assessed for eligibility for inclusion in the NRHP. Assessments have not been conducted for buildings and structures in TAs-III, -IV, and -V; thus, their eligibility to the NRHP is unknown. Fifty-two buildings in TA-I were assessed and determined to be ineligible (Hoagland 1991, 1993; Sebastian 1993; Merlan 1993). The remaining buildings and structures in that area have not been assessed due to their young age. As the buildings in the four TAs attain the 50-year mark, the DOE will assess them for eligibility for inclusion in the NRHP (Merlan 1991). TA-II has been determined to be eligible to the NRHP as a district, with most of the larger buildings contributing to that status (DOE 1998o).

The DOE is responsible for the cultural resources contained in these TAs and has adopted implementing policies and guidelines that address the management of cultural resources. The DOE does not have a cultural resource management plan for the land it owns on KAFB due to the paucity of sites on these lands.

Other KAFB Lands Used by SNL/NM Through Land Use Agreements

A number of cultural resource inventories on KAFB have included areas used by SNL/NM through various land use agreements with the USAF and the USFS. These areas have been completely surveyed for cultural resources, except for the southeastern one-third of the Joint Operating Agreement Area (Starfire Optical Range) (Figure 4.8–1). In the areas that have been inventoried, archaeological sites are frequent only in the areas coinciding with the settlement patterns discussed previously, such as the Joint Use Agreement Area



Source: SNL/NM 1997j

Figure 4.8–2. Areas With a Concentration of Archaeological Sites on KAFB and the DOE Buffer Zone

Known archaeological sites on KAFB are primarily concentrated in four areas.

(uplands), the DOE Withdrawn Area used by SNL/NM as a buffer for the Lurance Canyon Burn Site (near a tributary to Arroyo del Coyote), and the DOE permit area along Arroyo del Coyote. The unsurveyed portion of the Joint Use Agreement Area is likely to contain sites based on the high density of sites located in the adjacent inventoried areas. No building or structure assessments have been conducted in these areas.

Responsibility for managing the cultural resources contained in these areas falls to the agency that owns the specific parcel of land, though the land use agreements usually stipulate that the DOE must conduct the necessary studies to determine if an area scheduled for DOE activities contains cultural resources. For KAFB areas permitted to the DOE, the guidelines and policies of the USAF direct managing cultural resources in concert with the KAFB cultural resource management plan (Trierweiler 1998). For the entire Withdrawn Area, the management of cultural resources follows the policies and procedures of the USFS, along with the guidelines presented in the *Cibola National Forest Land and Resource Management Plan* (USFS 1985). The DOE and the USFS have two separate memorandums of agreement (dated May 15, 1989, and January 22, 1987) that address agency responsibilities on portions of the Withdrawn Area.

The DOE Buffer Zones Used by SNL/NM

SNL/NM uses two areas outside and adjacent to the KAFB boundary. These areas, leased from the state of New Mexico and the Pueblo of Isleta, comprise the DOE buffer zones. The land leased from the state of New Mexico has undergone a 20-percent cultural resource sample inventory (Doleman 1989). This inventory identified three archaeological sites within the leased area, one of which is eligible to the NRHP and the other two are potentially eligible. The land leased from the Pueblo of Isleta has not undergone a cultural resource inventory and no cultural resources are currently known in this area (Geister 1998). Based on the settlement patterns evident on adjacent KAFB areas, a low density of archaeological sites in both these areas is expected. No building or structure assessments have been conducted on either leased area. Responsibility for the cultural resources in these areas is retained by the land-owning agencies (state of New Mexico or Pueblo of Isleta/BIA).

KAFB Lands Not Used by SNL/NM

Cultural resource inventories conducted on KAFB have also included areas not used by SNL/NM. Locations of archaeological sites in these areas follow the settlement patterns discussed previously, such as along Tijeras Arroyo, Arroyo del Coyote, and in the uplands near the Joint Use Agreement Area. Some inventories assessed the eligibility of certain buildings and structures. Of these areas, the DOE is responsible only for those areas owned by the DOE (Table 4.3–1), which may be used by, permitted to, or out-granted to other agencies.

4.8.3.4 Traditional Cultural Properties

A TCP is a place or object that is significant to a particular living community. This significance is "derived from the role the TCP plays in the community's historically rooted beliefs, customs, and practices" (NPS 1990). TCPs are associated with the cultural practices and beliefs that are rooted in a community's history and important in maintaining the cultural identity of the community.

Consultations to identify TCPs were conducted for the purposes of the SWEIS. Consultations were held with 15 Native American tribes with a cultural interest in the area to determine the presence of cultural properties significant to them within the ROI (Appendix C). No specific TCPs have yet been identified through these consultations. Although no specific locations have been identified during these consultations, some tribes have stated that they have concerns for cultural sites in the ROI that are important to them. Consultations will continue with some tribes, which could lead to the identification of TCPs in the future. A more detailed discussion of the TCP study methods and results can be found in Appendix C.

4.9 AIR QUALITY

4.9.1 Nonradiological Air Quality

4.9.1.1 Definition of Resource

Ambient air quality is determined by measuring or modeling ambient pollutant concentrations and comparing the concentrations to the corresponding standards. As directed by the *Clean Air Act* (CAA) of 1970 (42 U.S.C.§7401), the EPA has set the National Ambient Air Quality Standards (NAAQS) for several criteria pollutants to protect human health and welfare (40 CFR Part 50). These pollutants include particulate matter less than 10 microns in diameter (PM_{10}), sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, and ozone. The Draft SNL/NM SWEIS indicated that on September 16, 1997, a new NAAQS became effective for particulate matter with a size classification defined as less than or equal to 2.5 microns in diameter ($PM_{2.5}$). This new standard would have been in addition to the PM_{10} NAAQS. It is estimated that the new $PM_{2.5}$ standard, if it had gone into effect, would not have required local area controls until about 2005 and that compliance determinations would not have been required until around 2008. However, on May 14th, 1999, the U.S. Court of Appeals for the District of Columbia overturned the new air quality standards.

On June 5, 1998, ambient air quality became subject to a new 8-hour, 0.08-ppm ozone standard, replacing the previous 1-hour, 0.12-ppm ozone standard (63 FR 31034). This new ozone standard was also overturned on May 14, 1999. Under the new standard, in the year 2000, the EPA would have designated areas that did not meet the 8-hour standard based on the most recently available 3 years of ozone data available at that time (that is, 1997 through 1999).

A primary NAAQS has been established for carbon monoxide, and both primary and secondary standards have been established for the remaining criteria pollutants. Primary NAAQS define levels of air quality judged necessary, with an adequate margin of safety, to protect public health. Secondary NAAQS define levels of air quality judged necessary to protect public welfare from any known or anticipated adverse effects of a pollutant.

Air quality for SNL/NM is governed by regulations promulgated locally by the Albuquerque/Bernalillo County Air Quality Control Board (A/BC AQCB) and Federally by the EPA. The EPA has delegated authority for regulating sources under the CAA to the state of New Mexico. In turn, the state of New Mexico has delegated authority for regulating sources to the A/BC AQCB, located in Bernalillo county.

The A/BC AQCB promulgates regulations in 20 NMAC 11 for compliance with the CAA, as well as applicable state and local air quality requirements. The Albuquerque Environmental Health Department (AEHD) Air Quality Division (AQD) administers the regulations promulgated by the A/BC AQCB (SNL/NM 1997a). The New Mexico Environmental Improvement Board (NMEIB) has established ambient air quality standards (20 NMAC 2.3) that are generally more stringent than the Federal standards and that incorporate additional standards for hydrogen sulfide and total reduced sulfur. In addition to the criteria pollutants provisions, the EPA established in 40 CFR Part 62 the National Emission Standards for Hazardous Air Pollutants (NESHAP) and Title III of the 1990 CAA Amendments, which define hazardous air pollutants (HAPs). The primary nonradiological pollutants considered in the SWEIS are criteria pollutants and chemical pollutants.

Chemical pollutants include the 188 HAPs defined by the EPA in Title III of the CAA. Also included are other potentially toxic chemical air pollutants for which occupational exposure limits (OELs) have been defined by various organizations, including those chemicals categorized as volatile organic compounds (VOCs) (any organic compound that participates in atmospheric photochemical reactions except those designated by the EPA administrator as having negligible photochemical reactivity). The OEL used for this analysis is a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.

4.9.1.2 Region of Influence

The ROI is defined in the *New Mexico Air Pollution Control Bureau Dispersion Modeling Guidelines* (NMAPCB 1996) as the maximum extent of a source's significant impact. Significant impact is provided for each of the criteria pollutants as a specific concentration for a given averaging period (for example, 5.0 $\mu g/m^3$ for nitrogen oxide for a 24-hour averaging period). The maximum extent of significant ambient concentrations for the primary stationary source at SNL/NM (the steam plant) is approximately 15 mi for nitrogen oxide. The ROI for nonradiological air quality is, therefore, an area approximately 15 mi in radius about the SNL/NM steam plant. The steam plant is the primary stationary source at SNL/NM and determines the maximum extent of significant ambient concentrations (Figure 4.9–1).

The area contained within a 15-mi radius around the steam plant falls largely within the Albuquerque air basin and within Bernalillo county, with a small portion extending into northern Valencia county.

4.9.1.3 Affected Environment

The 1996 baseline air quality at SNL/NM and the ambient air quality within the ROI represent the affected environment. SNL/NM's contribution to the ambient air quality of the affected environment is based on its sources of emissions. The primary stationary sources of criteria pollutants are the steam plant boilers (which represent more than 90 percent of the total emissions of criteria pollutants), Building 862 generators, and the fire testing facilities located at the Lurance Canyon Burn Site (SNL/NM 1997a). Other sources are spatially separated, thereby contributing minimal impacts. Emissions of chemical air pollutants include those from facilities that release chemicals to the atmosphere and from operations at the burn site.

Meteorology and Climatology

The climate at SNL/NM and in the surrounding region is semiarid. The ambient temperatures in the region are characteristic of high-altitude, dry continental climates. Winter daytime temperatures average approximately 50°F, with nighttime temperatures often dropping into the low teens. Summer daytime temperatures generally do not exceed 90°F, except in July, when average maximum temperatures reach 93°F. The Albuquerque basin is characterized by low precipitation, averaging between 7.5 and 10 inches a year. Most of this precipitation falls from July through September and usually occurs from thunderstorm activities and the intrusion of warm, moist tropical air from the Pacific Ocean. The storms are accompanied by localized heavy wind gusts. Winter months are typically dry, with less than 2 inches of precipitation and limited snowfall. The average annual relative humidity is about 43 percent. New Mexico has one of the greatest frequencies of lightning in the U.S. Tornadoes are uncommon in the Albuquerque basin (SNL/NM 1997a).

Temperature, relative humidity, and precipitation do not vary dramatically across the region. Daily and seasonal wind patterns occur near the mountains and plateau. Daytime upslope flows are usually coupled with downslope flows during the night. Strong springtime, easterly winds occur near canyons, and light north-south flows occur in the Rio Grande valley.

In general, areas closer to the mountains or canyons experience more frequent winds from an easterly direction at night. Daytime wind patterns are not as pronounced, but generally flow toward the mountains or along the Rio Grande valley. The Rio Grande valley experiences the most frequent calm conditions and the lowest average wind speed. In most areas, the nighttime wind direction frequency produces the most dominant average annual direction.

Ambient Air Quality

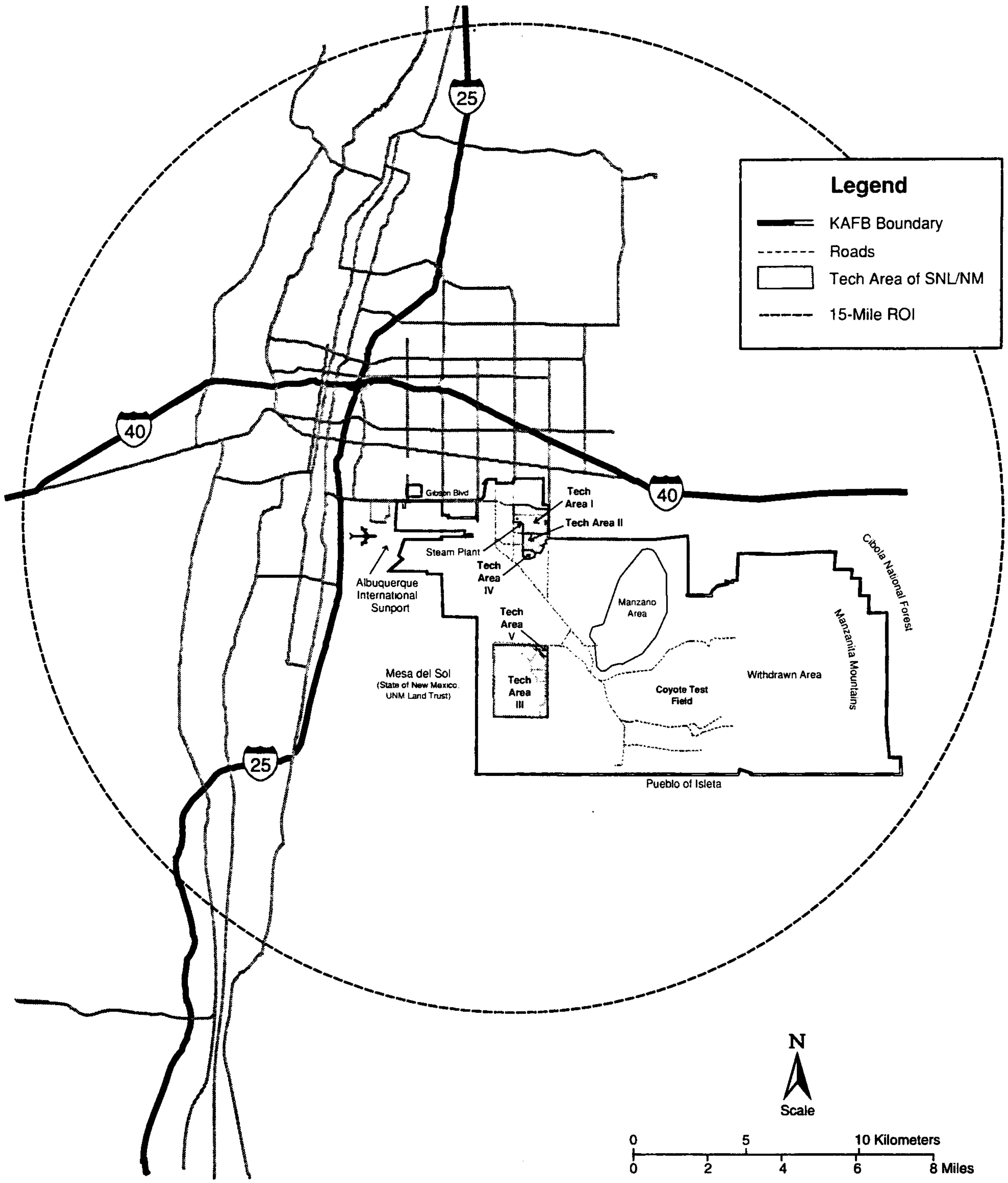
This section describes the existing ambient air quality, which includes regional and SNL/NM air quality. Existing air quality in the region and for SNL/NM is defined by air emissions and air quality monitoring data.

Regional Air Quality

From 1978 through 1996, the EPA classified the Albuquerque/Bernalillo county region as a nonattainment area for carbon monoxide. In 1983, the area experienced 74 violations of the NAAQS for carbon monoxide. Control measures, such as the vehicle emissions testing, oxygenated fuels programs, and the winter "No Burn" program, have helped decrease the amount of carbon monoxide pollution and reduce the number of NAAQS violations. The Federal Motor Vehicle Control Program, which requires improved emissions standards for new cars, has also been a major factor in reduced vehicle emissions. Since 1992, the region has not violated NAAQS standards (COA n.d. [no date] [d]). On July 15, 1996, the EPA redesignated the region from nonattainment to a maintenance level for carbon monoxide.

Few industrial emission sources exist in the region. However, more than one-third of New Mexico's population lives in the Albuquerque metropolitan area and the population is projected to increase an average of 10,000 to 15,000 per year. With increased population comes more motor vehicles, new development and housing, new employment, and more (often longer) commutes to work. Major sources of air emissions result from using motor vehicles, the seasonal use of wood-burning stoves and fireplaces, and open burning activities (COA n.d.[d]).

The dry climate, unpaved roads and parking lots, and wood-burning activities are primary sources of dust particles (PM_{10}) that cause poor visibility. The dry



Source: SNL/NM 1997a

Figure 4.9–1. Air Quality Region of Influence

The region of influence for nonradiological air quality extends 15 mi around the SNL/NM steam plant.

conditions result in poor soil stabilization, thereby increasing dust from agriculture, construction activities, and roads. These all contribute to high levels of particulate matter in the air. These conditions can also clog air filters in vehicles, reducing air flow to carburetors. The high elevation of this region results in incomplete and less efficient fuel burning and increased carbon monoxide emission. Wood and open burning activities also contribute to carbon monoxide pollution. However, motor vehicles have been, and continue to be, the major source of carbon monoxide (COA n.d.[d]).

SNL/NM is in the Albuquerque Middle Rio Grande Intrastate Air Quality Control Region (AQCR) 152 (40 CFR §81.83). The EPA has classified this AQCR as follows:

- Better than national standards – sulfur dioxides
- Unclassifiable/attainment – ozone
- Unclassifiable – PM_{10}
- Cannot be classified or better than national standards – nitrogen dioxide
- Maintenance – carbon monoxide
- Not designated – lead (40 CFR §81.332)

Wood burning has been an important contributor to the visible winter brown cloud. In 1985, a "No Burn" program, from October through February, began on a voluntary basis. This program, now mandatory, has become an important element of the A/BC AQCB's program for carbon monoxide abatement. The program prohibits operating a solid fuel heating device within the woodsmoke-impacted area during a declared no-burn period unless the device is a wood heater that has been emission-certified by the EPA. In recent years, the "No Burn" program has resulted in improved visibility on calm winter nights and mornings, as well as reductions in monitored carbon monoxide levels.

The AEHD and the NMED monitor the ambient air in the Albuquerque basin to determine the air quality in neighborhoods, background locations, and expected maximum impact locations and to estimate impacts from mobile vehicles. Fourteen monitoring stations throughout the Albuquerque basin measure criteria pollutants, including carbon monoxide, nitrogen dioxide, PM_{10}, and ozone. These monitoring stations do not measure lead or sulfur dioxide. An additional station, the Criteria Pollutant Monitoring Station (CPMS) located in TA-I, measures lead and sulfur dioxide. Figure 4.9–2 presents the locations of ambient air monitoring stations within the Albuquerque basin (except for station 3ZC, located at Bandelier National Monument, approximately 50 mi north-northeast of SNL/NM). Figure 4.9–3 presents the monitoring stations located within KAFB.

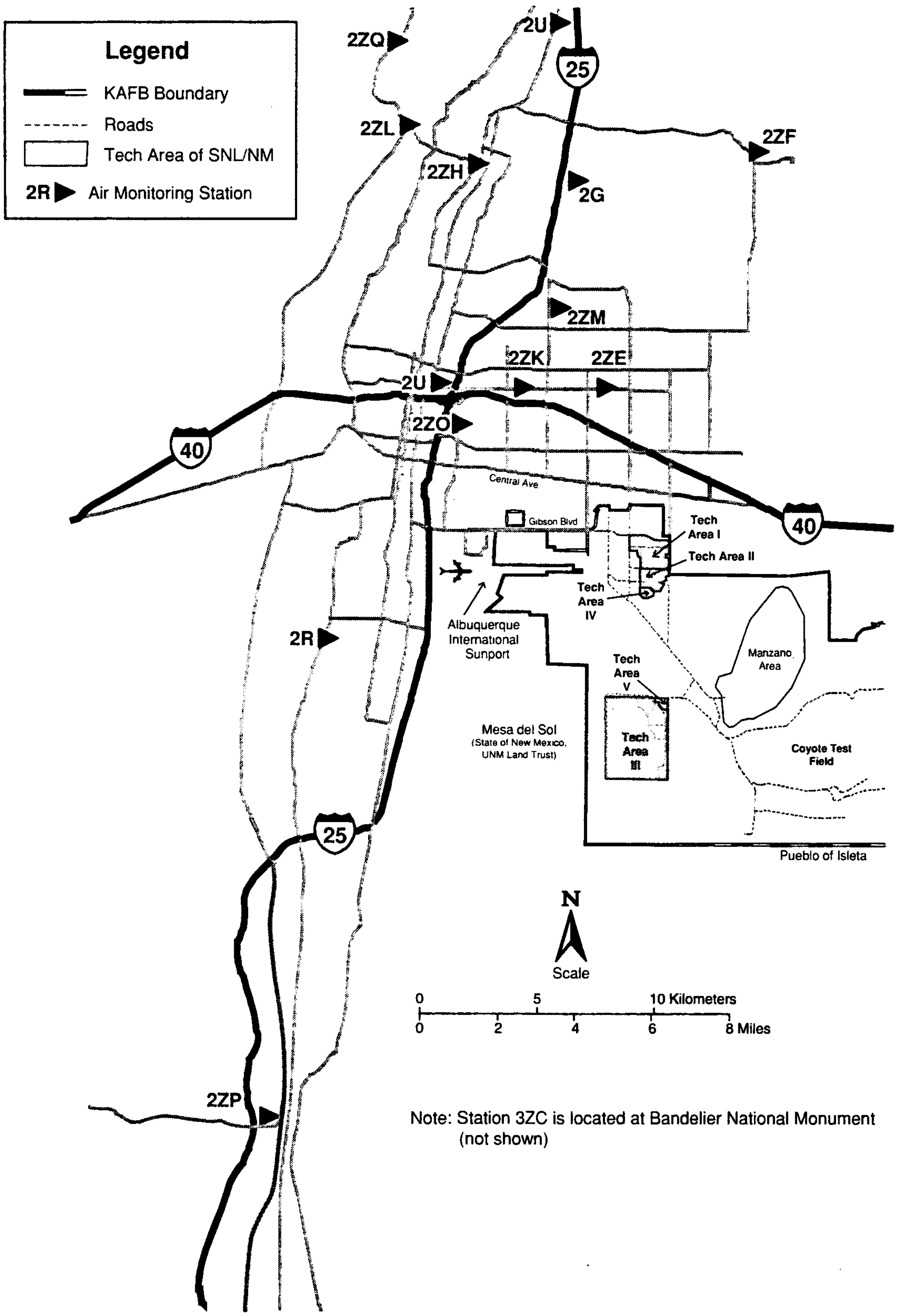
Table 4.9–1 compares maximum air concentrations monitored in the Albuquerque basin during 1996 to applicable Federal (40 CFR Part 50) and state (20 NMAC 2.3) standards for each pollutant. The annual standards are not to be exceeded. Short-term standards may be exceeded, generally once, before a violation must be reported. The preamble of the state regulation (Section 108) allows excesses over short periods of time due to unusual meteorological conditions. Air quality standards were not exceeded in 1996 or 1997 (SNL/NM 1997a).

SNL/NM Air Quality

The major stationary sources of criteria pollutant emissions at SNL/NM are the steam plant, electric power generator plant, and Lurance Canyon Burn Site. Emissions from the steam plant, electric power generator plant, and Lurance Canyon Burn Site include carbon monoxide, nitrogen oxide, sulfur dioxide, and PM_{10}. The emissions factors for the steam plant and electric power generator plant were developed specifically for the SNL/NM operating permit application. The emissions were calculated by using the fuel throughputs provided by SNL/NM and emission factors obtained from the EPA's *Compilation of Air Pollutant Emission Factors-AP–42* (EPA 1995b). Table 4.9–2 summarizes the emissions associated with these facilities for 1992 through 1996, as well as VOC and HAP emissions from the entire site. SNL/NM annual emissions show a trend toward lower annual emissions from 1992 through 1996 for PM_{10}, sulfur dioxide, VOCs, and HAPs. The nitrogen oxide and carbon monoxide emissions fluctuate with the annual demand for steam.

VOC and HAP emissions come from laboratories, miscellaneous chemical operations, and the fire testing facilities. Chemical uses and the corresponding emissions occur in each TA and in the outlying test areas. In 1996, HAP emissions associated with chemical users were 2.4 tons (SNL/NM 1997a). VOC emissions for 1996 were approximately 4.07 tons (SNL/NM 1997a).

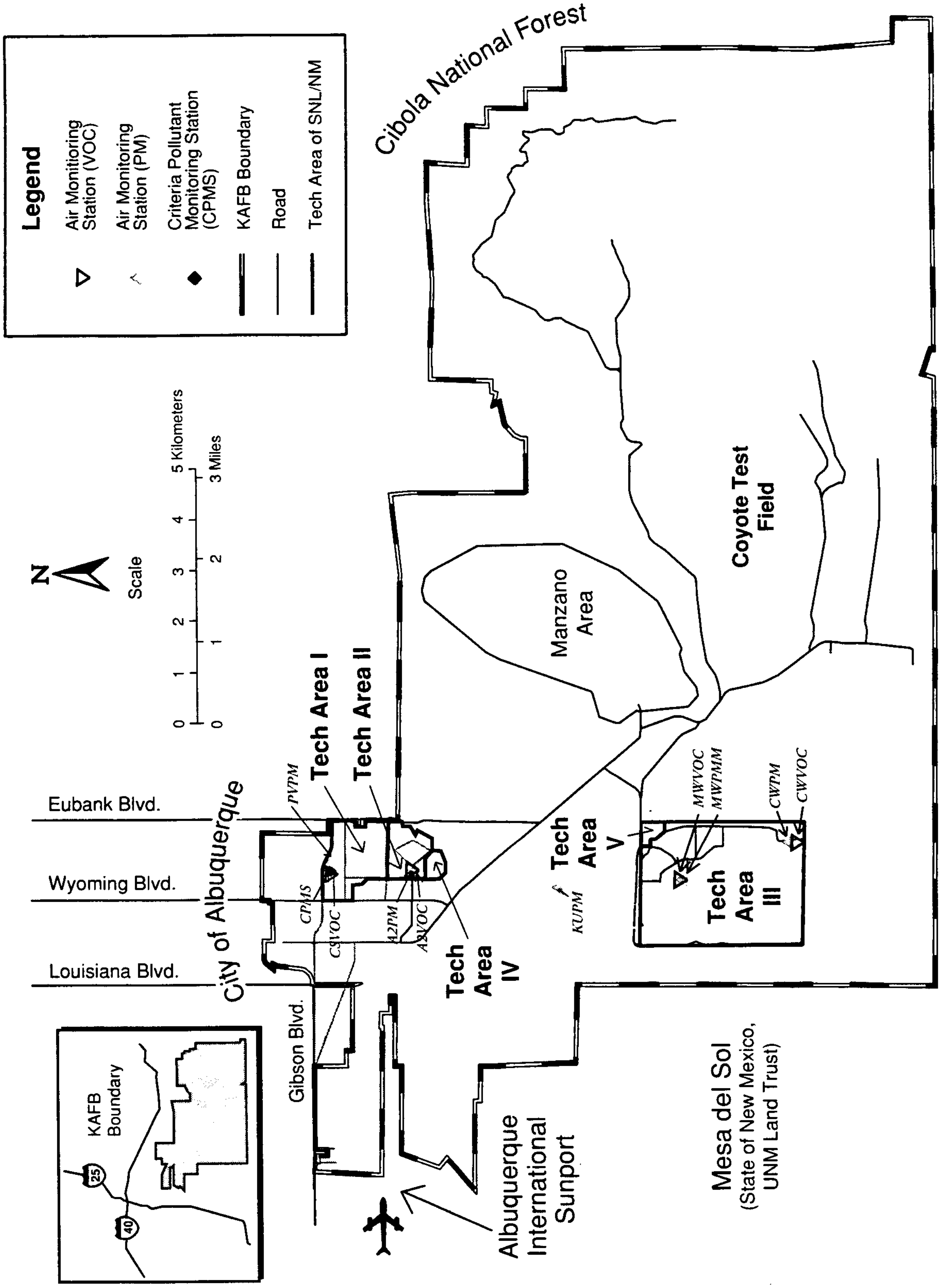
In addition to regional ambient air quality monitoring for criteria pollutants, SNL/NM operates six onsite monitoring stations for PM_{10}. Monitoring results indicate that sampling locations closer to the most populated areas of SNL/NM generally reveal higher PM_{10} concentrations. In addition, PM_{10} concentrations generally increase during



Source: SNL/NM 1997j, 1998f

Figure 4.9–2. Locations of Offsite Criteria Pollutant Monitoring Stations

Fourteen monitoring stations measure criteria pollutants throughout the Albuquerque Basin.



Source: SNL/NM 1997j

Figure 4.9–3. Locations of Onsite Criteria Pollutant Monitoring Stations

Ten ambient air monitoring stations are located within the boundaries of KAFB.

Table 4.9–1. Comparison of 1996 Maximum Ambient Air Concentrations With Applicable National and New Mexico Ambient Air Quality Standards (ppm)

POLLUTANT	AVERAGING TIME	NAAQS	NMAAQS	MAXIMUM AMBIENT AIR CONCENTRATION	MONITORING LOCATION
Carbon Monoxide	8 hours	9	8.7	8.30	2ZK
	1 hour	35	13.1	12.0	2ZK
Lead	Quarterly	1.5[a]	-	0.001[a]	CPMS
Nitrogen Dioxide	Annual	0.053	0.05	0.022	2ZM
	24 hours	-	0.10	0.045	2ZM
Total Suspended Particulates	Annual	-	60[a]	NA	-
	30 days	-	90[a]	NA	-
	7 days	-	110[a]	NA	-
	24 hours	-	150[a]	NA	-
Particulate Matter	Annual	50[a]	-	37[a]	2R
	24 hours	150[a]	-	96[a]	2R
	Annual	0.03	0.02	0.0001	CPMS
Sulfur Dioxide	24 hours	0.14[a]	0.10[a]	0.003[a]	CPMS
	3 hours	0.50[a]	-	0.009[a]	CPMS
Ozone[b]	1 hour	0.12	-	0.111	2ZF
Hydrogen Sulfide	1 hour	-	0.01	NA	-
Total Reduced Sulfur	0.5 hour	-	0.03	NA	-

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL/NM 1997a
CPMS: Criteria Pollutant Monitoring Station
NA: not available
NAAQS: National Ambient Air Quality Standard
NMAAQS: New Mexico Ambient Air Quality Standard
ppm: parts per million
[a] micrograms per cubic meter
[b] New 8-hour, 0.08-ppm ozone standard, applicable to SNL/NM, will apply in year 2000 (see Section 4.9.1.1).

Table 4.9–2. Estimated Air Emissions from Stationary Sources at SNL/NM, 1992 through 1996 (tons/year)

POLLUTANT	SOURCE	1992	1993	1994	1995	1996
Nitrogen Oxide	Lurance Canyon Burn Site[c]	0.07	0.02	0.02	0.02	0.02
	Steam plant	47.78[a]	155.08[b]	148.06[b]	126.00[b]	153.00[b]
	Building 862 generators	0.03	5.55	0.61	1.11	0.90
	TOTAL	**47.88**	**160.65**	**148.69**	**127.13**	**153.92**
Carbon Monoxide	Lurance Canyon Burn Site[c]	2.87	0.77	0.79	0.75	0.78
	Steam plant	4.44[a]	16.25[b]	15.60[b]	13.80[b]	14.20[b]
	Building 862 generators	0.00	0.28	0.02	0.29	0.23
	TOTAL	**7.31**	**17.3**	**16.41**	**14.84**	**15.21**
PM_{10}	Lurance Canyon Burn Site[c]	2.60	0.70	0.71	0.69	0.71
	Steam plant	1.76[a]	3.90[b]	3.75[b]	3.45[b]	2.93[b]
	Building 862 generators	0.00	0.93	0.02	0.02	0.01
	TOTAL	**4.36**	**5.53**	**4.48**	**4.16**	**3.65**
Sulfur Dioxide	Lurance Canyon Burn Site[c]	0.14	0.04	0.04	0.04	0.04
	Steam plant	2.12[a]	0.33[b]	0.26[b]	0.22[b]	0.22[b]
	Building 862 generators	0.00	0.87	0.13	0.08	0.06
	TOTAL	**2.26**	**1.24**	**0.43**	**0.34**	**0.32**
VOCs	All facilities	NA	63.32	24.00	9.8	4.07
HAPs	All facilities	NA	50.75	17.79	5.52	2.4

Source: SNL/NM 1997a
HAPs: hazardous air pollutants
NA: not available
PM_{10}: particulate matter less than 10 microns in diameter
SMERF: Smoke Emission Reduction Facility
SNL/NM: Sandia National Laboratories/New Mexico
SWISH: Small Wind-Shielded Facility
VOCs: volatile organic compounds
[a] Based on actual stack emission measurements
[b] Based on published, theoretical emission factors in EPA AP-42
[c] Fire testing facilities include a number of open pools, the SMERF, and the SWISH located in Lurance Canyon

the windy season due to blowing soil particles. Dry weather conditions enhance this trend of increased concentration during windy periods. Table 4.9–3 presents the criteria pollutant concentrations at monitoring stations in TA-I. These stations measure concentrations of criteria pollutants from the nearest SNL/NM emission sources.

In 1996, VOC samples were collected at four onsite monitoring stations. These locations were selected for their proximity to known VOC emission sources. Table 4.9–4 presents the estimated 8-hour concentrations of VOCs calculated from onsite monitoring data for 1996 and the respective 8-hour OELs. These data are presented for comparison and indicate that the concentrations of VOCs measured at the onsite monitors are well below the respective OEL concentrations for an 8-hour workday.

The monitored VOCs represent a portion of the total chemical emissions from SNL/NM facilities. Monitoring data are not available for additional chemical compounds.

Steam Plant

The steam plant produces heat for buildings in TA-I and the eastern portion of KAFB. During 1996, all five boilers at the plant used a total of 740 M standard ft^3 of natural gas. These boilers can also run on diesel oil and used approximately 15,000 gal of oil during 1996 for system testing. Criteria pollutant emissions for 1992 through 1996 for the steam plant are presented in Table 4.9–2. The annual emissions for each pollutant vary from year to year based upon the heating degree days, fuel mix (natural gas versus fuel oil), and plant boiler loading, which have different efficiencies at different loadings.

Electric Power Generator Plant

SNL/NM has four standby generators, each with a 600-kW capacity. These diesel-fired generators are in TA-I, Building 862. The generators have a local air quality permit limiting operation to 500 hours per year per generator. They are started monthly for maintenance and testing, as well as during electrical power outages in TA-I.

Fire Testing Facilities (Lurance Canyon Burn Site)

The fire testing facilities (Lurance Canyon Burn Site) include a number of open pools, the Smoke Emission Reduction Facility (SMERF), and the Small Wind-Shielded (SWISH) Facility. The open pools emit directly to the atmosphere, while SMERF and SWISH are closed and emit through exhaust stacks. The fire testing facilities are used to test the response of shipping containers, aerospace components, and other items to high-temperature conditions. These facilities use a variety of fuels including jet fuel (JP-8), sawdust, a sawdust-propellant-acetone (SPA) mixture, explosives, and urethane foam.

These facilities typically average 42 tests per year; each test lasts about 30 minutes, although some can last as long as 4 hours. During 1996, the fire testing facilities used 10,400 gal of JP-8 and approximately 8 tons of sawdust (or wood). Based on process knowledge, emissions from these tests are known to include carbon monoxide, nitrogen oxide, sulfur dioxide, PM_{10}, and chemical pollutants (SNL/NM 1997a).

Mobile (Vehicular) Sources

Mobile sources (motor vehicles) are a major source of criteria pollutant emissions in and around SNL/NM. Carbon monoxide levels are the highest from November through January (MRGCOG 1997c). The EPA's *Mobile Source Emission Factor* computer model, *MOBILE5a* (EPA 1994), showed an estimated 920 tons of carbon monoxide emissions from SNL/NM commuter traffic for November through January (SNL 1996c), which is approximately 3.7 percent of the estimated carbon monoxide emissions for Bernalillo county vehicular emissions during the same period. Total SNL/NM mobile source carbon monoxide emissions for 1996 are 4,087 tons. For more information on the number of vehicles, see Volume II, Table D.1–30.

4.9.2 Radiological Air Quality

4.9.2.1 Definition of Resource

Specific SNL/NM facilities discharge low quantities of radionuclides to the air. These releases can be evaluated according to the individual and population dose created from the combined releases of all facilities at SNL/NM. The degree of hazard to the public is directly related to the type and quantity of the radioactive materials released. How long a person is exposed to the released material is also a factor in assessing potential health effects. Dose estimates are modeled from emissions determined at each facility and compared to regulatory dose limits for the protection of public health.

4.9.2.2 Region of Influence

The ROI is the 50-mi radius of SNL/NM, which is consistent with the recommended DOE 5400.5 guidance. The ROI includes the counties of Bernalillo, McKinley, Cibola, San Miguel, Santa Fe, Sandoval, Valencia, Socorro, and Torrance, and the major cities of Albuquerque and Rio Rancho.

Table 4.9–3. 1996 Criteria Pollutant Concentrations from the Criteria Pollutant Monitoring Station with Applicable National and New Mexico Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	NAAQS (ppm/μg/m³)	NMAAQS (ppm/μg/m³)	BASELINE CONCENTRATION (ppm/μg/m³)	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9/8,564	8.7/8,279	2.86/2,722	33
	1 hour	35/33,305	13.1/12,466	8.30/7,898	63
	Annual	-	-	0.78/742	NA
Lead	30 days	-	-	0.0021[a]	NA
	Quarterly	1.5[a]	-	0.001[a]	0.07
Nitrogen Dioxide	Annual	0.053/83	0.05/78	0.012/19	24
	24 hours	-	0.10/156	0.035/55	35
Particulates (TSP)	Annual	-	60[a]	14.76[a]	30
	30 days	-	90[a]	NA	NA
	7 days	-	110[a]	NA	NA
	24 hours	-	150[a]	49[a]	33
Particulate Matter (PM_{10})	Annual	50[a]	-	14.76[a,b]	30
	24 hours	150[a]	-	49[a,b]	33
Sulfur Dioxide	Annual	0.03/65	0.02/44	0.0003/0.7	1.5
	24 hours	0.14/305	0.10/218	0.003/6.5	3
	3 hours	0.50/1,088	-	0.009/20	2
Ozone	Annual	-	-	0.033/54	NA
	1 hour	0.12/196	-	0.103/168	85.8
Hydrogen Sulfide	1 hour	-	0.01/12	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03/33	NA	NA

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL/NM 1997a
- indicates no standard for listed averaging time
°R: degrees Rankin
CPMS: Criteria Pollutant Monitoring Station
ft: feet
NA: not available
NAAQS: National Ambient Air Quality Standard
NMAAQS: New Mexico Ambient Air Quality Standard
ppm: parts per million

TSP: total suspended particulates
[a] micrograms per cubic meter
[b] highest quarterly lead monitoring data measured at the CPMS site in 1996
[c] highest one hour ozone monitoring data measured at the CPMS in 1996
[d] PM_{10} is assumed equal TSP
Note: Some of the pollutants are stated in parts per million (ppm). These values were converted to micrograms per cubic meter (μg/m³) with appropriate corrections for temperature (530°R) and pressure (elevation 5,400 ft) following New Mexico dispersion modeling guidelines (revised 1996).

Table 4.9–4. Maximum Ambient Concentrations of Volatile Organic Compounds from Onsite Monitors for 1996

VOCS	ESTIMATED 8-HOUR CONCENTRATION[a] (ppb)	8-HOUR OEL[b] (ppb)
1,1,1-trichloroethane	134.235	348,000
1,4-dioxane+2,2,4-trimethylpentane	1.35	25,000
1-butene	0.741	NA
2,2,4-trimethylpentane	0.426	NA
3-methylpentane	0.765	NA
Acetone	20.025	250,000
Benzene	1.674	100
Bromodichloromethane	0.096	NA
Carbon Tetrachloride	0.357	5,000
Chloromethane	1.371	5,000
Dichlorodifluoromethane	1.887	1,000,000
Ethylbenzene	0.411	100,000
Halocarbon 113	0.291	NA
Isobutene	0.648	NA
Isobutene + 1-butene	1.2	NA
Isohexane	1.425	NA
Isopentane	5.526	120,000
m/p-xylene	0.897	100,000
Methylene Chloride	0.258	50,000
n-Butane	5.466	800,000
n-Hexane	0.831	50,000
n-Pentane	2.496	120,000
n-Undecane	0.219	NA
o-Xylene	0.435	100,000
Tetrachloroethene	0.126	NA
Toluene	3.117	50,000
Trichloroethene	0.366	NA
Trichloroethene+Bromodichloromethane	0.195	NA
Trichlorofluoromethane	0.831	1,000,000
Total Nonmethane Hydrocarbons	259.191	NA

Source: SNL/NM 1997a
NA: not available
OEL: occupational exposure limit
ppb: parts per billion
VOC: volatile organic compound
[a] Estimated value calculated by multiplying the 24-hour measured concentration by 3.
[b] OELs are the minimum time-weighted exposure concentration for an 8- or 10-hour workday and a 40-hour work week to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect based upon the following sources:
American Conference of Governmental Industrial Hygienists
U.S. Occupational Safety and Health Administration
National Institute of Occupational Safety and Health
Deutsche Forschungsgemeinschaft (DFG), Federal Republic of Germany, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area

4.9.2.3 Affected Environment

Data from 1992 through 1996 were reviewed to characterize the baseline operational radiological emissions and corresponding dose estimates for specific SNL/NM facilities. The sources of this data were annual NESHAP reports, annual surveillance/monitoring reports, existing site environmental descriptions, radioactive emissions, and dose evaluations.

SNL/NM facilities that release radionuclides are shown in Figure 4.9–4. Table 4.9–5 identifies the types and quantities of radionuclides released from these facilities from 1993 through 1996. The 1992 estimated radiological emissions data and doses were not included in this baseline due to large variations in the data. These releases were used to calculate the doses at various receptors, thereby identifying a maximally exposed individual (MEI) member of the public and also the dose to the total population (732,823) within 50 mi of SNL/NM.

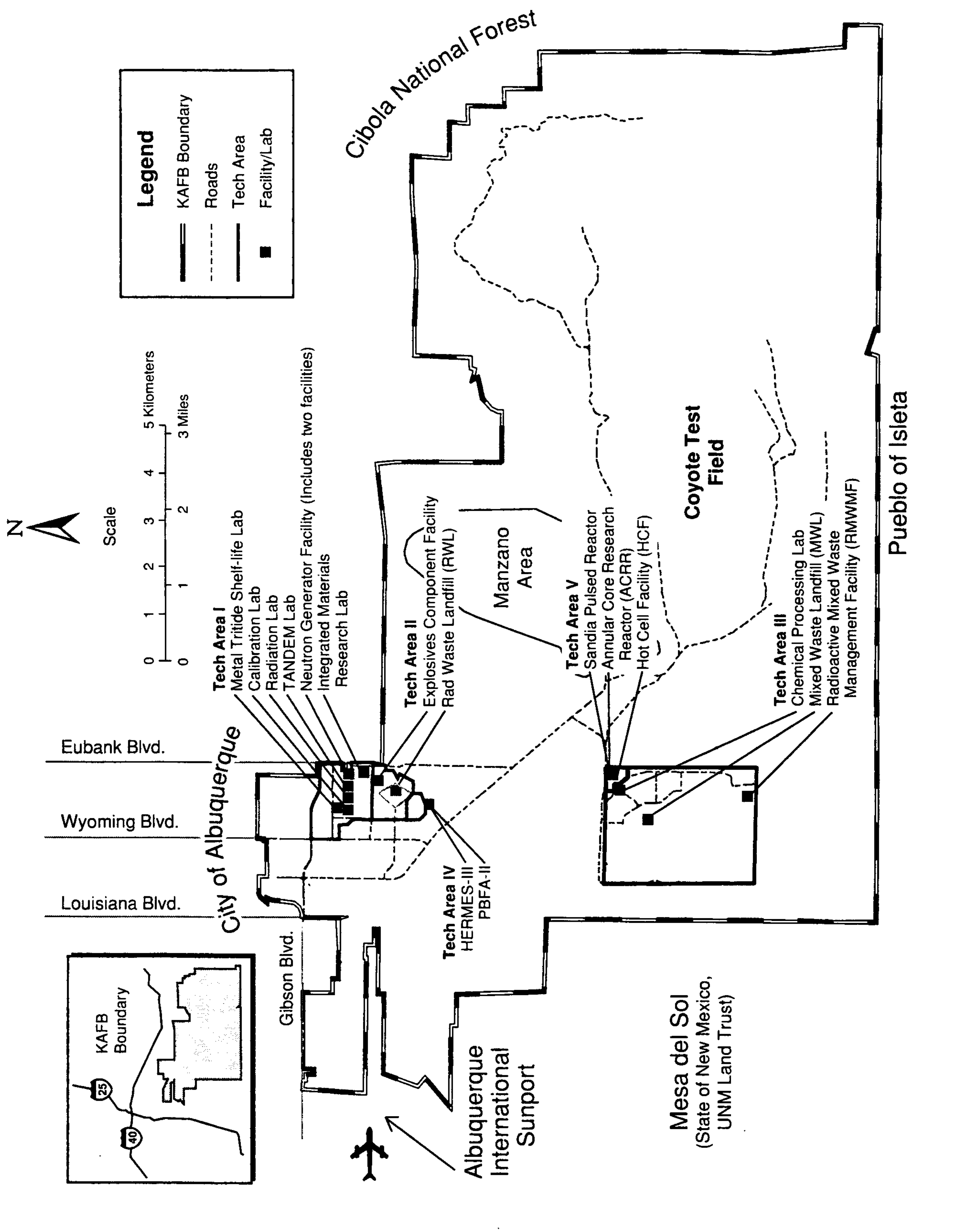
Because the general public (such as visitors to the golf course or National Atomic Museum) and Air Force personnel (such as families at base housing) have access to SNL/NM, both onsite and site boundary locations are considered as potential locations for an MEI. Table 4.9–6 presents the total dose to the MEI, along with the dose contributions from each facility for each year's radionuclide emissions, which are calculated using the *Clean Air Assessment Package* (*CAP88-PC)* computer model (DOE 1997e). These calculated doses are less than the regulatory limit of 10 mrem/yr of exposure to an individual of the public from airborne releases of radiological materials (40 CFR Part 61). These doses also are small compared to an individual background radiation dose of 360 mrem/yr (Section 4.10.3).

Maximally Exposed Individual

A hypothetical person at a location who could potentially receive the maximum dose of radiation or hazardous chemicals.

Both the dose to the MEI and the collective dose to the entire population within 50 mi of SNL/NM were assessed. Although releases from separate facilities contribute to the collective population dose, the computer model evaluated emissions out to a 50-mi radius, based on a single common release point centered at TA-V. The distances between buildings are relatively small compared to 50 mi, therefore, dose estimate results were only minimally affected. The calculated collective doses for SNL/NM operations from 1993 through 1996 are presented in Table 4.9–6.

Looking at the trend in SNL/NM radiological air emissions, higher releases occurred in 1996 than in the years 1993 through 1995 (Table 4.9–5). This has been attributed to converting and refurbishing the Annular Core Research Reactor (ACRR) for medical isotope production. Also, NESHAP "confirmatory measurements" requirements for radioactive air emissions were instituted at the Sandia Pulsed Reactor (SPR) and ACRR; these measurements were higher than calculated emissions. Since the SWEIS is addressing potential impacts for projected and planned future operations, the 1996 operations are considered representative of radiological air emissions for characterizing future SNL/NM operations. It can be seen from Table 4.9–5, that MEI dose is dominated by SPR, ACRR, and HCF source emissions.



Source: SNL/NM 1997d

Figure 4.9–4. SNL/NM Radionuclide-Releasing Facilities

Radionuclide-releasing facilities are located in all five technical areas.

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Sandia Pulsed Reactor, Building 6590	TA-V	Point	Argon-41	0.48	0.55	1.7	9.51
Annular Core Research Reactor, Building 6588	TA-V	Point	Argon-41	2.70	2.1	3.0	35.4
Hot Cell Facility, Building 6580	TA-V	Point	Tritium	0	1.1×10^{-5}	2.0×10^{-5}	0
			Iodine-131	0	0	0	1.96×10^{-3}
			Iodine-132	0	0	0	1.29×10^{-4}
			Iodine-133	0	0	0	9.51×10^{-3}
			Iodine-135	0	0	0	1.32×10^{-3}
			Krypton-83m	0.068	0.017	0.016	9.57×10^{-5}
			Krypton-85	3.7×10^{-6}	5.7×10^{-6}	3.3×10^{-5}	1.53×10^{-3}
			Krypton-85m	0.14	0.063	0.12	0.587
			Krypton-87	0.17	0.032	0.0014	0.0294
			Krypton-88	0.36	0.11	0.10	0.527
			Rubidium-86	1.1×10^{-7}	1.5×10^{-7}	8.0×10^{-7}	0
			Rubidium-87	1.0×10^{-14}	1.4×10^{-14}	8.1×10^{-14}	0
			Rubidium-88	0.41	0.019	4.1×10^{-4}	0
			Rubidium-89	0.0011	4.8×10^{-5}	0	0
			Xenon-131m	5.7×10^{-6}	5.8×10^{-4}	5.7×10^{-5}	3.45×10^{-4}
			Xenon-133	0.026	0.034	0.24	17.5
			Xenon-133m	0.0013	0.0017	0.011	0.768
			Xenon-135	0.40	0.41	1.4	14.7
			Xenon-135m	0.18	0.0051	2.7×10^{-4}	0.976
			Xenon-137	0	2.2×10^{-27}	0	0
			Xenon-138	0.0019	1.4×10^{-4}	1.4×10^{-14}	0
High-Energy Radiation Megavolt Electron Source, Building 970	TA-IV	Point	Nitrogen-13	0.58	2.32	5.5×10^{-4}	2.85×10^{-4}
			Oxygen-15	0.0050	0.030	5.5×10^{-5}	2.85×10^{-5}
Particle Beam Fusion Accelerator Building	TA-IV	Point	Nitrogen-13	0.042	0.042	0.042	0.042
			Oxygen-15	0.0050	0.0050	0.005	0.005
Mixed Waste Landfill	TA-III	Diffuse	Tritium	1.9	0.29	0.29	0.29

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996 (continued)

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Chemical Processing Laboratory, Building 6600	TA-III	Point	Na-22	0	2.4×10^{-12}	2.4×10^{-12}	2.4×10^{-12}
			Gadolinium-153	0	1.0×10^{-13}	0	0
			Americium-241	0	1.0×10^{-13}	1.0×10^{-13}	1.0×10^{-13}
			Uranium-232	0	0	1.0×10^{-13}	1.0×10^{-13}
			Plutonium-241	0	0	$1.0 \mathrm{X} 10^{-13}$	1.0×10^{-13}
Radioactive and Mixed Waste Management Facility, Building 6920	TA-III	Point	Tritium	0	0	0	4.12
Radioactive Waste Landfill	TA-II	Diffuse	Americium-241	0	0	0	4.7×10^{-13}
			Plutonium-239/240	0	0	0	3.9×10^{-15}
			Plutonium-238	0	0	0	7.9×10^{-15}
Explosive Components Facility, Building 905	TA-II	Point	Tritium	0	0	0	7.0×10^{-4}
Integrated Materials Research Laboratory, Building 897	TA-I	Point	Carbon-14	0	0	0	2.21×10^{5}
Neutron Generator Facility, Building 870	TA-I	Point	Tritium	0	0	0	0.11
TANDEM Accelerator, Building 884	TA-I	Point	Tritium	0	0	0	1.0×10^{-6}
			Carbon-11	4.2×10^{-5}	5.2×10^{-5}	8.8×10^{-6}	5.3×10^{-3}
			Nitrogen-13	9.9×10^{-5}	1.2×10^{-4}	2.1×10^{-5}	9.3×10^{-8}
			Oxygen-14	0	3.2×10^{-7}	5.3×10^{-8}	0
			Oxygen-15	0.0017	0.0021	0.00035	0.021
			Fluorine-17	0	8.0×10^{6}	1.3×10^{-6}	8.0×10^{-4}
			Fluorine-18	9.4×10^{-6}	1.2×10^{-5}	2.0×10^{-6}	4.4×10^{-5}

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996 (concluded)

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Radiation Laboratory, Building 827 & Building 805	TA-I	Point	Tritium	1.0×10^{-5}	1.0×10^{-5}	2.0×10^{-5}	1.00×10^{-5}
			Nitrogen-16	0	2.0×10^{-7}	2.0×10^{-7}	2.00×10^{-7}
			Nitrogen-17	0	0	1.0×10^{-8}	0
			Nitrogen-13	1.0×10^{-8}	1.0×10^{-8}	0	1.0×10^{-8}
			Nitrogen-15	0	0.10	0	0
			Argon-41	1.0×10^{-9}	1.0×10^{-9}	1.0×10^{-9}	1.00×10^{-9}
			Carbon-13	0	0.20	0	0
			Carbon-14	2.0×10^{-12}	2.0×10^{-12}	2.0×10^{-12}	0
			Curium-244	7.0×10^{-11}	7.0×10^{-11}	0	0
			Lead-210	4.0×10^{-13}	4.0×10^{-13}	0	0
			Uranium-238	4.0×10^{-12}	4.0×10^{-12}	0	0
			Plutonium-239	6.0×10^{-12}	6.0×10^{-12}	0	0
			Americium-241	1.0×10^{-11}	1.0×10^{-11}	0	0
Metal Tritide Shelf-Life Laboratory, Building 891	TA-I	Point	Tritium	6.0×10^{-5}	6.0×10^{-5}	5.0×10^{-9}	5.0×10^{-9}
Calibration Laboratory, Building 869	TA-I	Point	Tritium	0	1.5×10^{-6}	3.7×10^{-5}	2.51×10^{-4}
Neutron Generator Testing Facility, Building 935	TA-I	Point	Tritium	0	0	2.8×10^{-5}	0

Sources: SNL 1994b, 1995c, 1996a, 1997d
- concentration not measured or facility inactive
SNL/NM: Sandia National Laboratories/New Mexico
TA: technical area
yr: year
[a] Historical releases do not necessarily equate to projected releases presented in Sections 5.3.7.2, 5.4.7.2, and Appendix D.2. This is due in part to DOE project and program changes expected through 2008.

Table 4.9–6. Summary of Dose Estimates to SNL/NM Public from Radioactive Air Emissions (1993 to 1996) Modeled Effective Dose Equivalent (mrem/yr) to SNL/NM MEI and (person-rem) to Population

SOURCE	YEAR			
	1993	1994	1995	1996
MEI (mrem/yr)				
Sandia Pulsed Reactor, Building 6590	$5.9x10^{-5}$	$[5.0x10^{-4}]$[a]	$2.5x10^{-4}$	$1.2x10^{-3}$
Annular Core Research Reactor, Building 6588	$1.6x10^{-3}$		$6.0x10^{-4}$	$5.4x10^{-3}$
Hot Cell Facility, Building 6580	-	-	-	$3.9x10^{-4}$
High-Energy Radioactive Megavolt Electron Source	$1.7x10^{-5}$	$2.9x10^{-5}$	$5.8x10^{-9}$	$2.0x10^{-9}$
Particle Beam Fusion Accelerator, Building 983	$1.2x10^{-6}$	0	$4.0x10^{-7}$	$3.3x10^{-7}$
Mixed Waste Landfill	$8.5x10^{-6}$	$5.0x10^{-6}$	$4.0x10^{-6}$	$4.0x10^{-6}$
Chemical Processing Laboratory, Building 6600	-	$1.3x10^{-11}$	$3.7x10^{-11}$	$3.2x10^{-11}$
Radioactive and Mixed Waste Management Facility, Building 6920	-	-	-	$1.4x10^{-5}$
Radioactive Waste Landfill	-	-	-	$7.6x10^{-12}$
Explosive Components Facility, Building 905	-	-	-	$3.1x10^{-9}$
Integrated Materials Research Laboratory, Building 897	-	-	-	$4.8x10^{-12}$
Neutron Generator Facility, Building 870	-	-	-	$4.7x10^{-8}$
TANDEM Accelerator, Building 884	$2.7x10^{-9}$	$1.2x10^{-9}$	$3.0x10^{-10}$	$4.5x10^{-8}$
Radiation Laboratory, Building 827 & Building 805	$2.8x10^{-9}$	$8.8x10^{-10}$	$2.9x10^{-10}$	$4.6x10^{-11}$
Metal Tritide Shelf-Life Laboratory, Building 891	$1.0x10^{-9}$	$1.9x10^{-10}$	$3.0x10^{-14}$	$1.8x10^{-14}$
Calibration Laboratory, Building 869	-	$7.7x10^{-12}$	$5.7x10^{-10}$	$1.2x10^{-9}$
Neutron Generator Test Facility, Building 935	-	-	$2.1x10^{-9}$	-
TOTAL	**$1.6X10^{-3}$**	**$5.3X10^{-4}$**	**$8.5X10^{-4}$**	**$7.0X10^{-3}$**
Collective Dose (person-rem) for Population Within 50 Miles Population Dose, person-rem	0.026	0.012	0.016	0.14

Sources: SNL 1994b, 1995c, 1996a, 1997d
- concentration not measured or facility inactive
MEI: maximally exposed individual
mrem/yr: millirems per year
SNL/NM: Sandia National Laboratories/New Mexico
[a] Dose total for Sandia Pulsed Reactor and Annular Core Research Reactor

4.10 HUMAN HEALTH AND WORKER SAFETY

4.10.1 Definition of Resource

This section on human health and worker safety describes how existing physical and environmental conditions affect public health and worker health and safety. It includes all individuals who could be affected by radioactive and nonradioactive hazardous materials released from SNL/NM operations. These individuals are referred to as receptors.

This section compares SNL/NM worker health and safety performance records from 1992 to 1996 to equivalent national, regional, or local health statistics. The current relationship of people to the SNL/NM environment is assessed by resource area. These assessments constitute the framework for understanding the impacts from the alternatives presented in Chapter 5.

4.10.2 Region of Influence

For a human to be exposed to a released material, there must be both complete transport and exposure pathways (Figure 4.10–1). Since pathways differ, the ROI for assessing health impacts to people in and around SNL/NM is specific to each exposure pathway. The ROIs for impacts to public health from radiological and nonradiological air emissions are the population living and working within 50 mi and 15 mi of SNL/NM, respectively. The ROIs for impacts to public health from pathways associated with groundwater, soils, and surface water relate more to the physical extent of that resource (such as the extent of groundwater used for drinking by the city of Albuquerque, discussed in Section 4.6.2).

4.10.3 Affected Environment

The environment within the ROI includes environmental resources such as air, groundwater, and soil, which, if affected, could subsequently affect public health and worker health and safety. See the specific resource sections for descriptions of existing conditions for these resources.

Any environmental releases due to activities described in the SWEIS have the potential to affect the health of people who live around and work at SNL/NM. Specifically, the SWEIS addresses the effects of radiation from radiological materials and the effects of hazardous materials on human health, as well as occupational safety issues common to laboratory and industrial work sites.

4.10.3.1 National and Regional Health Information

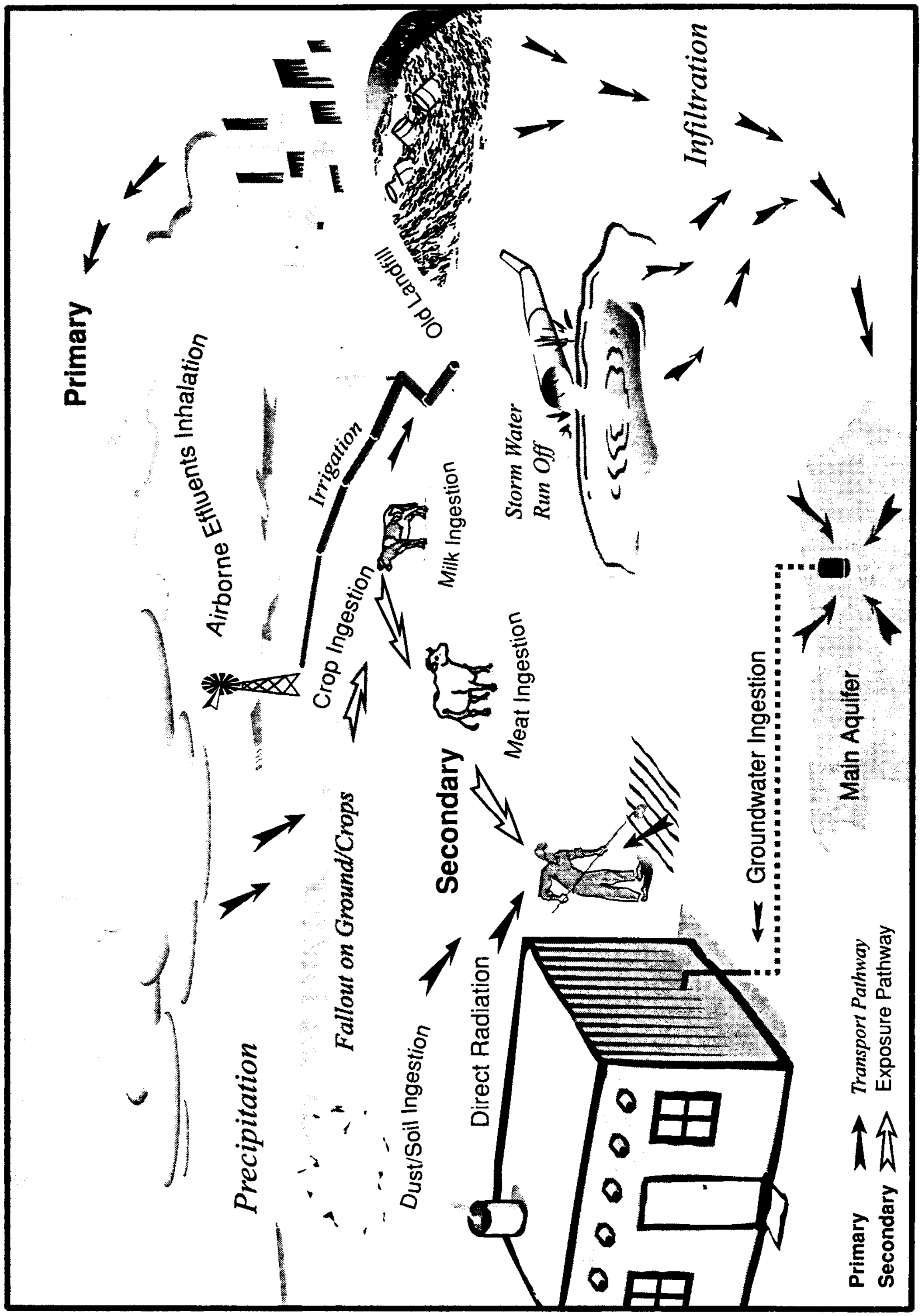
The general health of the population within the U.S., based on the types and rates of cancer, is assessed annually by the American Cancer Society (ACS). In the U.S., men have a 1 in 2 lifetime risk of developing cancer; for women, the risk is 1 in 3. The National Cancer Institute estimates that approximately 7.4 M Americans alive today have a history of cancer and that one out of every four deaths in the U.S. is from cancer (ACS 1997a).

The ACS annually estimates the number of cancer deaths and the number of new cancer cases nationally and by state. Nationally, the estimated 1997 cancer mortality rate was 173 deaths per 100,000 persons; for New Mexico, the rate was 146 per 100,000 persons. The estimated 1997 number of new cancer cases likely to occur in the U.S. was 1.4 M, with 7,000 occurring in New Mexico (excluding skin cancer cases). Estimates were based on 1997 population growth estimates.

The DOE has developed various programs and data collection/tracking systems that can be analyzed for epidemiological trends or for epidemiological studies by independent agencies or individuals. The DOE Office of Epidemiological Surveillance Program tracks the illnesses and injuries (incidence rates) of more than 65,000 DOE workers. SNL/NM has electronically coded and archived over 10 years of employee health information through this program. The database gives epidemiologists the opportunity to analyze health events that have affected the SNL/NM workforce over an extended time. The archived information has been categorized and summarized in the DOE *1993 Epidemiologic Surveillance Report* (DOE n.d. [b]).

Transport and Exposure Pathways

The pathways that release materials to the environment and subsequently reach people are known as transport and exposure pathways. A *transport pathway* is the environmental medium, such as groundwater, soils, or air, by which a contaminant is moved (for example, chemicals carried in the air or dissolved in groundwater and moved along by wind or groundwater flow). An *exposure pathway* is how a person comes into contact with the contaminant, for example, breathing (inhalation), drinking water (ingestion), or skin contact (dermal).



Source: Original

Figure 4.10–1. Transport and Exposure Pathways

For a human to be exposed to a released material, there must be both complete transport and complete exposure pathways.

These studies document health conditions of the worker population in general, but do not assess the effects of specific chemicals or radiation doses from SNL/NM operations on human health. Therefore, the health effects data are not associated with specific SNL/NM operations, environmental releases, or worker or public exposures to hazardous or radioactive materials.

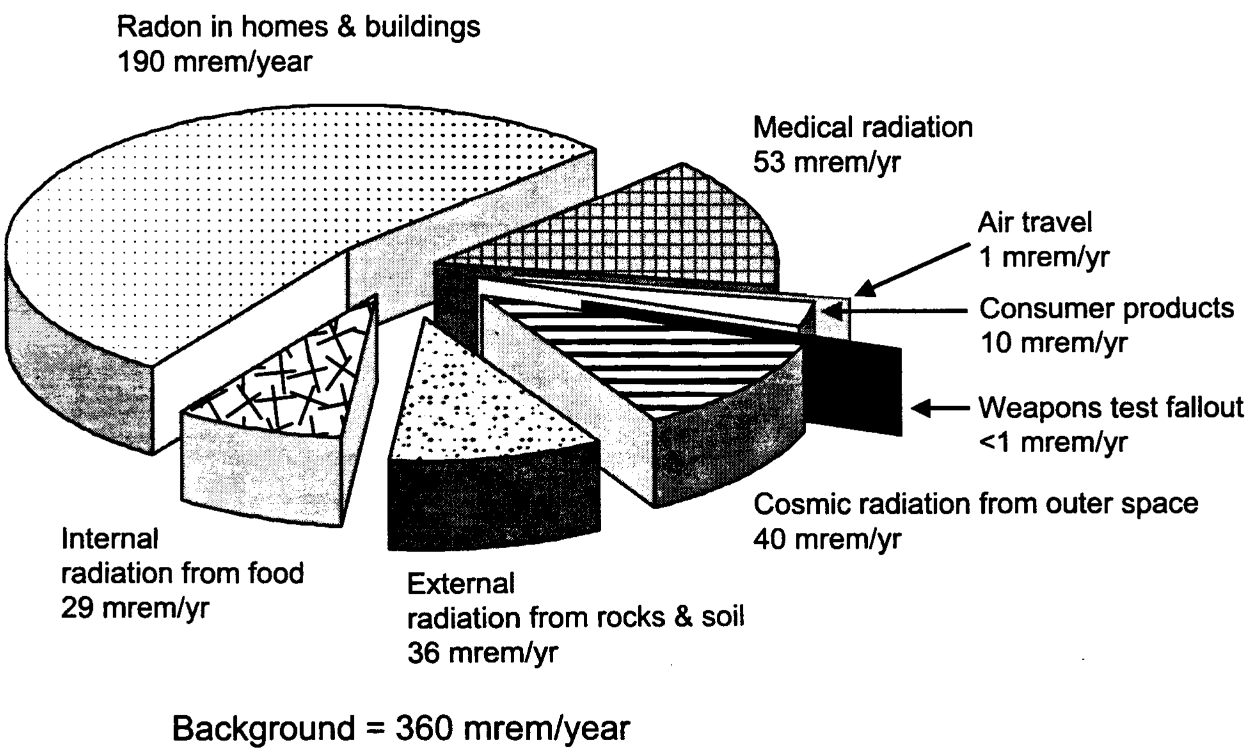
4.10.3.2 Public Health

Radiological and nonradiological hazardous materials released from SNL/NM facilities reach the environment and people through different transport pathways. The SWEIS focuses on transport media associated with inhalation, ingestion, or direct contact exposure pathways, such as air and drinking water, because they are the ways in which the greatest amount of a pollutant can reach people. The SWEIS evaluates the possibility of collective effects due to multiple pathways and indirect pathways for any impact contribution.

Radiological

Figure 4.10–2 presents major sources and levels of background radiation exposure to individuals in the vicinity of SNL/NM (SNL 1997d). All annual doses to individuals from background radiation are practically constant over time. The collective dose to the population varies as a result of increases or decreases in population size. The background radiation dose of 360 mrem/yr is unrelated to SNL/NM operations.

Air releases of radionuclides from the operation of a specific facility at SNL/NM result in radiation exposures to people in its vicinity. The radiation dose is calculated annually based on actual facility emissions monitoring data. Table 4.9–6 shows radiation doses from 1993 through 1996 for maximally exposed individual members of the public at SNL/NM. Based on the risk estimator of 500 fatal cancers per 1 M person-rem (ICRP 1991) to the public, a person exposed to the greatest amount of these SNL/NM radiological air releases would have an



Sources: NCRP 1987, SNL 1997d
mrem/yr: millirems per year

Figure 4.10–2. Major Sources and Levels of Background Radiation Exposure in the SNL/NM Vicinity

The total annual background dose of radiation to an individual in the vicinity of SNL/NM is 360 millirem.

> **Calculating Radiological Effects**
>
> Estimating potential human health effects involves a series of calculations that indicate the potential health consequence of a particular action or accident. Effects can be calculated both for individuals and for a population. The health effect of concern is a person dying from cancer caused by being exposed to low levels of radiation. To quantify the radiological impact, the radiation dose must be calculated.
>
> The dose is a function of the exposure pathway (external, inhalation, or ingestion) and the type and quantity of radionuclides involved. The calculated concentrations of radionuclides in the air from emissions are used in conjunction with uptake parameters, usage rates, duration times, and radionuclide-specific dose factors in determining internal dose. The total dose is the sum of external and internal doses from all pathways.
>
> After the dose is estimated, the health impacts (number of additional latent cancer fatalities in a population or probability of additional latent cancer fatalities for an individual) are calculated from current internationally recognized risk factors (Section 4.10.3). These health impacts are further explained in Section 4.10.

annual increased risk of dying from cancer of $3.5x10^{-9}$. In other words, the likelihood of this person dying of cancer because of the maximum 1-year dose from SNL/NM operations is less than 4 chances in 1 B. This annual release has the potential to increase the number of latent cancer fatalities in the entire population within 50 mi of SNL/NM by $7.0x10^{-5}$.

Radiological contamination contained in other environmental resources affected by SNL/NM has the potential to reach the public by different transport pathways. Environmental sampling programs involving resources such as groundwater, soils, and surface water are designed to monitor and assess the potential for public exposures to these pollutants through these different media.

Radiation exposures are not expected through surface water, soils, groundwater, and natural vegetation, based on information in the SNL/NM *1996 Site Environmental Report* (SNL 1997d). Data collected from environmental sampling show that these media do not present complete exposure pathways that connect SNL/NM to the general population. The public, therefore, is not in contact with radiological pollutants from these media.

Nonradiological

Nonradiological chemical air pollutants are released from SNL/NM facilities that house chemistry laboratories or chemical operations. Air samples collected near known chemical emission sources are presented as the highest expected chemical air pollutant levels from current SNL/NM operations. Due to dilution and dispersion, lower levels of these air pollutants would occur at locations offsite and further away from the sources.

The maximum ambient concentrations of VOCs measured by monitoring stations onsite at SNL/NM in 1996 are identified in Table 4.9–4 (SNL/NM 1997a). These concentrations are below safety levels established for workers in industrial areas. Although there are no SNL/NM-operated monitoring stations offsite, it is possible to make the assessment that concentrations decrease with distance from the source and, therefore, are also below health-risk levels for impacts to public health.

Small amounts of nonradiological chemical contamination, which have been caused by past SNL/NM operations, have been identified in other environmental resources (such as groundwater and soils-subsurface [Sections 4.5 and 4.6]). Chemicals existing in the environment have the potential to reach members of the public through these different transport pathways. Environmental sampling programs involving resources such as groundwater, soils, and surface water, are designed to monitor and assess the potential for public exposure to these pollutants through these different media. Evaluations of groundwater, soils, and surface water information indicate that the public is not in contact with these areas of contamination within SNL/NM site boundaries and that the contamination is not being transported offsite (Sections 4.5.3, 4.6.3, and 4.6.6).

4.10.3.3 Worker Health and Safety

SNL/NM operations are required to be in compliance with the DOE and Occupational Safety and Health Administration (OSHA) requirements for worker health and safety. DOE ES&H programs regulate the work environment and seek to minimize the likelihood of work-related exposures, illnesses, and injuries.

Radiological

SNL/NM's Occupational Radiation Protection Program complies with the Federal requirements in 10 CFR Part 835, *Occupational Radiation Protection,* and DOE N 441.1, *Radiological Protection for DOE Activities.* These requirements provide protection to onsite workers and visitors at SNL/NM.

Workers receive approximately the same background radiation dose as members of the general public. Some workers receive an additional dose from working in specific radiation facilities. The Sandia Dosimetry System (SANDOS) database records worker radiation dose information as the total effective dose equivalent (TEDE), which is a sum of external and internal radiation doses. Summary information is then provided to the DOE's Radiation Exposure Monitoring System (REMS) database. Radiation monitoring devices, known as dosimetry badges, report an individual's external dose information. Bioassays provide internal dose information. Annually, information from dosimetry badges and bioassays is totaled as an individual TEDE and provided to each worker.

The SANDOS and REMS databases also contain information on the number of badges issued. This is used to compile the annual average dose to workers at SNL/NM. Because the reporting limit used to assess dosimetry badges is 10 mrem (external and internal radiation dose) above background, only exposures greater than or equal to 10 mrem above background are used in deriving the annual average collective TEDE to workers. For purposes of the SWEIS, this annual average collective TEDE is applied to this group of workers characterized as radiation-badged workers (badges with greater than 10 mrem). The actual annual average worker dose for the entire SNL/NM workforce is much lower than the annual average radiation-badged worker dose.

Table 4.10–1 lists the annual average, maximum, and collective radiation-badged worker doses, based on data for 1992 through 1996. Based on the International Commission on Radiation Protection (ICRP 1991)-recommended risk estimator of 400 fatal cancers per 1 M person-rem among workers (ICRP 1991), the annual average collective dose increases the number of additional fatal cancers by 4.8×10^{-3} in the radiation-badged worker population from routine SNL/NM operations. The annual average radiation-badged worker dose (based on the 5-year average) increases the radiation-badged worker's lifetime risk of fatal cancer from a one-year exposure by 1.68×10^{-5}. The radiological limit for an individual worker is 5,000 mrem/year (10 CFR Part 835). The maximum annual dose of 2,000 mrem/yr for an individual worker is set as an administrative guideline limit at SNL/NM.

Dosimetry Badges

All employees, contractors, and visitors entering or working in radiation areas are issued radiation monitoring devices known as dosimetry badges. The Sandia Dosimetry System (SANDOS) and the DOE's Radiation Exposure Monitoring System (REMS) databases record worker radiation dose information as the total effective dose equivalent (TEDE), which is a sum of external and internal radiation doses. The reporting limit for dosimetry badges used is 10 mrem above background, and therefore only exposures greater than or equal to 10 mrem are used in deriving the annual average collective TEDE for the radiation-badged worker population (workers receiving 10 mrem or more above background).

Exposure to Radiation

All people are constantly exposed to some form of radiation. This radiation can be from different sources: cosmic from space, medical from X-rays, internal from food, and external from rocks and soil (such as radon in homes). The "Roentgen equivalent, man" (rem) unit is a measurement of the dose from radiation and its physical effects and is used to predict the biological effects of radiation on the human body. Therefore, one rem of one type of radiation is presumed to have the same biological effects as one rem of any other type of radiation. This relationship allows comparison of the biological effects of radiological materials that emit different types of radiation. A commonly used dose unit of measure is millirem (mrem), which is equal to 0.001 rem. A person-rem is a collective radiation dose unit for expressing the dose when summed across all persons in a specified population group.

Nonradiological

Occupational Injuries/Illnesses

OSHA has identified the most important risks to the health of workers as common industrial accidents that normally involve falls, slips, trips, contact with objects,

Table 4.10–1. Radiation-Badged Worker Doses (TEDE) at SNL/NM (1992-1996)

RADIATION-BADGED WORKER[a]	YEAR	RADIATION DOSES	FEDERAL STANDARD/DOE GUIDELINE
Annual Average Dose[b] (millirem/year)	1992	35	ALARA
	1993	40	ALARA
	1994	52	ALARA
	1995	34	ALARA
	1996	47	ALARA
AVERAGE	--	**42**	**ALARA**
Annual Maximum Dose (millirem/year)	1992	920	5,000
	1993	520	5,000
	1994	830	5,000
	1995	500	5,000
	1996	845	5,000
AVERAGE	--	**723**	**5,000**
Annual Collective Dose (person-rem)	1992	16	ALARA
	1993	12	ALARA
	1994	10	ALARA
	1995	10	ALARA
	1996	12	ALARA
AVERAGE	--	**12**	**ALARA**

Source: SNL/NM 1997k
ALARA: as low as reasonably achievable
mrem: millirem
TEDE: total effective dose equivalent

[a] Radiation-badged workers are those having badges measuring greater than 10 mrem.
[b] Annual average dose equals the collective TEDE divided by the number of badges with a measured dose greater than 10 mrem above background, which is the detection limit of the dosimetry used.

and so on, and that result in sprains, cuts, abrasions, fractures, and other injuries. Monitoring and using personal protective equipment minimize or prevent overexposures to hazardous chemicals.

SNL/NM must comply with Federal requirements to track and report occupational illnesses and injuries as required by 29 CFR Part 1904, DOE O 231.1, DOE O 232.1, and the associated *OSHA Record Keeping Guidelines for Occupational Injuries and Illness, 1986* (29 CFR Part 1904). DOE contractors must report to DOE/Headquarters (HQ) the same type of information on occupational injuries and illnesses that private industry provides to the Bureau of Labor Statistics (BLS). SNL/NM and its contractors annually report all illnesses and injuries as required by OSHA. Table 4.10–2 and Figure 4.10–3 compare the 1992 through 1996 nonfatal injury/illness case rates per 100 workers (or 200,000 hours equivalent) for SNL/NM, the DOE, private industry in New Mexico, and private industry nationally. SNL/NM injury/illness rates are much lower than those of private industry (national or local) and are similar to the DOE as a whole.

The numbers of lost workdays resulting from nonfatal injuries and illnesses are also recorded annually. Table 4.10–3 and Figure 4.10–4 compare the lost workday case rates (number of lost workdays per 100 workers or 200,000 hours equivalent) for SNL/NM, the DOE and contractors, private industry in New Mexico, and private industry nationally. Both the DOE and SNL/NM show lower lost workdays than those of private industry (national and local).

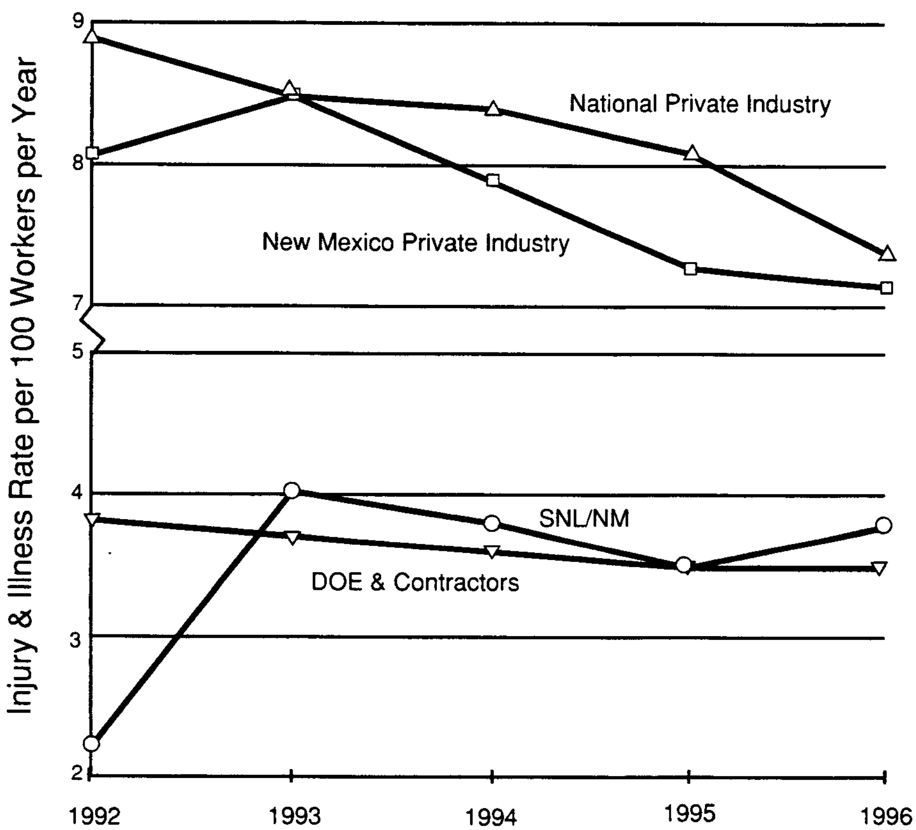
Occupational Fatalities

As shown in Table 4.10–4, approximately 6,000 occupational fatalities occur each year nationwide (SNL/NM 1997b). Private industry accounts for approximately 5,500 of that total. Based on 5 years of data listed in Table 4.10–4, New Mexico has an average of 57 occupational fatalities per year. Ninety percent of occupational fatalities occur in private industry, while government, including Federal, state, and local, account for 10 percent (DOL 1997j). SNL/NM has never experienced a fatal occupational injury (SNL/NM 1997b).

Table 4.10–2. Comparison of Nonfatal Occupational Injury/Illness Rates[a] (1992 through 1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	2.3	4.1	3.8	3.5	3.8
DOE & Contractors	3.8	3.7	3.6	3.6	3.5
New Mexico Private Industry	8.1	8.5	7.9	7.3	7.3
National Private Industry	8.9	8.5	8.4	8.1	7.4

Sources: DOE 1997b, n.d.(h); DOL 1996, 1997b-f, j, i, n, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l
[a] Rates are per 100 workers per year.



Sources: DOE 1997b, n.d. (h); DOL 1996, 1997b-f, i, j, n, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l

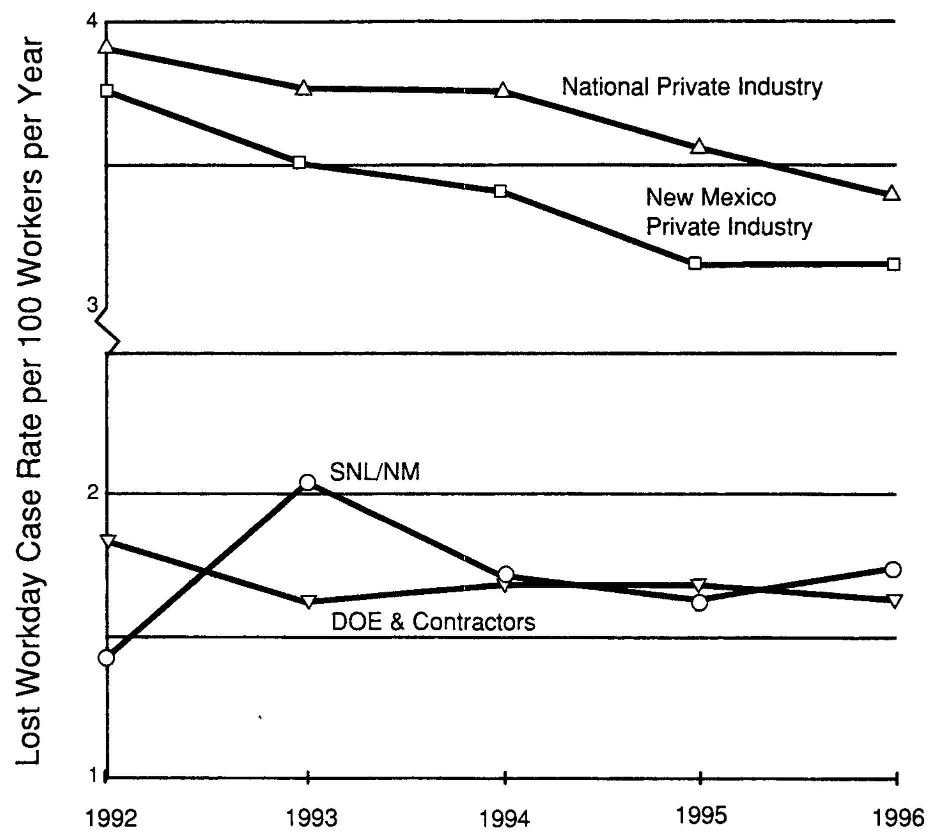
Figure 4.10–3. Comparison of Nonfatal Occupational Injury/Illness Rates (1992 through 1996).

SNL/NM's nonfatal occupational injury/illness rates compared favorably with local and national private industry rates.

Table 4.10–3. Comparison of Lost Workday Case Rates[a] (1992 through 1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	1.44	2.05	1.77	1.63	1.73
DOE & Contractors	1.8	1.6	1.7	1.7	1.6
New Mexico Private Industry	3.8	3.5	3.4	3.2	3.2
National Private Industry	3.9	3.8	3.8	3.6	3.4

Sources: DOE 1997b; DOL 1996, 1997b-f, i, j, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l;
[a] Rates are per 100 workers per year.



Sources: DOE 1997b; DOL 1996, 1997b-f, i, j, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l

Figure 4.10–4. Comparison of Lost Workday Case Rates (1992 through 1996)

SNL/NM's lost workday case rates compared favorably with local and national private industry rates.

Table 4.10–4. Comparison of Total Fatal Occupational Injuries (1992-1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	0	0	0	0	0
New Mexico Private Industry	35[a]	55	54	58	60
National Private Industry	5,497	5,590	5,923	5,495	5,521
National Total (Government & Private Industry)	6,217	6,331	6,632	6,275	6,112

Sources: DOL 1992, 1993, 1994, 1995, 1997a, g, h, k-m; SNL/NM 1997b
[a] Reflects startup of collection program; number is considered low/conservative.

Occurrences

DOE O 231.1, *Environment, Safety and Health Reporting* (see Chapter 7), and its predecessors specify criteria for reporting specific conditions, incidences, or situations related to the safety and security of operations of DOE and its contractors in formal occurrence reports. Occurrence reporting increases sensitivity to potentially unsafe conditions, requires analyses to determine the causes of events, provides a vehicle for formal corrective actions, and fosters lessons-learned programs. The *ORPS* database tracks occurrences (DOE 1998h).

Table 4.10–5 lists, by reporting category, the SNL/NM occurrence reports between 1993 and 1996. The number of reportable occurrences in categories "personnel safety" and "personnel radiation protection" have remained relatively constant at SNL/NM (SNL/NM 1997b). The personnel safety category, which includes any reportable injury, illness, or overexposure to hazardous chemicals or radiation, accounts for less than 10 percent of reportable occurrences. Not all reported occurrences in Table 4.10–5 result in adverse effects on human health; they also report on other categories, such as security violations and observations that are potentially hazardous conditions.

Industrial Hygiene Reports

The industrial hygiene (IH) program monitors airborne chemicals and hazards in the workplace. A wide variety of workplace chemicals are monitored, such as heavy metals, VOCs, solvents, acids, as well as other potentially harmful health hazards, including noise and radio frequency.

The IH program investigates a wide variety of conditions and situations potentially involving health impacts to workers. An Industrial Hygiene Investigation Report (IHIR) is completed when formal investigations are conducted. IHIRs are performed or initiated through various avenues such as a worker complaint, scheduled monitoring, use assessments, worker risk assessments, change of building use (for example, changing laboratory to office space), and for other health and safety-related reasons.

Table 4.10–6 identifies the total number of IHIRs performed by IH program staff from 1992 through 1996. Less than 25 percent of these investigations involved air monitoring for worker exposures to hazardous materials, including chemicals in the workplace. Very few of these investigations ever revealed an environment where an overexposure to a chemical (above a health control limit) might occur. Reportable/ recordable chemical exposures to an individual are reported in the *ORPS* database (DOE 1998h). The SNL/NM *Worksite Accident Reduction Expert (WARE)* database captures personal chemical exposure incidents (both OSHA/DOE recordable/ reportable) (SNL/NM 1998d, 1998k). These incidents are investigated by either safety or industrial hygiene representatives, depending upon the type of accident, illness, or injury. Investigation report results are entered by safety representatives into the SNL/NM *WARE* database, which ultimately feeds recordable incidents into the DOE's *Computerized Accident/Incident Reporting System (CAIRS)* database, or directly by industrial hygiene personnel into the *CAIRS* database through completed IHIR reports. These databases identify personal chemical exposures exceeding a health control limit and are investigated or reported in the *ORPS* database.

A search was performed in the DOE's *ORPS* and *CAIRS* databases and SNL/NM's *WARE* database for personal chemical overexposures exceeding a health control limit. Data showing SNL/NM personal chemical exposures for 1992 through 1996 are listed in the bottom row of Table 4.10–6. Within SNL/NM facilities, one or two reportable chemical exposures occurred each year during the past 5 years. None of these were monitored overexposures. SNL/NM has an extensive safety and health program, compliance policies, and personal protective procedures in place to reduce or minimize the potential for work-related chemical exposures to hazardous or toxic chemicals.

Table 4.10–5. SNL/NM Safety and Security Occurrences by Reporting Category (1993-1996)[a]

CATEGORY	YEAR			
	1993	1994	1995	1996
Facility Condition	48	25	27	33
Environmental	11	16	6	2
Personnel Safety	1	5	2	4
Personnel Radiological Protection	2	2	4	3
Safeguards & Security	7	1	5	3
Transportation	1	2	2	1
Value Basis Reporting	2	4	4	3
Facility Status	0	0	0	0
Nuclear Explosive Safety	0	0	0	0
Cross Category Items	5	4	4	12
GRAND TOTAL	**77**	**59**	**54**	**61**

Source: SNL/NM 1997b
[a] Some occurrences received more than one classification, so the total differs slightly from the total number of occurrences.

Table 4.10–6. SNL/NM Industrial Hygiene Investigation Reports Summary (1992-1996)

IHIRs	YEAR				
	1992	1993	1994	1995	1996
Total Number of IHIRs	436	702	933	799	411
Number With Hazardous Material Air Monitoring Data	151	210	207	113	65
Number With Data Showing Personal Chemical Exposures	1	1	2	0	2

Sources: SNL/NM 1997e, 1998d, 1998k
IHIR: Industrial Hygiene Investigation Report

4.11 TRANSPORTATION

4.11.1 Definition of Resource

This section describes current regional and local transportation activities, including descriptions of any highway, rail, air, or marine transportation infrastructure that the DOE uses to support hazardous material and waste movements at SNL/NM. Transportation activities at SNL/NM involve the receipt, shipment, and transfer of hazardous and nonhazardous materials and waste. Receipt refers to material received from an offsite location; shipment refers to material sent to an offsite location; and transfer refers to material moved from one onsite location to another.

4.11.2 Region of Influence

The transportation ROI consists of three areas: within KAFB, the major transportation corridors in Albuquerque, and the routes to and from DOE facilities and waste disposal sites.

4.11.3 Affected Environment

Moving or transporting hazardous material and waste under any conditions can pose inherent risks and impacts to workers and the public. However, SNL/NM has standard operating procedures in place to minimize these risks, and to ensure worker and public safety. Normal transportation activities affect air quality, noise and vibration, and traffic congestion. Some degree of external radiation exposure to workers and the public, which is known as incident-free exposure, also occurs during routine operations.

4.11.3.1 Responsible Organizations and Materials Tracking

SNL/NM organizations share responsibility for ensuring the safe receipt, shipment, and transfer of hazardous material and waste. These organizations perform the administrative and logistical operations involved in inspecting, packaging, handling, loading, transferring, shipping, and receiving these materials.

Accountable radioactive material receipts, shipments, and onsite transfers are tracked through the *Local Area Network Nuclear Material Accountability System (LANMAS)*, a database that tracks the location of nuclear materials inventory. Explosive material shipments are tracked through the Explosive Inventory System, which records all receipts, onsite transfers, and shipments of explosive materials by tracking the movement of each individual unit. It is common for several trackable units to be moved simultaneously on the same conveyance.

Chemical purchases are tracked through the Chemical Inventory System (CIS) maintained by SNL/NM. The majority of chemical purchases, received in small quantity containers, are made through the just-in-time (JIT) procurement procedures, which are designed to limit any excess chemical inventory in storage onsite. Other purchases, delivered in bulk loads, include compressed gasses such as hydrogen and liquid nitrogen, large quantity acids and bases, and bulk fuels. JIT chemical vendors are required to issue a 10-digit barcode to each chemical container and to compile the following delivery information: vendor catalog number, quantity, unit of measure, delivery location (building, room, and quad), organization number, delivery date and time, person delivered to, price, and the material requisition number. The vendor is also responsible for providing the following chemical-specific data for inclusion in the CIS files: chemical name, physical state, manufacturer/supplier name, standard industry barcode number, Chemical Abstract Service (CAS) numbers of ingredients, *Superfund Amendments and Reauthorization Act* (SARA) storage code, SARA temperature code, SARA pressure code, and National Fire Protection Association (NFPA) codes. The vendors are required to transfer the accumulated data and catalog updates to the SNL/NM CIS every Monday, Wednesday, and Friday, or as otherwise agreed upon by the vendor and the CIS department. Each vendor is responsible for the accuracy of the data they submit to the CIS. In addition, vendors also provide Material Safety Data Sheets (MSDSs) for all chemicals not having an MSDS on record.

4.11.3.2 Types and Quantities of Material and Waste Transported

The affected environment considered under this analysis includes all transportation activities related to normal operations at SNL/NM. Normal operations encompass all operations required in order to maintain production at SNL/NM facilities. However, special operations, those operations outside the scope of normal facility production, sometimes occur and can have a substantial effect on the overall transportation activities at SNL/NM. Special operations and new programs routinely undergo program-specific assessments to consider any impacts that may result from their inception. These are also included in the site-wide analysis. One special program, the ER Project, is discussed separately because, within its limited duration, this project will be the single largest waste generator at SNL/NM, based on current projections.

Table 4.11–1 lists the number of hazardous material and waste shipments, receipts, and transfers made by SNL/NM during 1996. U.S. Department of Transportation (DOT)

Table 4.11–1. Annual Receipts, Shipments, and Transfers of Hazardous Material at SNL/NM

TYPE OF MOVEMENT		HAZARDOUS MATERIAL/WASTE	NUMBER OF MOVEMENTS[a]
Receipt	*Materials*	Radioactive material[b]	109 (1997)
		Chemical material	2,750 (1997)
		Explosives	123 (1997)
		Fuels:	
		Diesel/unleaded	0
		Jet	0
		Propane	136
	Waste	TRU	0
		MTRU	0
		LLW	0
		LLMW	1
		Hazardous waste[c]	12 (1997)
		Solid waste	0
Shipment	*Materials*	Radioactive material[b]	196 (1997)
		Chemical material	164
		Explosives	180 (1997)
	Waste[d]	TRU	0
		MTRU	0
		LLW	4
		LLMW	1
		Hazardous waste[c]	64 (1997)
		Recycled	8 (1997)
		Solid waste	51 (1997)
	ER Waste[f]	TRU	0
		MTRU	0
		LLW	22
		LLMW	0
		Hazardous waste[c]	27 (1997)
Transfer	*Materials*	Radioactive material[b]	10 (1997)
		Chemicals[h]	0
		Explosives	1,453 (1997)
		Fuels:	
		Diesel/unleaded	72
		Jet	1
		Propane	0
	Waste	TRU[g]	0 (1997)
		MTRU[g]	4 (1997)
		LLW[g]	761 (1997)
		LLMW[g]	35 (1997)
		Hazardous waste[c]	Daily
		Solid waste	Daily

Source: SNL/NM 1997a
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
TSCA: *Toxic Substance Control Act*
[a] 1996 figures unless otherwise noted
[b] Data are restricted to accountable nuclear material
[c] Hazardous waste includes RCRA, TSCA, and medical waste.
[d] Waste shipments due to normal operations
[e] The Hazardous and Solid Waste Department records the quantity of waste shipped offsite. This assumes that the quantity of waste collected on the site in any year is approximately equal to the quantity shipped offsite for disposal.
[f] Waste shipments due to the ER Project, a limited duration special project
[g] Data are in terms of the estimated maximum collection trips per year by the Radioactive and Mixed Waste Department. Actual onsite conveyances of radioactive and mixed wastes are not included in the table.
[h] Chemical transfers are included within the chemical waste shipments.

definitions and standards (49 CFR Part 173) establish the means to determine if a material constitutes a hazard for offsite transportation. SNL/NM standards, which were developed in accordance with DOE, DOT, and USAF policies, determine if a material constitutes a hazard for onsite transportation. A *hazardous material*, as defined in 49 CFR Part 173, is one that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, can, without proper management, significantly contribute or pose a potential hazard to human health or the environment. The types of SNL/NM hazardous materials regulated by the DOT include radioactive materials, chemicals, explosive materials, and fuels. There are also three types of waste transported by SNL/NM: radioactive waste; hazardous waste (which includes RCRA chemical and explosives waste, medical waste, and TSCA waste, primarily asbestos and polychlorinated biphenyls [PCBs]); and nonhazardous solid waste.

In 1997, SNL/NM received more than 25,000 chemical containers in approximately 2,750 shipments. The majority of these receipts were small quantity purchases made through the JIT vendors. The remainder of the receipts were large quantity purchases received as bulk loads, including compressed hydrogen tube trailers, and acids received from tanker trucks. Typically, JIT chemicals are provided through local vendors and are usually shipped from locations within 40 km of SNL/NM.

In 1997, the JIT materials received from Fisher Scientific (representing 25 percent of all JIT chemicals received from vendors) were primarily flammable, approximately 46 percent (DOT Hazard Class [HC] 3); corrosive, approximately 35 percent (HC 8); and toxic substances, approximately 2 percent (HC 6.1) (FWENC 1998a). Flammables include materials such as acetone, isopropyl alcohol, methanol, propyl alcohol, and toluene. Corrosives include materials such as nitric acid, acetic acid, sulfuric acid, hydrogen chloride, and sodium hydroxide. Toxic chemicals include materials such as methylene chloride, trichloroethene, and chloroform.

Chemicals are the most frequently received hazardous materials at SNL/NM. The second most frequently received hazardous material is radioactive material. Radioactive and explosive materials shipments are often delivered through government carriers.

SNL/NM ships radioactive material in both excepted and DOT-specific packaging. The most common type of shipments is excepted packaging shipments. Packaging includes containers and all accompanying components or materials required to adequately contain the material.

Radioactive material that is shipped in excepted packaging has a radioactive level below the limit established in specific regulations contained within 49 CFR Part 173. Generally, in order to be shipped as excepted packaging, the radiation exposure level at any point along the surface of the package cannot exceed 0.5 mrem per hour. The package type used must meet the standards set by the carrier and a statement must be included with the package that cites the specific regulation within 49 CFR Part 173 allowing the material to be shipped without shipping papers. Typical materials that fall under the excepted material criteria are low-level radioactive source material, instruments, and empty packaging.

Material with radioactive levels in excess of the excepted packaging regulations must be shipped in either a Type A or Type B container. Type A containers are designed to undergo the routine stresses of transport. For a container to be considered Type A, it must be constructed and identified as following specific guidelines found within 49 CFR Part 173. Radioactive material requiring Type A containers consists of two categories, A1 and A2. A1 material is "special form" radioactive material, and A2 material is radioactive material in forms other than special form and low-specific-activity (LSA) radioactive material. Maximum activities of isotopes for A1/A2 are found in both 10 CFR Part 71 and 49 CFR Part 173. Radioactive material exceeding the activities posted in the A1/A2 table must be shipped in a Type B container. Type B containers are designed and tested to undergo stresses that exceed those usually associated with routine shipping, such as wrecks, fires, and so on. LSA radioactive material is shipped in industrial packing containers. Specifications for these containers are also found in 49 CFR Part 173. Chapter 7 provides detailed information regarding the specific regulations cited above.

SNL/NM also purchases propane to provide space heating to TAs-III and -V and other remote areas. Propane purchases should diminish significantly in the near future as remote facilities convert to natural gas heating. Offsite sources deliver other fuels, such as gasoline, diesel, and jet fuels, directly to KAFB. Then SNL/NM purchases these fuels from KAFB as needed; thus, most fuel shipments are considered transfers rather than receipts.

4.11.3.3 Destinations and Origins of Shipments, Receipts, and Transfers

SNL/NM receives radioactive material and explosives from a number of locations across the U.S. and, since 1994, has shipped radioactive material to 96 locations. The common and recently used destinations are listed in Table 4.11–2. At

Table 4.11–2. Most Common Origins/Destinations of SNL/NM Materials and Waste Receipts and Shipments

TYPE OF MOVEMENT	TYPE OF MATERIAL/WASTE	MOST COMMON ORIGIN/DESTINATION	MOVEMENTS[a]
RECEIPTS			
Materials	Radioactive	Los Alamos National Laboratory, Los Alamos, NM	30
		Pantex Plant, Amarillo, TX	31
		Martin Marrietta, Largo, FL	17
	Chemical	Various local vendors, Albuquerque, NM (1997)	2,750
	Explosive[b]	Pantex Plant, Amarillo, TX (1997)	22
		SNL/CA, Livermore, CA (1997)	18
		Strategic Weapons Facility – Pacific, Silverdale, WA	9
		Tonopah Test Range, Tonopah, NV (1997)	19
		New explosive material (1997)	423
Waste	Hazardous	SNL/NM, Albuquerque offsite laboratories	12
	LLMW	SNL/CA, Livermore, CA	2
	TRU	Lovelace, Albuquerque, NM	0
SHIPMENTS			
Materials	Radioactive	Harris Semiconductor, Mountaintop, PA	65
		El Segundo, CA	33
		Pantex Plant, Amarillo, TX	12
	Chemical	Burnet, TX	13
		Carlsbad, CA	16
		Livermore, CA	9
	Explosive (1997)	Los Alamos National Laboratory, Los Alamos, NM	11
		Strategic Weapons Facility - Atlantic, Kings Bay, GA	26
		Vandenberg AFB, CA	25
		Strategic Weapons Facility – Pacific, Silverdale, WA	24
		Tonopah Test Range, Tonopah, NV	20
Waste	LLW	Envirocare, Clive, UT	0 (22 ER)
		Nevada Test Site, Mercury, NV	4
	LLMW	Permafix, Gainesville, FL	1
		DSSI, Oak Ridge, TN (from Permafix)	0
		Envirocare, Clive, UT	14
	TRU/MTRU	Los Alamos National Laboratory, Los Alamos, NM (1997)	0

Table 4.11–2. Most Common Origins/Destinations of SNL/NM Materials and Waste Receipts and Shipments (concluded)

TYPE OF MOVEMENT	TYPE OF MATERIAL/WASTE	MOST COMMON ORIGIN/DESTINATION	MOVEMENTS[a]
Waste (continued)	Hazardous (1997)	Deer Park, TX	5
		ENSCO, El Dorado, AK (1997)	11
		Keers, Mountainair, NM	9
		Kirtland AFB, Albuquerque, NM (1997)	7
		Laidlaw – Gray Back, UT (1997)	1
		Laidlaw – Grassy Mountain, UT (1997)	8 (27 ER)
		Laidlaw – Lone Mountain, Waynoka, OK (1997)	1
		Laidlaw – Aptus, Aragonite, UT	12
		Laidlaw – BDT, Clarence, NY (1997)	4
		NSSI – Sources & Services, Inc, Houston, TX (1997)	1
		Salesco Systems, Inc, Phoenix, AZ (1997)	4
		Transformer Disposal Specialists, Tonkowa, OK (1997)	2
	Solid Waste	Rio Rancho Sanitary Landfill, Rio Rancho, NM (1997)	51
	Recyclable Hazardous (1997)	Kinsbursky Brothers, Anaheim, CA	2
		Safety-Kleen Corp, Albuquerque, NM	2
		Tab Manufacturing, Albuquerque, NM	4

Sources: FWENC 1998a; Rinchem 1998a; SNL/NM 1997a, 1998z, 1998aa
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
SNL/CA: Sandia National Laboratories/California
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
[a] Figures given for 1996 unless otherwise noted
[b] Many explosives received were new explosives. In 1997, 423 of 638 trackable units received were new with no tracking unit number. Because unit numbers were identified, actual numbers of these receipts is unknown.

present, SNL/NM ships hazardous waste offsite to several facilities for treatment and disposal. Most of these sites are located in the southwestern U.S. (Table 4.11–2).

4.11.3.4 Historic Records of Hazardous Material Transportation Incidents

Since 1994, SNL/NM has had six transportation-related incidents involving the onsite transfer of hazardous material. One incident occurred in 1997, two in 1996, and three in 1994 (Table 4.11–3). None resulted in the release of a hazardous cargo to the environment. No member of the workforce or the public was exposed to or harmed by hazardous material related to the incidents. Only one incident, on April 12, 1994, involved injuries to occupants of the vehicle involved.

Since 1994, SNL/NM has had seven transportation-related incidents involving the offsite shipment or receipt of hazardous material. Two incidents occurred in 1998, two in 1996, two in 1995, and one in 1994 (Table 4.11–3). None resulted in the release of a hazardous cargo to the environment and no member of the workforce or the public was exposed to or harmed by hazardous material related to the incidents.

4.11.3.5 Emergency Response and Training

The *Emergency Preparedness Plan* describes the process SNL/NM uses to prepare for and respond to emergencies (SNL/NM 1997a). The plan is reviewed annually and revised as necessary. Emergency planning is required under the *Emergency Planning and Community Right-to-Know Act of 1996* (42 U.S.C. §11001).

Table 4.11–3. SNL/NM Transportation Incidents, 1994 to 1998

DATE	INCIDENT DESCRIPTION	INJURIES	DEATHS	HAZARDOUS MATERIAL	MATERIAL RELEASED
ONSITE INCIDENTS					
4/12/94	Truck rollover with minor injuries	Yes	No	Two compressed gas cylinders	No
6/10/94	Material being moved sustained a leak of nonPCB-bearing transformer oil.	No	No	Oil	No
9-30-94	Radioactive material being transported in improperly placarded vehicle	No	No	Radioactive material	No
2/13/96	Radioactive contamination found in container in a nonradioactive control area.	No	No	Radioactive contamination	No
8/12/96	Survey found radioactive material in items sent to property reapplication.	No	No	Radioactive material	No
8/1/97	Radioactive Class II item being transported was improperly shipped as a radioactive limited quantity material.	No	No	Radioactive material	No
OFFSITE INCIDENTS					
6/20/94	Sample material sent to contract laboratory was identified as radioactive.	No	No	Radioactive material	No
1/11/95	SNL/NM assessed two violations for hazardous materials that were not properly classified, marked, or labeled.	No	No	Hazardous material	No
3/21/95	Explosives shipped in shipping pipe labeled as empty	No	No	Explosives	No
1/23/96	Follow-up survey found a container with internal radioactive contamination.	No	No	Radioactive material	No
9/11/96	Hazardous material package incorrectly packaged and labeled	No	No	Hazardous material	No
2/19/98	Shipment from vendor of explosive components received with cap not attached to safety containment cylinder.	No	No	Explosives	No
3/18/98	Radioactive material contamination levels found to exceed DOT limits concerning receipt and subsequent shipment offsite. Follow-up surveys at destination indicated material to be below DOT limits.	No	No	Radioactive material	No

Source: SNL/NM 1998f
PCB: polychlorinated biphenyl
DOT: U.S. Department of Transportation

4.11.3.6 SNL/NM Site-Related Traffic

Road Network

Interstate 40, which runs east-west, and Interstate 25, which runs north-south, are the two major routes through Albuquerque. (Figure 4.2–1) Figure 4.11–1 shows the road network for the city of Albuquerque. Figure 4.11–2 shows the road network for SNL/NM and KAFB and the onsite routes specified for transporting hazardous material.

In 1995, approximately 7,868 trucks were estimated to have entered Albuquerque by way of interstates on any given work day; however, only 1,514 were placarded, and only 383 of these were indicated to be carrying hazardous materials. SNL/NM made an estimated 15 offsite truck shipments per day in 1996.

Traffic enters SNL/NM through three principal KAFB gates; Wyoming, Gibson, and Eubank. These gates handle 26 percent, 30 percent, and 20 percent of the total traffic entering KAFB, respectively. An additional entrance to KAFB, the Truman gate, serves KAFB's western area, and exclusively handles KAFB-related traffic. The principal mode of transportation for moving hazardous material shipments to or from SNL/NM is by truck. Most commercial truck traffic to SNL/NM uses the Eubank gate because it provides easy access to SNL/NM shipping and receiving in Building 957 (TA-II).

Other SNL/NM Modes of Transportation

SNL/NM uses the Albuquerque International Sunport for passenger and airfreight services. Commercial airfreight services, such as Emery Air Freight or Federal Express, are available at the Sunport. Ross Aviation, Inc., also located at the Sunport, is available to support DOE programs and operations. Access to Ross Aviation is at the east end of KAFB.

Occasionally, SNL/NM may ship materials to or from Kauai, Hawaii, either by way of air or marine transport, based on regulatory requirements and restrictions. Such shipments occur as needed and could be hazardous in nature. However, since 1994, no identified shipments have used marine transport.

Since the Burlington Northern & Santa Fe Railroad, located in Albuquerque, discontinued its spur to KAFB in 1994, SNL/NM has not had an active rail spur. Any current or future rail shipments would have to travel by truck to the Santa Fe railway yard in downtown Albuquerque.

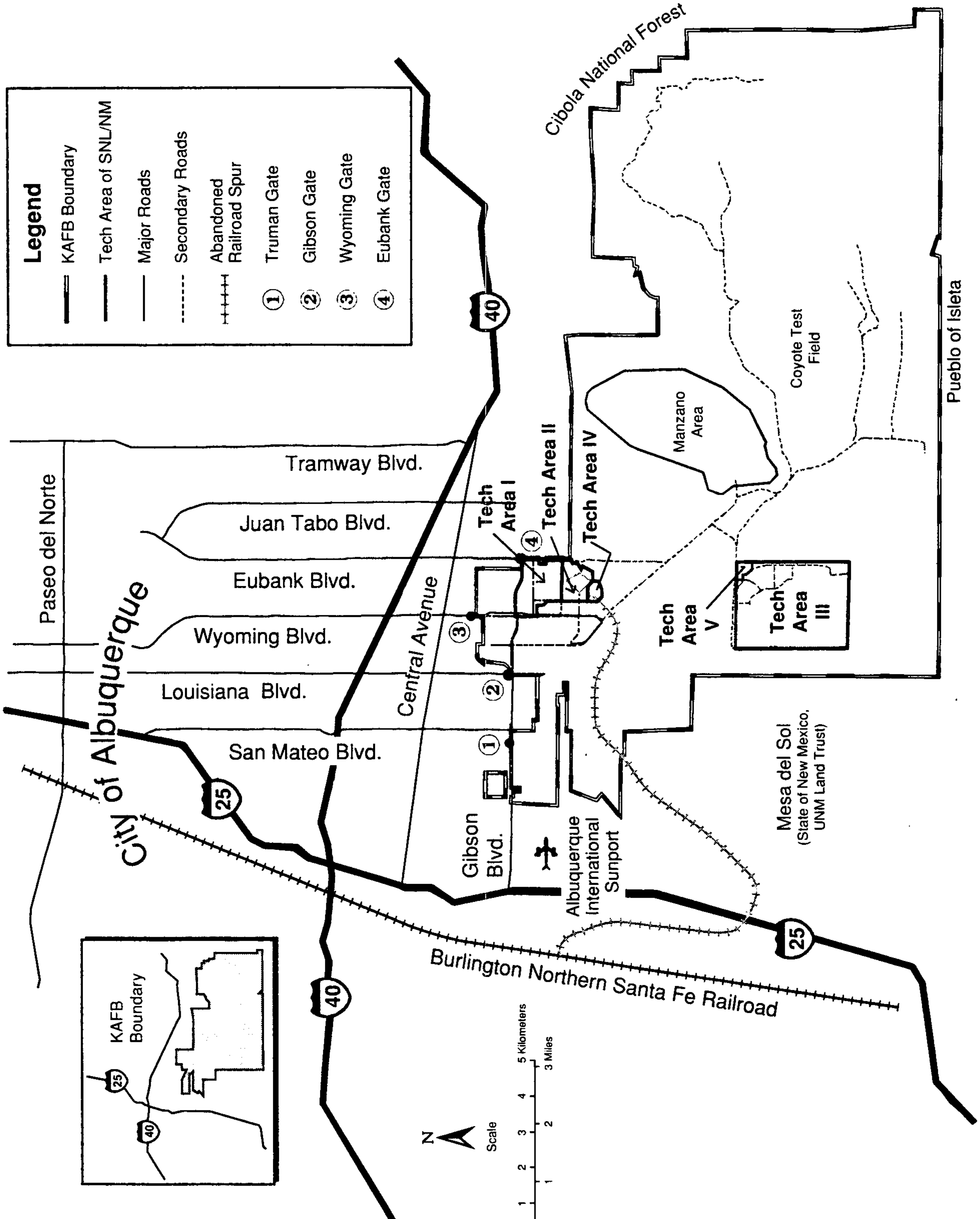
Employee-Related Traffic Volume

SNL/NM staff coming to and leaving KAFB and traffic from maintenance and contractor vehicles are significant contributors to KAFB traffic. A recent estimate of the employee-related traffic volume describes the traffic from SNL/NM commuters and SNL/NM and DOE-owned vehicles (SNL 1996c). The Sandia Vehicle Decal Office issued 22,940 decals in a 3-year period for SNL/NM employees, SNL/NM contractors, and DOE personnel. During the same period, 40,959 decals were issued for KAFB (exclusive of those associated with SNL/NM). Thus, SNL/NM accounted for 36 percent of the 63,899 decals issued.

An earlier traffic study by the Middle Rio Grande Council of Governments also determined that SNL/NM accounted for 36 percent (13,582 vehicles) of daily KAFB commuters (SNL 1996c).

4.11.3.7 Traffic Accident Injuries and Fatalities

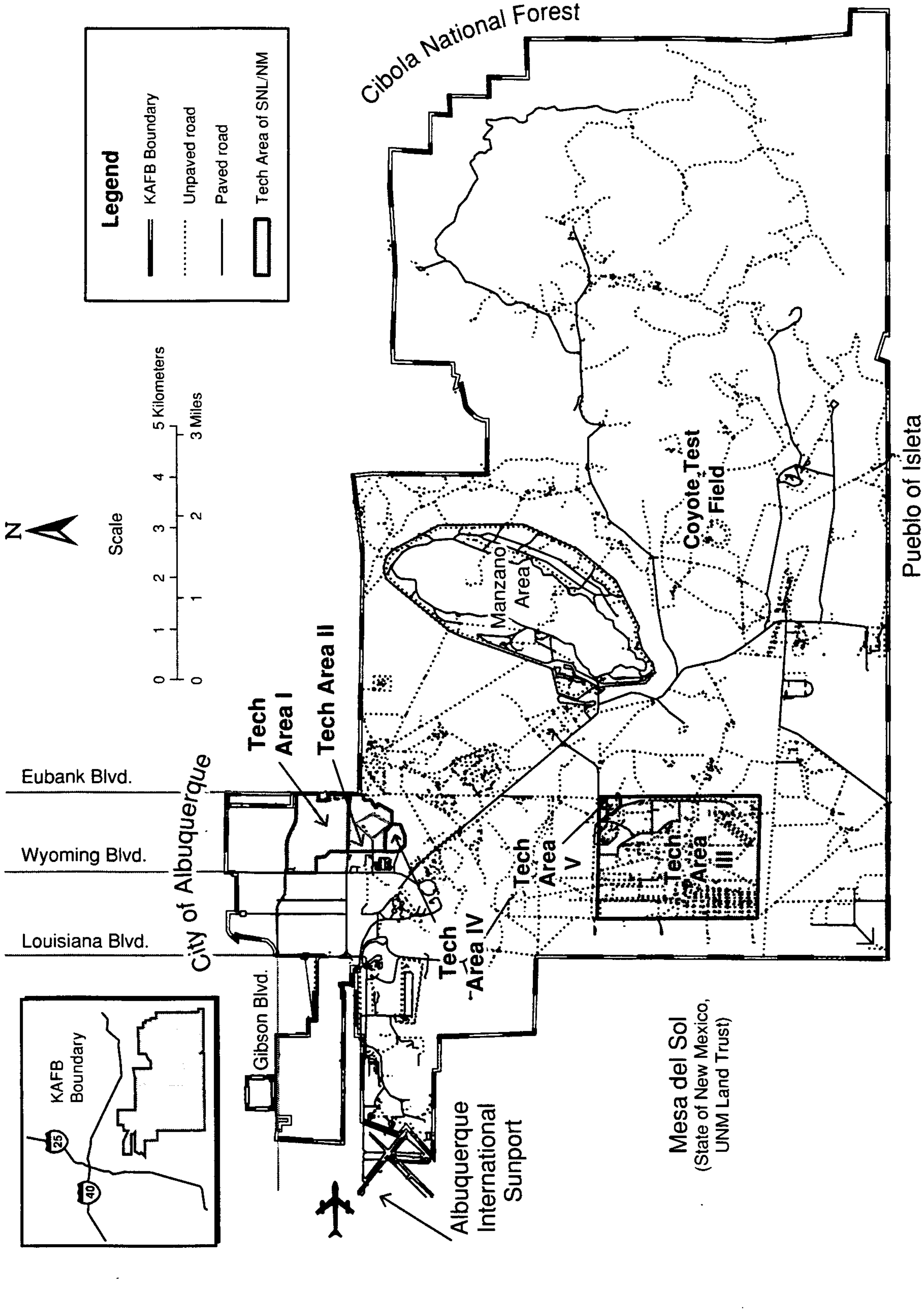
Table 4.11–4 lists SNL/NM traffic accidents from 1994 through 1997. Some of the accidents caused minor injuries, but none caused fatalities.



Source: SNL/NM 1997j

Figure 4.11–1. Major Albuquerque Transportation Routes

Interstates 40 and 25 and a network of streets maintained by the city of Albuquerque serve KAFB.



Source: SNL/NM 1997j

Figure 4.11–2. KAFB Transportation Routes

A large network of roads is used to transport material and wastes from site to site on KAFB.

4.12 WASTE GENERATION

4.12.1 Definition of Resource

Waste management activities consist of managing, storing, and preparing for offsite disposal of all wastes in accordance with applicable Federal and state regulations, permits obtained under these regulations, and DOE orders. The waste categories generated onsite under normal operations include radioactive waste (including LLW, LLMW, transuranic [TRU] waste and mixed transuranic [MTRU] waste); hazardous waste, which includes RCRA hazardous (chemical and explosives) waste and biohazardous (medical) waste; TSCA waste (primarily asbestos and PCBs); and nonhazardous solid waste and process wastewater.

4.12.2 Region of Influence

The ROI for waste generation involves SNL/NM and its facilities, including the HWMF, the TTF, the Solid Waste Transfer Facility (SWTF), the RMWMF, the High Bay Waste Storage Facility (HBWSF), the Interim Storage Site (ISS), and offsite SNL operations that generate and ship waste to SNL/NM (Table 4.11–2). The process design capacities for radioactive waste storage units covered under existing permits are shown in Table 4.12–1. The ROI does not include offsite waste disposal facilities because they involve the private sector or other Federal facilities. Waste management facility locations are shown in Figure 4.4–2.

The transportation of waste is discussed in Section 4.11, and details of the analysis are presented in Appendix G .

4.12.3 Affected Environment

The generation of the many different waste streams at SNL/NM creates a continuous need for proper packaging, labeling, manifesting, transporting, storing, and disposing solutions.

4.12.3.1 Normal Operations

The affected environment considered under this analysis is limited to those facilities that generate waste under normal operations at SNL/NM. Normal operations encompass all current operations that are required to maintain production at SNL/NM facilities. Other waste considered includes small amounts generated from SNL or DOE-funded operations at other DOE or Federal facilities that may also be managed at SNL/NM. For example, historically, TRU waste generated by the

Radioactive Waste Categories

***Low-Level Waste* (LLW)**—Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel or by-product tailings containing uranium or thorium from processed ore (as defined in Section 11[e][2] of the *Atomic Energy Act* [42 U.S.C. §2011]). Test specimens of fissionable material, irradiated for research and development only and not for the production of power or plutonium, may be classified as LLW, provided that the concentration of transuranic is less than 100 nanocuries per gram.

***Low-Level Mixed Waste* (LLMW)**—Waste that contains both hazardous waste regulated under the *Resource Conservation and Recovery Act* (42 U.S.C. §6901) and low-level waste.

Transuranic Waste (TRU)—TRU waste is waste containing more than 100 nanocuries of alpha-emitting TRU isotopes per gram of waste, with a half-life greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary of the U.S. Department of Energy has determined, with concurrence of the Administrator of the U.S. Environmental Protection Agency, does not need the degree of isolation required by the disposal regulations; or (c) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Mixed Transuranic Waste (MTRU)—TRU waste that also contains hazardous waste, as defined and regulated under the *Resource Conservation and Recovery Act* (42. U.S.C. §6901).

Other Waste Categories

Hazardous Waste—Any solid waste (definition includes semisolid, liquid, or gaseous material) having the characteristics of ignitability, corrosivity, toxicity or reactivity, defined by the *Resource Conservation and Recovery Act* (RCRA).

Nonhazardous Waste—Chemical waste not defined as a RCRA hazardous waste. The term nonhazardous waste does not necessarily imply the level of protection needed to properly manage the waste.

Table 4.12–1. Process Design Capacity for Radioactive Waste Storage Units at SNL/NM

UNIT	CONTAINER STORAGE (m^3)
RMWMF	8,000
HBWSF	1,800
Manzano Bunker 37034[a]	235
Manzano Bunker 37045[a]	176
Manzano Bunker 37055[a]	176
Manzano Bunker 37057[a]	176
Manzano Bunker 37063[a]	235
Manzano Bunker 37078[a]	279
Manzano Bunker 37118[a]	279
ISS	510
TOTAL	**11,866**

Source: DOE 1996c
HBWSF: High Bay Waste Storage Facility
ISS: Interim Storage Site
m^3: cubic meters
RMWMF: Radioactive and Mixed Waste Management Facility
[a] Bunkers are located within the Manzano Area (see Figure 4.4–2).

Lovelace Respiratory Research Institute has been managed at SNL/NM.

4.12.3.2 New Operations

Several new operations are currently in the planning stages at SNL/NM. However, they are considered outside of the scope of the current affected environment description for this analysis because they have not yet reached operational status. New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future. SNL/NM has identified operations at four facilities that fall under this category: Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA), Radiographic Integrated Test Stand (RITS), Hot Cell Facility (HCF), and Annular Core Research Reactor (ACRR). The latter two are associated with the Molybdenum Isotopes Production Project (MIPP) (DOE 1996b). Due to the specific nature of waste material, it will be handled at the originating facilities until shipped offsite for disposal. Waste generated during the preparations for these operations has been omitted from assessments of existing operations in this SWEIS.

4.12.3.3 Special Projects

Special projects are limited-duration projects, such as corrective actions, that are considered separately from facility production. These projects can make a large contribution to the overall waste generation activities at SNL/NM. However, special projects and new programs routinely undergo program-specific assessments to consider any impacts that may result from their inception and are, therefore, not considered in-depth in the SWEIS.

One special project, the ER Project, within its limited duration, will actually be the single largest waste generator at SNL/NM, although it is not a component of normal operations. The Office of Environmental Management (EM) manages the ER Project, which is a phased program designed to identify, assess, and remediate DOE-owned or -operated facilities that have contamination from disposal sites, releases, or spills. SNL/NM has received a permit modification from EPA Region VI and the NMED for a Corrective Action Management Unit (CAMU) designed to be a treatment and disposal unit exclusively for ER Project-generated hazardous waste. The CAMU is near the former Chemical Waste Landfill (CWL), an ongoing ER Project remediation site near the southern boundary of TA-III. Authorization has been received from the EPA and NMED to treat metal-contaminated soil and organic compound-contaminated soil, respectively. Construction of the bulk waste staging area and temporary storage area components of the CAMU has been completed. Construction will be completed on the treatment area and disposal cell components of the CAMU as needed to accommodate contaminated soil from the CWL and other ER Projects. Excavation of the CWL was scheduled to begin in September 1998. The *Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* analyzes potential environmental effects of the characterization and waste cleanup or corrective action at ER sites (DOE 1996c).

Other facility maintenance and infrastructure support operations would continue (as outlined in Section 2.3.5) with refurbishment, renovation, and removal of outdated facilities such as small office buildings, temporary structures, and trailers. Appendix D of the SNL Sites Comprehensive Plan identifies the specific structures under consideration over the next 10 years (SNL 1997). This program will potentially generate large volumes of TSCA waste, primarily asbestos, and building debris that will increase SNL/NM's disposal needs. One hundred thirty-eight buildings, accounting for 179,204 gross ft^2, are scheduled for removal within FY 1998 and FY 1999. Building debris estimates associated with this special project are included in the assessments of the waste generated from existing operations. Separate NEPA review may be required in the future depending on the scale and extent of the work involved.

4.12.3.4 Radioactive Waste

Radioactive waste generated at SNL/NM includes LLW, TRU waste, LLMW, and MTRU waste. Radioactive waste is characterized as either TRU or LLW, according to its radiological characteristics. Either type is considered mixed waste (MTRU or LLMW) if it also contains a RCRA hazardous waste component. LLW and LLMW are produced primarily in laboratory experiments and component tests. Other R&D activities that use radioactive materials may also generate LLW. TRU and MTRU wastes are produced in reactors and from the cleanup of reactor tests.

As part of the effort to minimize the total quantity of radioactive waste that is generated at SNL/NM, facilities that generate this type of waste are designated as Radioactive Materials Management Areas (RMMA). An RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material or an area that is exposed to beams or other sources of radioactive particles (such as neutrons and protons) capable of causing activation. Managers of facilities must document the location of all RMMAs. Procedures to minimize the generation of radioactive wastes are then developed with the Generator Interface and Pollution Prevention Department, Health Protection Department, and the Radiation Protection Operation Department.

SNL/NM has the capability to treat some mixed wastes onsite at the RMWMF and HBWSF. Treatment methods, quantity limits, and amounts treated in 1996 are shown in Table 4.12–2. Although treatment capacity appears to exceed demand, this is a permitted treatment quantity, based on the actual equipment, and often assumes conditions for operation not intended by the facility. Limits are often rate-oriented (for example, kg per hour) even though the actual operations are of short duration.

Historic Radioactive Waste Generation

Radioactive waste has historically been generated from the use of plutonium and other TRU isotopes, experiments involving nuclear reactor fuels, or R&D activities that used radioactive materials. In addition, small quantities are periodically received from remote test facilities and the Lovelace Respiratory Research Institute on KAFB. Table 4.12–3 summarizes radioactive waste quantities generated onsite from 1992 through 1995.

Current Radioactive Waste Generation

Table 4.12–4 presents information on the generation of radioactive waste during 1996. It lists totals by waste type and major generators.

Legacy Waste

Legacy waste is considered to be waste material currently in storage pending disposal. SNL/NM is in the process of disposing of this waste as treatment and disposal capacity becomes available. For the most part, legacy waste is either radioactive or classified. Radioactive legacy waste, currently in storage pending treatment or disposal, is discussed in Appendixes G and H. ER Project-generated waste is considered a type of legacy waste; however, within the SWEIS, ER Project waste is addressed separately. Projections for elimination of radioactive legacy waste are shown in Figures 4.12–1, 4.12–2, and 4.12–3. All radioactive waste in storage at the end of FY 1998 is considered to be legacy waste. Figure 4.12–1 shows that legacy LLW inventory will be reduced to zero by the end of FY 2005. Figure 4.12–2 shows that legacy LLMW inventory will be reduced to zero by the end of FY 2002. Figure 4.12–3 shows that the legacy TRU/MTRU inventory will be reduced to zero in FY 2004, with shipment of this waste to LANL for certification.

4.12.3.5 Hazardous Waste

Hazardous waste refers specifically to nonradioactive waste, including RCRA chemical and explosives waste, biohazardous medical waste, and TSCA waste (primarily asbestos and PCBs). The hazardous waste generated at SNL/NM is predominantly chemical laboratory trash generated from experiments, testing, other research and development (R&D) activities, and infrastructure fabrication and maintenance.

Historic Hazardous Waste Generation

SNL/NM disposed of hazardous waste onsite from the start of operations until 1981. After 1981, waste was shipped offsite for disposal. Table 4.12–5 contains a summary of hazardous waste generated during normal operations from 1992 through 1995. Medical waste

Table 4.12–2. Mixed Waste Treatments, Quantity Limits, and Amounts Treated Onsite in 1996

TREATMENT [a]	PROCESS LIMIT		AMOUNT TREATED IN 1996
	RMWMF	HBWSF	
Container Storage	8,000,000 L	1,500,000 L	
Thermal Treatment	110 kg per hour	110 kg per hour	None
Neutralization	1,000 L per day	1,000 L per day	21 L
Chemical Treatment	537 kg per hour	537 kg per hour	<1 kg
Centrifugation	360 gal per hour	360 gal per hour	None
Encapsulation	0.3 L per hour	0.3 L per hour	None
Flocculation	360 gal per hour	360 gal per hour	None
Physical Treatment	6,500 L per day	6,500 L per day	None
Reverse Osmosis	100 L per day	100 L per day	None
Mechanical Processing	1,500 kg per hour	1,500 kg per hour	None
Other Treatment	30 kg per hour	30 kg per hour	None

Source: SNL/NM 1997a
gal: gallon
HBWSF: High Bay Waste Storage Facility
kg: kilogram
L: liter
RMWMF: Radioactive and Mixed Waste Management Facility
[a] Treatment options are discussed in the SNL/NM Site Treatment Plan. Final approval of treatment options is not expected prior to the renewal of the existing hazardous waste permit sometime after 2000. The DOE has paid annual operating fees associated with the treatment units since 1996.

Table 4.12–3. Radioactive Waste Generated from 1992 through 1995[a]

RADIOACTIVE WASTE GENERATED[b]	LLW	TRU	LLMW	MTRU
1992	42	0	6	0
1993	40	0	7	0
1994	54	0	2	0
1995	45	0	18	0

Source: SNL/NM 1997a
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] Values are in cubic meters, rounded to two significant digits
[b] It was assumed that the amount of waste placed into storage correlates to the amount of waste generated during a similar period of time.

Table 4.12–4. 1996 Radioactive Waste Generation by Major Contributors and Special Projects[a]

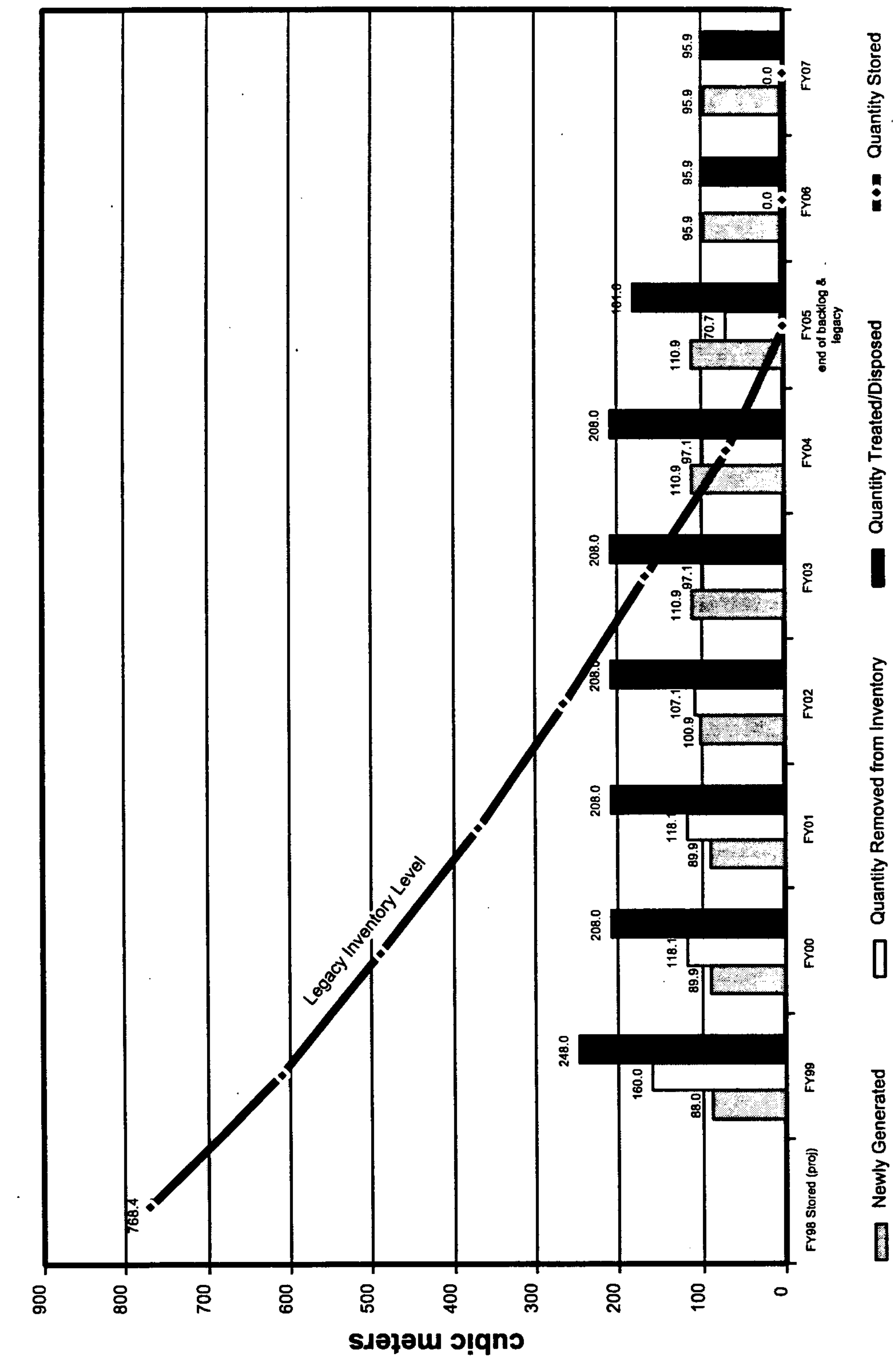
GENERATORS	LLW	LLMW	TRU	MTRU
Environmental Restoration Project[b]	310	62	0	0
Neutron Generator Facility, Building 870 and Related Production Activities	11	<0.1	0	0
Research Accelerator Facilities, TA-IV	0.3	0	0	0
Research Reactor Facilities, TA-V	140	6	4	0
Decontamination and Decommissioning	31	4	0	0
Waste Management of Legacy Waste	11	71	0	0
Other (Balance of Plant)[c]	74	0.3	0	0
TOTALS	**577**	**143**	**4**	**0**

Source: SNL/NM 1997a
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic waste
TA: technical area
TRU: transuranic waste
[a] Values are in cubic meters, rounded to two significant digits.
[b] Special program, not a component of normal operations
[c] Balance of operations refers to generation of mission-related waste not otherwise accounted for under selected facilities or special projects.

Table 4.12–5. Hazardous Waste Generated During Normal Operations from 1992 through 1995[a]

YEAR ACCEPTED AT HWMF	RCRA	TSCA
1992	147,000	5,000
1993	96,000	5,500
1994	86,000	24,000
1995	207,000	133,000

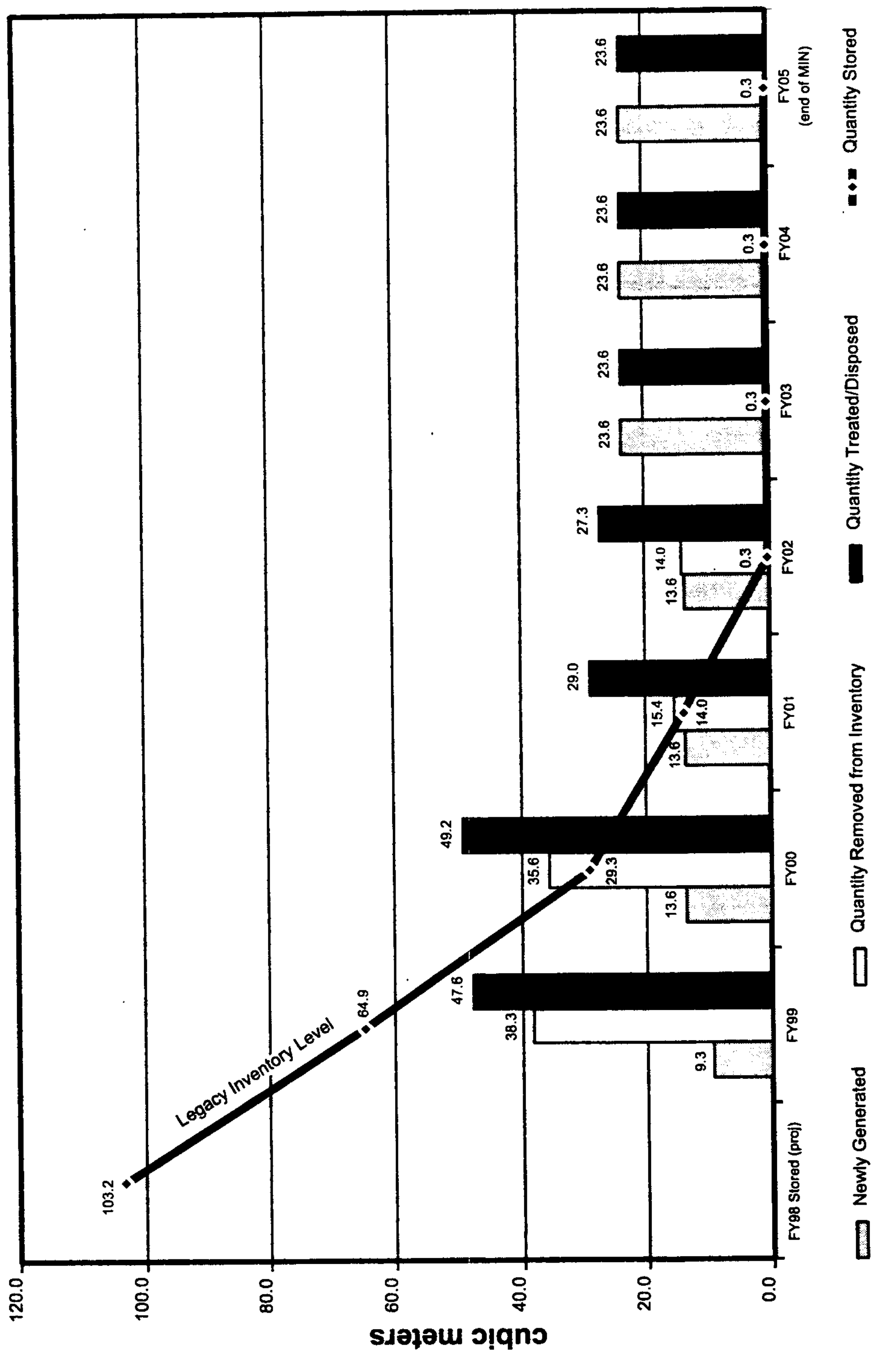
Source: SNL/NM 1997a
HWMF: Hazardous Waste Management Facility
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] Quantities given in kilograms
Note: Large variations may be attributable to startup and closeout of projects and relocation of laboratories from one building to another.



Source: Losi 1998

Figure 4.12–1. Projected Low-Level Waste Inventory, Fiscal Years 1999 through 2007

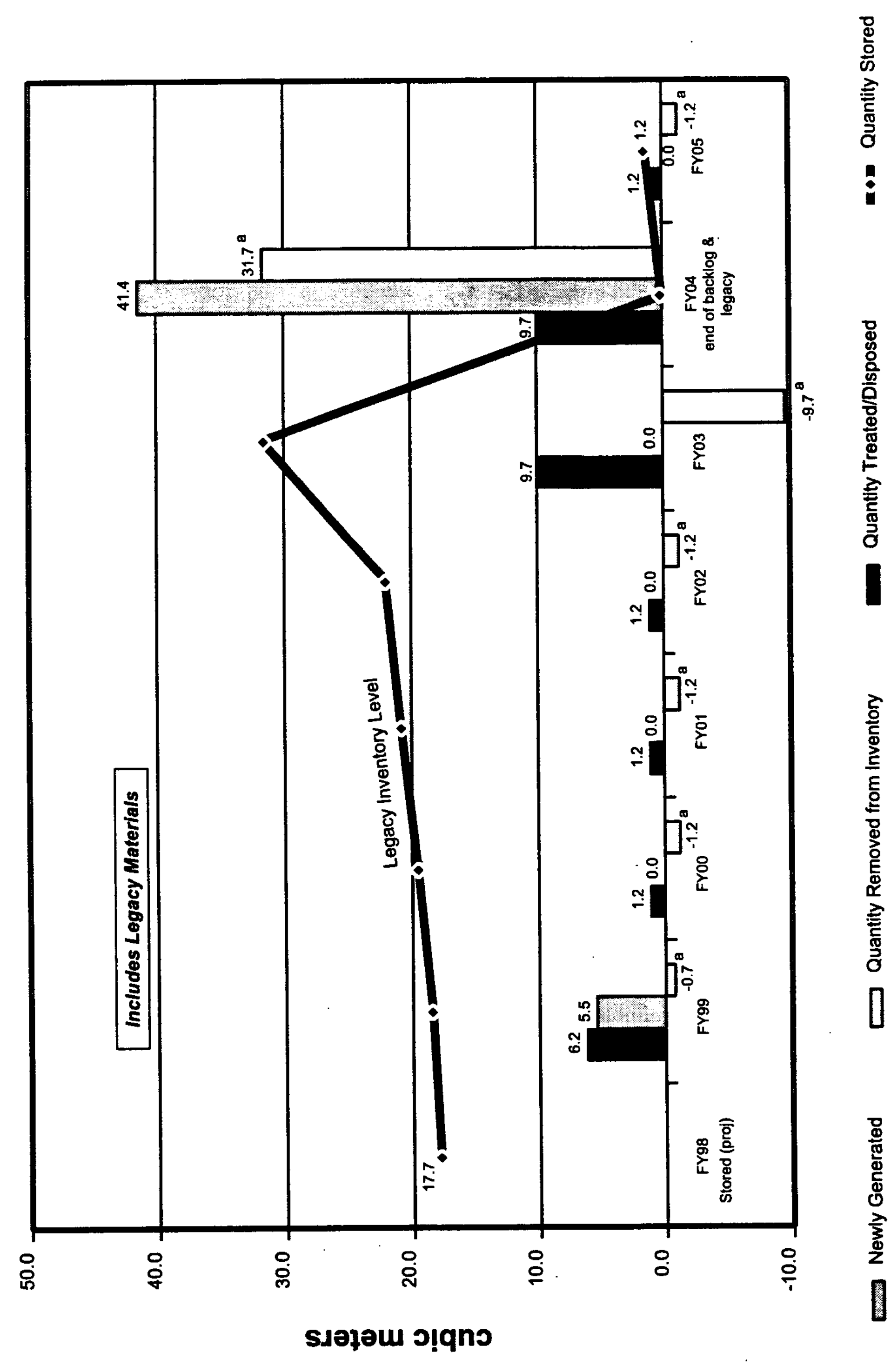
Legacy low-level waste inventory levels are projected to decrease to zero by 2005.



Source: Losi 1998

Figure 4.12–2. Projected Low-Level Mixed Waste Inventory, Fiscal Years 1999 through 2005

Legacy mixed waste inventory levels are projected to decrease to zero by 2002.



Source: Losi 1998

[a]Negative values for Transuranic and Mixed Transuranic indicate waste is placed into storage with no shipments occurring, resulting in an increase in inventory.

Figure 4.12–3. Projected Transuranic and Mixed Transuranic Waste Inventory, Fiscal Years 1999 through 2005

Transuranic waste volume is projected to increase through 2003 and then decrease by 2005.

totals generated in these years are unavailable. Prior to 1996, ER and D&D wastes were included within the RCRA and TSCA waste categories.

Current Hazardous Waste Generation

Table 4.12–6 presents data on hazardous waste generated by major programs in 1996 and some subgroups of major waste-generating programs or facilities. The programs or facilities listed in the table are the highest contributors. The remainder of RCRA-regulated hazardous waste is generated by approximately 1,000 additional onsite hazardous waste generators.
Figure 4.12–4 shows projected quantities of SNL/NM-generated RCRA hazardous waste declining through 2001.

The PCB waste generation for 1996 was unusually high due to transformer replacement activities. An additional 77,000 kg of other TSCA waste, primarily asbestos, were generated predominantly from D&D asbestos abatement projects. Finally, 1,400 kg of biohazardous waste were also generated by the Medical Department.
Figures 4.12–5 and 4.12–6 show historic asbestos waste generation and PCB waste generation with projections through 2002 (see Section 4.12.3.3 for additional information).

Explosive Waste

Explosive waste is a specific class of hazardous waste, RCRA characteristic code D003, that, due to its inherent danger, is addressed separately. Only one facility at SNL/NM, the TTF, is permitted under RCRA to treat this class of waste onsite. The TTF was specifically designed to treat explosive-contaminated waste, which did not meet DOT requirements for offsite transportation, from the Light Initiated High Explosive Facility. The TTF RCRA permit allows for treatment of up to 300 lb of waste per year. In 1996, 5,634 kg of explosive wastes were also sent to the KAFB Explosives Ordinance Disposal Unit.

4.12.3.6 Solid Waste

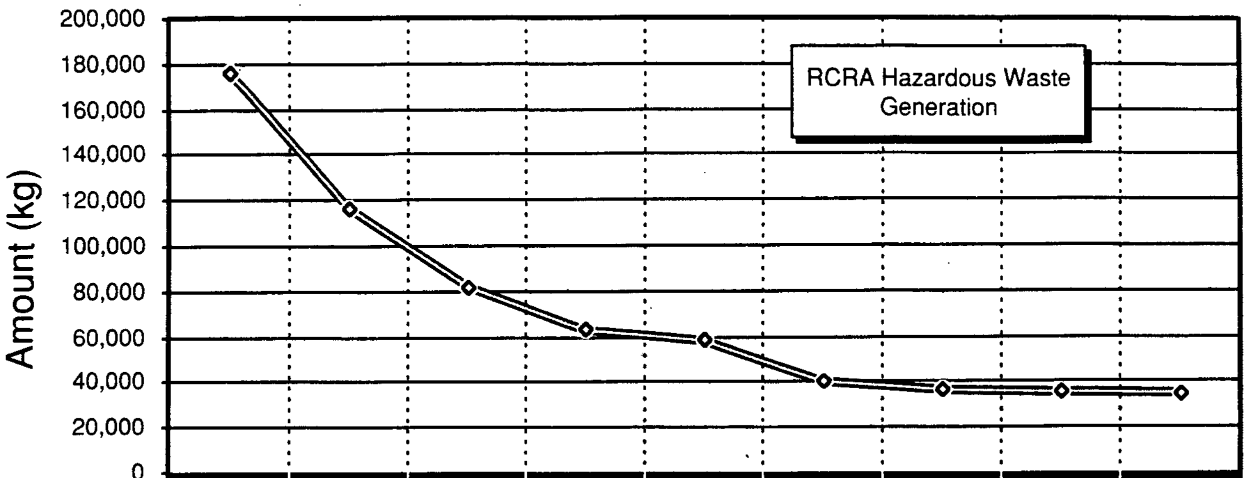
Solid waste consists predominantly of office and nonhazardous laboratory trash. It does not include food waste from cafeteria operations, which is managed under a separate contract with the USAF. Nonhazardous building debris generated from D&D activities may also be considered solid waste; however, it is currently managed at KAFB. After nonhazardous trash is transferred to the SWTF, it is screened for improperly disposed of and potentially hazardous materials, which are removed from the trash and disposed of through appropriate processes. All solid waste is currently disposed of at the Rio Rancho Sanitary Landfill in Rio Rancho, New Mexico.

Table 4.12–6. Major Hazardous Waste (RCRA and TSCA) Generators in Calendar Year 1996[a]

GENERATOR	RCRA	TSCA[b]
Environmental Restoration Project[c]	11,000	90
Neutron Generator Facility	220	680
Research Accelerators Facilities, TA-IV	1,100	41
Research Reactors Facilities, TA-V	110	460
Integrated Materials Research Laboratories	2,400	0
Compound Semi-Conductor Research Laboratory	2,000	0
Advanced Material Processing Laboratory	10,000	0
Other Generators	21,170	50,700
TOTALS	**48,000**	**52,000 (PCBs)[d]** **77,000 (Asbestos)[e]**

Source: SNL/NM 1997a
D&D: decontamination and decommissioning
PCBs: polychlorinated biphenyls
RCRA: *Resource Conservation and Recovery Act*
TA: technical area
TSCA: *Toxic Substance Control Act*

[a] Quantities given in kilograms
[b] PCBs unless otherwise noted
[c] The Environmental Restoration Project is a special program and not considered part of normal operations at SNL/NM.
[d] PCB generation for 1996 was unusually high due to transformer changeout.
[e] Asbestos generation predominantly was from D&D asbestos abatement projects.



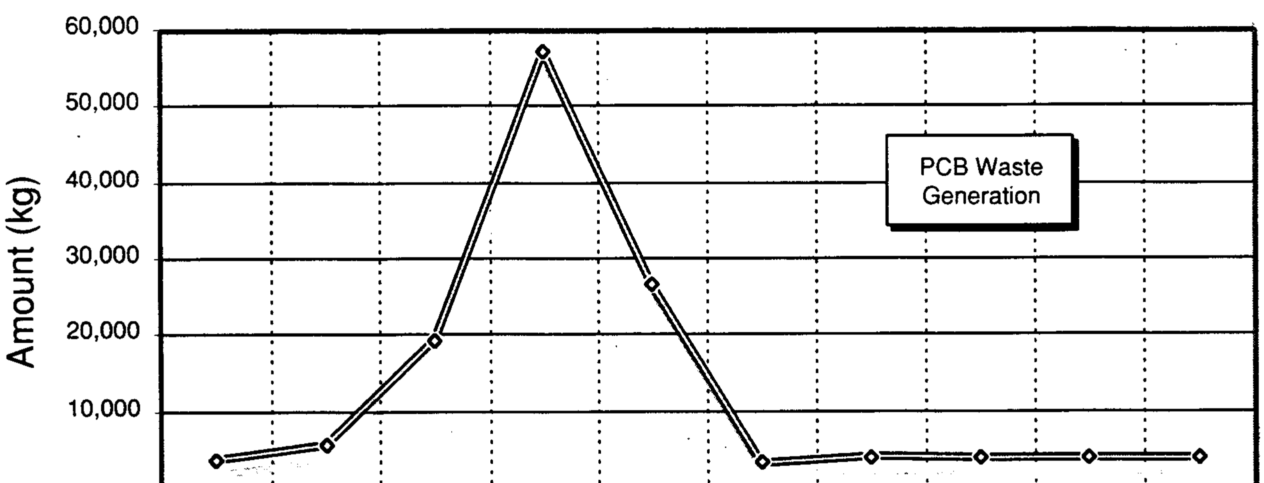
	1993	1994	1995	1996	1997	1998 (Estimated)	1999 (Estimated)	2000 (Estimated)	2001 (Estimated)
Amount (kg)	176,343	115,917	81,501	63,824	58,442	40,820	36,708	35,681	34,652

Fiscal Year

Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–4. RCRA Hazardous Waste Generation

RCRA hazardous waste generated at SNL/NM would continue to decline through 2001.



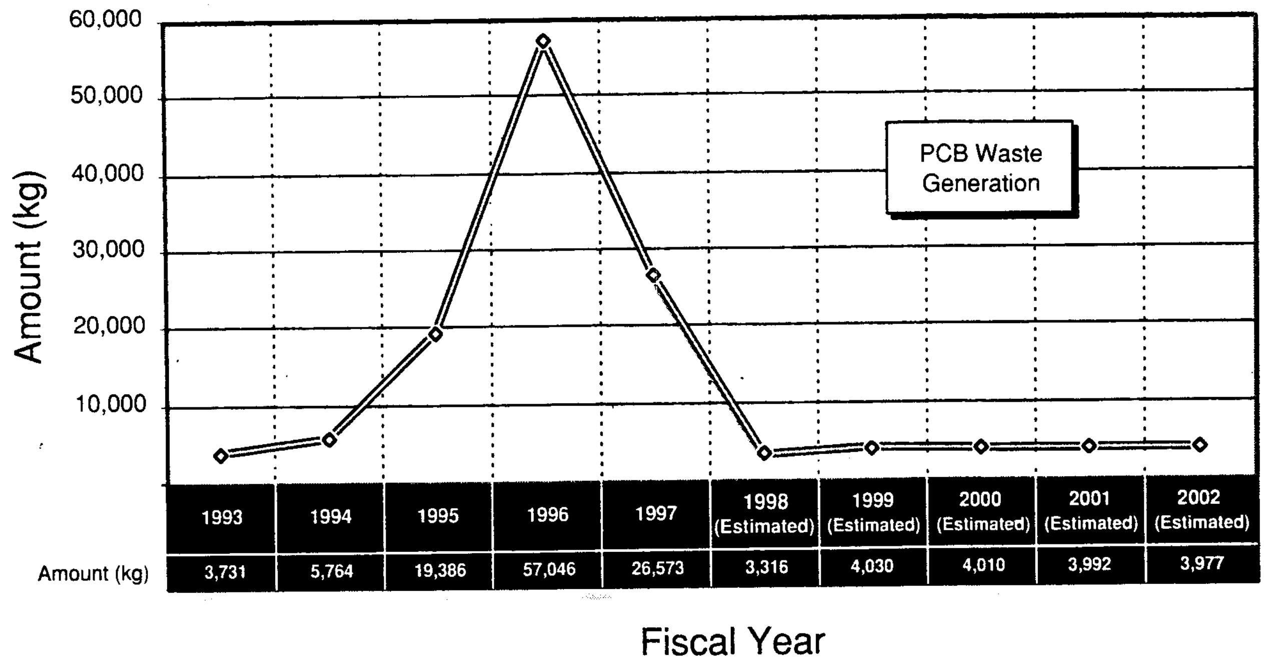
	1993	1994	1995	1996	1997	1998 (Estimated)	1999 (Estimated)	2000 (Estimated)	2001 (Estimated)	2002 (Estimated)
Amount (kg)	3,731	5,764	19,386	57,046	26,573	3,316	4,030	4,010	3,992	3,977

Fiscal Year

Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–5. Asbestos Waste Generation

Volumes of asbestos waste generated at SNL/NM would remain constant through 2002.



	1993	1994	1995	1996	1997	1998 (Estimated)	1999 (Estimated)	2000 (Estimated)	2001 (Estimated)	2002 (Estimated)
Amount (kg)	3,731	5,764	19,386	57,046	26,573	3,316	4,030	4,010	3,992	3,977

Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–6. Polychlorinated Biphenyls (PCB) Waste Generation

Volumes of PCB waste generated at SNL/NM would remain constant through 2002.

Historic Solid Waste Generation

Before August 1, 1994, solid waste was disposed of at the KAFB Solid Waste Landfill. From August 1, 1994, through May 13, 1996, the SNL/NM Solid Waste Management Program was in transition—the KAFB Landfill closed (except for nonhazardous construction and demolition waste and recyclable landscape debris) and SNL/NM built the SWTF.

During this transition, solid waste pickup and disposal was under contract to a commercial waste management company that transported from the pickup sites to the city of Albuquerque Cerro Colorado Landfill, initially, and then to the Rio Rancho Sanitary Landfill in Rio Rancho, approximately 28 mi from KAFB. On May 13, 1996, SWTF began screening waste. Since 1996, SNL/NM solid waste has been disposed of at local municipal landfills. Detailed records of disposal before August 1, 1994, are limited.

Current Solid Waste Generation

Table 4.12–7 presents information for solid waste generation from normal operations based on the period the SWTF operated from May through December 1996. In 1997, SNL/NM generated 51 solid waste shipments, totaling 1.1M kg or 2,100 m^3 (2,700 yd^3).

4.12.3.7 Pollution Prevention and Waste Minimization

DOE 5400.1 and Executive Order (EO) 12856 implement a pollution prevention program to comply with DOE requirements (58 FR 41981). The SNL/NM Pollution Prevention Program applies to all pollutants generated by routine and nonroutine operations. The scope of the Pollution Prevention Program includes activities that encourage pollution or waste source reduction and recycling, resource and energy conservation, and affirmative procurement of EPA-designated recycled products.

Trends and Requirements

Since 1993, SNL/NM has reduced waste generation, water use, and air emissions and has increased recycling and procurement of recycled material. Figure 4.12–7 presents 1997 recycling information for SNL by material type.

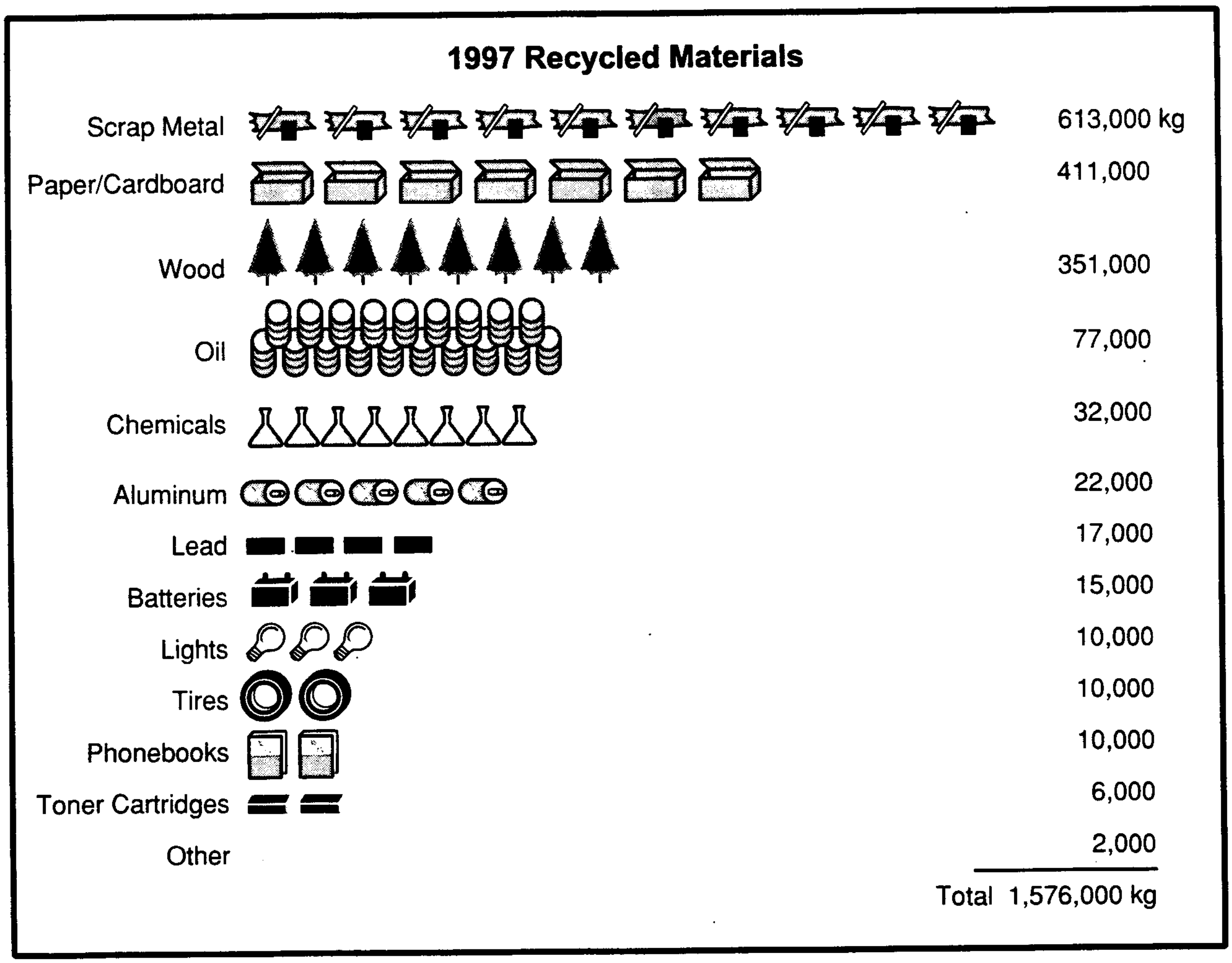
Waste Minimization

Waste minimization activities are not included in the previous descriptions to bound maximum waste projections for any given year. Actual waste trends are shown for RCRA hazardous, TSCA PCB, and TSCA asbestos wastes in Figures 4.12–4, 4.12–5, and 4.12–6. Actual figures for waste recycled are shown in

Table 4.12–7. 1996 Solid Waste Generation (Partial-Year Information)

DESCRIPTION	WEIGHT (kg)
Dumpster waste generated from May 13, 1996, through December 31, 1996	0.6 M
Average monthly dumpster waste generation	0.1 M
Average annual dumpster waste generation, estimated	1.1 M

Source: SNL/NM 1997a
lb: pound
M: million



Source: SNL 1998d

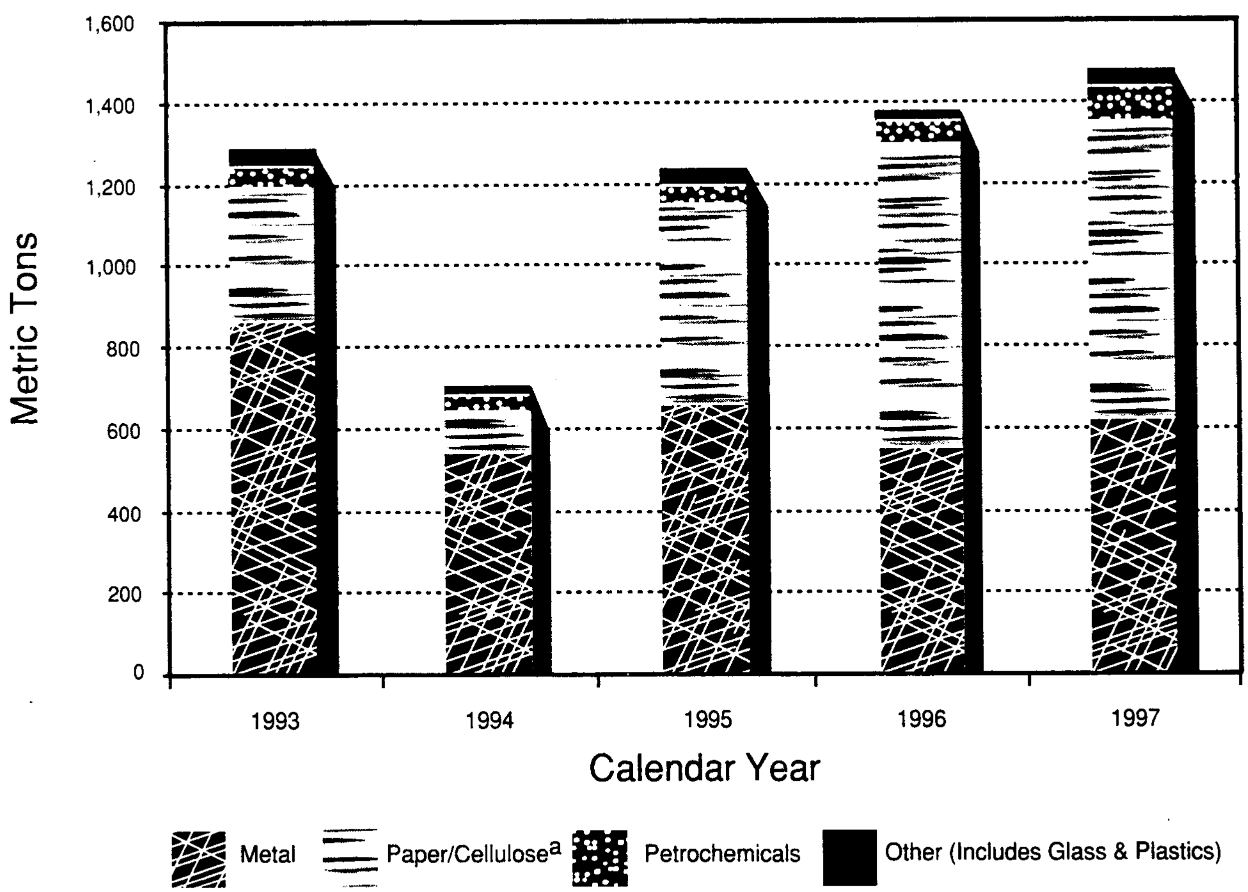
Figure 4.12–7. SNL Recycling in 1997

SNL has reduced waste generation through recycling.

Figures 4.12–7, 4.12–8, and 4.12–9. Prevention and minimization of waste generation and conservation of energy, water, and resources are the overall goals of this program.

The following wastes are tracked to determine SNL/NM's effectiveness in reducing wastes: LLW and LLMW, RCRA, state-regulated, TSCA, and sanitary waste. In addition, reductions of resource, water, and energy use are tracked. Following are the goals to be completed:

- Limit the generation of routine LLW to 20 m^3.
- Limit the generation of routine RCRA hazardous waste to 50 metric tons.
- Limit the generation of routine state-regulated chemical waste to 110 metric tons.
- Limit the generation of routine sanitary waste to 3,650 metric tons.
- Limit the generation of routine LLMW to 2.65 m^3.
- Increase the recycling rate to 33 percent of total sanitary waste generated.
- Increase procurement of EPA-designated recycled products to 100 percent in 1999, except where they are not commercially available competitively at a reasonable price or do not meet performance standards.
- Reduce annual energy use per square foot in regular buildings by 30 percent from FY 1985 to FY 2005. Assume a linear step reduction per year (for example, a 21 percent reduction by FY 1999).
- Reduce annual energy use per square foot in energy-intensive buildings by 20 percent from FY 1990 to FY 2005. Assume a linear step reduction per year (for example, a 12 percent reduction by FY 1999).
- Reduce water use at SNL/NM by 30 percent from 1994 to 2004. Assume a linear step reduction per year (for example, a 15 percent reduction by FY 1999).

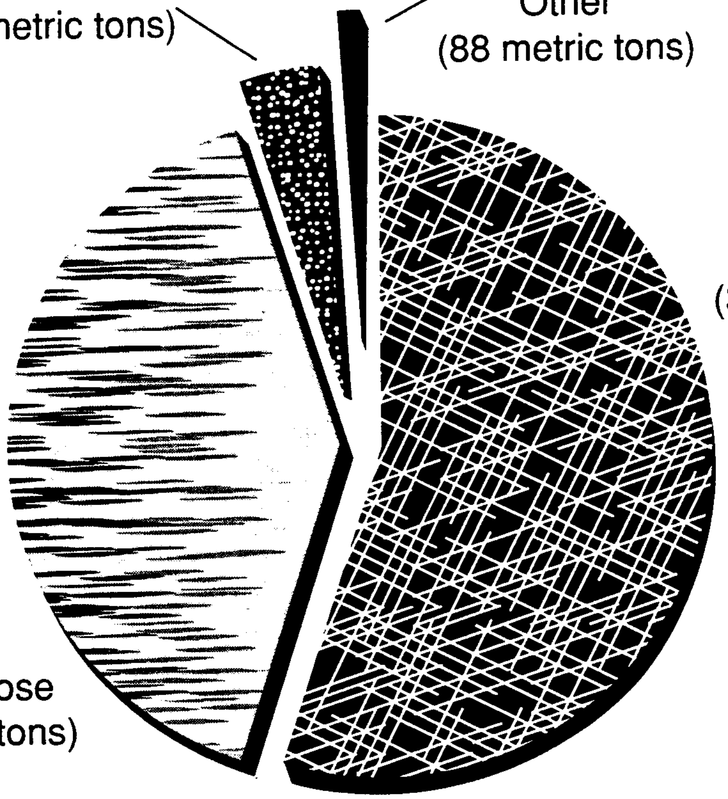


Source: SNL/NM 1998x

[a] Paper/cellulose quantities for 1996 and 1997 include amounts from LANL, the USAF, and other DOE activities at KAFB. For 1997, SNL/NM accounted for 51 percent of the recycled quantity, with LANL, the USAF, and other DOE accounting for 43, 3, and 3 percent, respectively.

Figure 4.12–8. Annual Recycling Trends, 1993 through 1997

SNL/NM annually recycles various material types.



Source: SNL/NM 1998x

Figure 4.12–9. Proportions of Recycled Materials, 1993 through 1997

Paper, cellulose, and metal comprise 95 percent of the material recycled at SNL/NM from 1993 through 1997.

Recycling

Recycled paper and cardboard are processed through the SWTF. In 1996, SNL/NM initiated a joint effort with Los Alamos National Laboratory (LANL) to cooperate in collecting, processing, and marketing LANL-generated recyclable paper. After creating a process, the program was expanded to include the Kirtland Area Office (KAO). Over the next few years, efforts to expand cooperation with other Federal and state facilities will continue.

4.13 NOISE AND VIBRATION

4.13.1 Definition of Resource

Noise is sound that is undesirable because it interferes with speech, communication, or hearing; is intense enough to damage hearing; or is otherwise annoying. Airblast noise from the detonation of explosives is impulsive in nature and generally lasts less than 3 seconds. The rapid onset of impulse noise or the vibration of buildings and other structures induced by a noise impulse can be annoying or discomforting to those around it.

Vibration is defined as a motion in which an object moves back and forth from its rest position when it is acted upon by an external force. The maximum ground-borne vibration level recommended by the U.S. Bureau of Mines to prevent threshold damage is 0.5 inches per second. The threshold level at which minor structural damage may begin to occur in 0.01 percent of structures is set at 2.0 inches per second. Noise from explosive detonations can cause buildings to vibrate, which is perceived by the occupants as shaking of the structure and rattling of the windows. These vibrations are perceived by the residents as the cause of existing or potential structural damage. The probability of this shaking causing structural damage is minimal.

4.13.2 Region of Influence

The ROI associated with noise includes the area within the Albuquerque basin. Noise decreases with distance from the source. The sound heard outside KAFB from airblast noise, resulting from the detonation of explosives or sonic booms from sled track activities, resembles a dull thud or short burst of sound. The distance at which this sound can be heard depends on the intensity of the initial airblast, the meteorological conditions, terrain, and background noise levels.

4.13.3 Affected Environment

This section describes the sources of noise resulting from activities conducted at SNL/NM and those associated with activities at KAFB and Albuquerque International Sunport. Although noise from activities at KAFB and the Sunport is not related to SNL/NM activities, it could affect SNL/NM operations.

Baseline sounds at SNL/NM consist of manufactured noise generated in and around the surrounding area, mainly from transportation and stationary sources. Activities at and around SNL/NM affect ambient (background) sound. These include aircraft associated with Albuquerque International Sunport and KAFB, vehicular traffic at KAFB, and industrial sources. SNL/NM test programs, including tests of high explosives, rocket motors, and large-caliber weapons and tests producing sonic booms, contribute to the noise baseline.

Quantifying the Effects of Sound

The process of quantifying the effects of sound begins with establishing a unit of measure that accurately compares sound levels. The physical unit most commonly used is the decibel (dB). The decibel represents a relative measure or ratio to a reference pressure. The reference pressure is a sound approximating the weakest sound that a person with very good hearing can hear in an extremely quiet room. The reference pressure is 20 micropascals, which is equal to 0 (zero) dB.

A-weighted sound levels (dBA) are typically used to account for the response of the human ear. A-weighted sound levels represent adjusted sound levels that are made according to the frequency content of the sound.

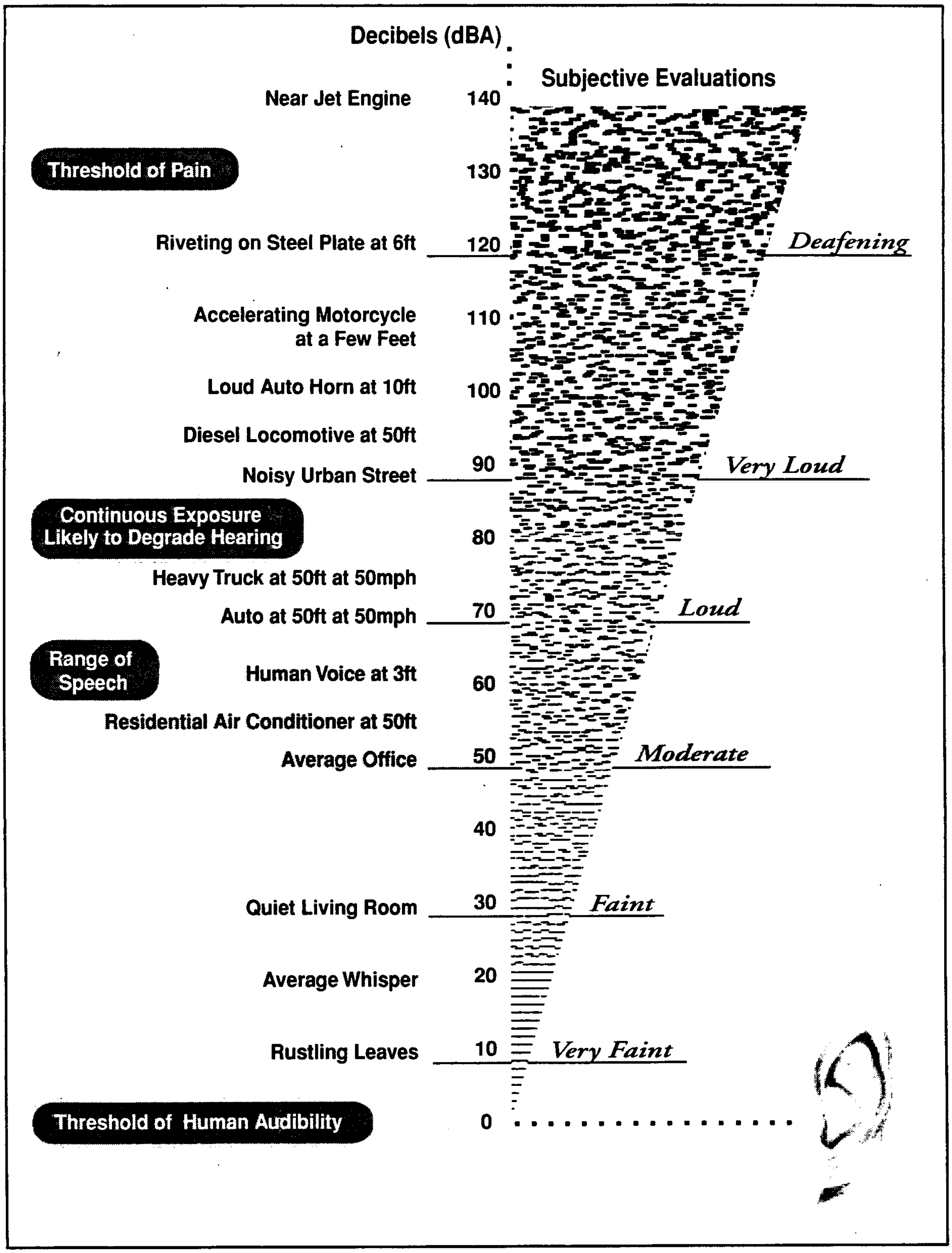
Noise effects to the community depend on the loudness of the sound, the intensity of vibrations, the frequency of the events, and the atmospheric conditions transmitting sound during the event. In most cases, the impulse sound heard outside KAFB resembles a dull thud or a short burst (less than 3 seconds). The noise baseline (aircraft, traffic, and industrial sources) would mask the sounds produced by most SNL/NM activities.

Industrial and construction activities are another source of noise. Some of these activities could affect the occupational health of SNL/NM personnel, but measures are in effect through the SNL/NM Hearing Conservation Program to ensure that hearing damage to personnel does not occur.

The regulatory setting that applies to noise at SNL/NM includes the *Noise Control Act of 1972* (42 U.S.C. § 4901), *Contractor Industrial Hygiene Program* (DOE 5480.10), *Occupational Noise Exposure* (29 CFR §1910.95), and *City of Albuquerque Noise Control Ordinance* (Ord. 21-1975, § 9-9-1).

4.13.3.1 SNL/NM Ambient Noise Levels

The ambient noise level is the sound pressure level of the all-encompassing noise associated with a given environment, usually a composite of sounds. Figure 4.13–1 shows a noise scale representing common noise events, the respective decibel (dB) level, and a subjective evaluation of the noise event.



Source: Original

Figure 4.13–1. Comparing Noise Levels to Events Within Range of Human Hearing

Decibel levels and subjective evaluations are compared for events within range of human hearing.

SNL/NM's ambient background sounds will be relatively consistent. Background sounds produced by generators, air conditioning, ventilation systems, vehicles, and employee activities constitute a substantial sound source during the morning, midday, and evening. The range of background noise levels associated with these sources is from 50 to 70 dB (SNL/NM 1997a).

SNL/NM testing produces the most perceptible impulse sound levels at TA-III, Coyote Test Field, and other outdoor test facilities. The 1996 baseline frequency of impulse noise events is 1,059 events. Only a small fraction of these events are loud enough to be heard or felt beyond the site boundary.

No residential areas on KAFB or in the city of Albuquerque are affected by either the damaging vibration area of 2.0 inches per second or the annoyance vibration area of 0.2 inch per second. SNL/NM facilities within the damage radius for vibrations are designed to withstand the effects of testing; therefore, damage would be unlikely (SNL/NM 1997a).

4.13.3.2 Ambient Noise Levels at Other Locations

SNL/NM is subject to aircraft noise from the Albuquerque International Sunport and KAFB and from vehicular traffic on KAFB. Aircraft noise is the most prevalent sound because Runway 8-26 is the primary runway for the Albuquerque International Sunport. Aircraft take off and land in an easterly direction on this runway about 75 to 80 percent of the time. Aircraft using this runway fly directly over SNL/NM. Noise abatement procedures to decrease aircraft noise in nearby neighborhoods, such as Ridgecrest and Four Hills, affect SNL/NM (SNL/NM 1997a). These procedures direct pilots to avoid these neighborhoods by flying over SNL/NM.

Noise levels at SNL/NM associated with aircraft from the Albuquerque International Sunport are too low to be considered potentially damaging to hearing. The noise is primarily annoying, interrupting conversations, telephone communications, and possibly the ability to concentrate on difficult tasks. Personnel in temporary buildings, such as trailers, are more likely to be affected because of the poor sound absorption qualities of the building materials in comparison to permanent buildings.

Based on Federal Aviation Administration (FAA) land use compatibility guidelines, adverse effects on people are most likely to occur within the 75-dB(A) day-night average noise level (DNL) area.

At the Albuquerque International Sunport, the 65-dB(A) and 70-dB(A) noise levels extend beyond the Sunport boundary with KAFB (SNL/NM 1997a), but not the 75-dB(A) noise level.

Motor vehicle noise is prevalent in the more congested areas of KAFB. The fluctuation of traffic noise over long periods is associated with peak traffic periods. In addition, noise levels are influenced by vehicle type, number of tires, road-surface conditions, and exhaust systems. The DNL in a 1995 KAFB traffic study in a 24-hr traffic count at the Gibson gate was 71 dB(A), averaged over a 24-hr period (SNL/NM 1997a).

The Air Force Research Laboratory, USAF/Explosive Ordnance Disposal (EOD), and the Defense Special Weapons Agency detonate explosives on KAFB. Activities that are not SNL/NM's are performed at the Giant Reusable Air Blast Simulator (GRABS) Site, Chestnut Site, High Energy Research Test Facility (HERTF) Site, USAF/EOD areas, and the DOE Live Fire Range.

Harmful noise levels (above 140 dB) from these activities remain within the boundaries of KAFB, with the exception of an 1,800-lb high-explosive detonation at the Chestnut Site, for which the 140-dB noise level extends beyond the KAFB site boundary and into the buffer zone on the Pueblo of Isleta (SNL/NM 1997a). Explosive detonations of this magnitude are expected to be rare.

Future development in the buffer zones on the Pueblo of Isleta and Mesa del Sol will create potential conflicts with respect to land use. Noise levels are projected to affect the buffer zones during high-explosive detonations at the Chestnut Site. Ground vibration may be of sufficient magnitude to generate structural damage if development occurs in the buffer zones. Impulse noise may affect the area, producing annoyance to inhabitants of developed areas should the land-use status change from its current buffer zone designation.

Day-Night Average Sound Level

The day-night average sound level (DNL) was developed to evaluate the total community noise environment. The DNL is the average A-weighted sound level during a 24-hr period, with 10 dB added to nighttime levels (between 10:00 p.m. and 7:00 a.m.). This adjustment is added to account for the increased human sensitivity to nighttime noise events.

4.14 SOCIOECONOMICS

4.14.1 Definition of Resource

This section describes the demographic and economic variables associated with community growth and development that have the potential to be directly or indirectly affected by changes in operations at SNL/NM. SNL/NM and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services required by SNL/NM operations. SNL/NM operations, in turn, create the demand and pay for the people, goods, and services in the form of wages, salaries, and benefits for jobs and dollar expenditures for goods and services. The measure of the communities' ability to support the demands of SNL/NM depends on their ability to respond to changing environmental, social, economic, and demographic conditions.

For a discussion of DOE operations and socioeconomic effects related to DOE operations at SNL/NM, see Section 6.2.

4.14.2 Region of Influence

The socioeconomics ROI is defined by the areas where SNL/NM employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The ROI consists of a four-county area (Bernalillo, Sandoval, Torrance, and Valencia counties) and includes the city of Albuquerque, which is where approximately 97.5 percent of SNL/NM employees reside (Figure 4.14–1). The ROI is also defined in *The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico, Fiscal Year 1996*, prepared by New Mexico State University (NMSU) for the DOE Office of Technology and Site Programs, DOE/AL (DOE 1997j). The FY 1997 report was reviewed; however, FY 1996 remained the year most representative of past operations. FY 1997 data are presented for comparison.

4.14.3 Affected Environment

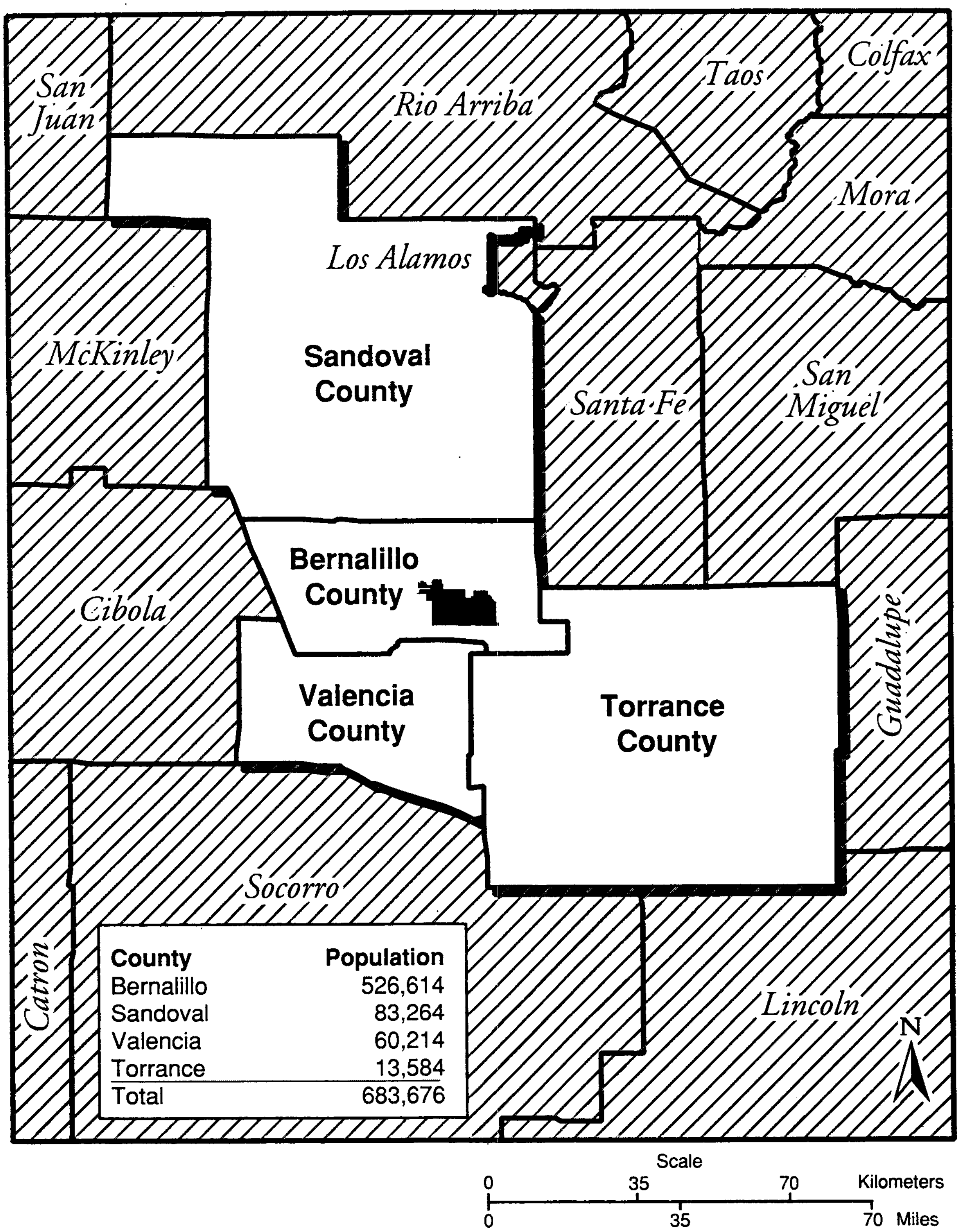
4.14.3.1 Demographic Characteristics

The estimated population in the four-county ROI in 1990 was approximately 599,416 people, of whom approximately 80 percent (480,577) reside in Bernalillo county. The predominant population in the ROI is white, although 37.1 percent of the total population have a Hispanic ethnic background (Table 4.14–1). Native Americans residing in the ROI account for 5 percent of the general population. The Pueblos of Cochiti, Isleta, Jemez, San Felipe, Sandia, Santa Ana, Santo Domingo, and Zia, and the Cañoncito Navajo Reservation are important centers of these Native American populations (Census 1995) within the ROI. In 1990, minorities made up 45.4 percent of the total ROI population and 49.6 percent (not shown in table) of the state population (based on revised 1990 census data). In April 1997, out of a total work force of 6,824 workers, minorities made up 27.4 percent of the SNL/NM work force, including 1,325 Hispanic, 203 Native American, 184 Black, and 155 Asian workers (SNL/NM 1997h).

According to the Bureau of the Census, the ROI population grew from 599,416 in 1990 to 683,676 by July 1, 1996, which is an increase of 83,260 people or 14.1 percent over the 1990 count (Census 1997a) (Table 4.14–1). Figure 4.14–2 shows population projections to 2010. Bernalillo county has attracted the highest population growth, a trend that is likely to continue. Sandoval and Valencia counties, however, have been increasing at faster rates than Bernalillo county, and probably will continue to grow at a faster percentage increase than Bernalillo, with Sandoval doubling in population by 2020. The growth of the Albuquerque area is increasingly affecting a multi-county region. The social and economic activities of Sandoval, Torrance, and Valencia counties are becoming more intertwined with Bernalillo county as urbanization increases. The most concentrated development is expected to be in the Rio Grande valley, but northwest Torrance county will also become increasingly developed (MRGCOG 1997b).

Some 62.4 percent of the population in the ROI is between the ages of 18 and 65. Approximately 81 percent of this population has completed high school, and 24.5 percent has attained a 4-year or higher college degree (Census 1995) (Table 4.14–1).

The 1989 total, median, and per capita income levels of the population in the ROI were approximately $7.8 B, $27,392, and $12,935, respectively (Table 4.14–1). While both the median and per capita income levels of the ROI were close to the respective state averages of $24,087 and $11,246, there are substantial differences in income levels among the counties, especially between Torrance county (at the low end) and Bernalillo county (at the upper end) (Table 4.14–1) (MRGCOG 1997b). At the time of the 1990 Census, an estimated 15.1 percent of the residents in the ROI were living below the official poverty thresholds. Poverty thresholds vary by size of family and number of



County	Population
Bernalillo	526,614
Sandoval	83,264
Valencia	60,214
Torrance	13,584
Total	683,676

Source: Census 1997a

Figure 4.14–1. Four-County ROI Population

The socioeconomic region of influence encompasses Bernalillo, Sandoval, Torrance, and Valencia counties.

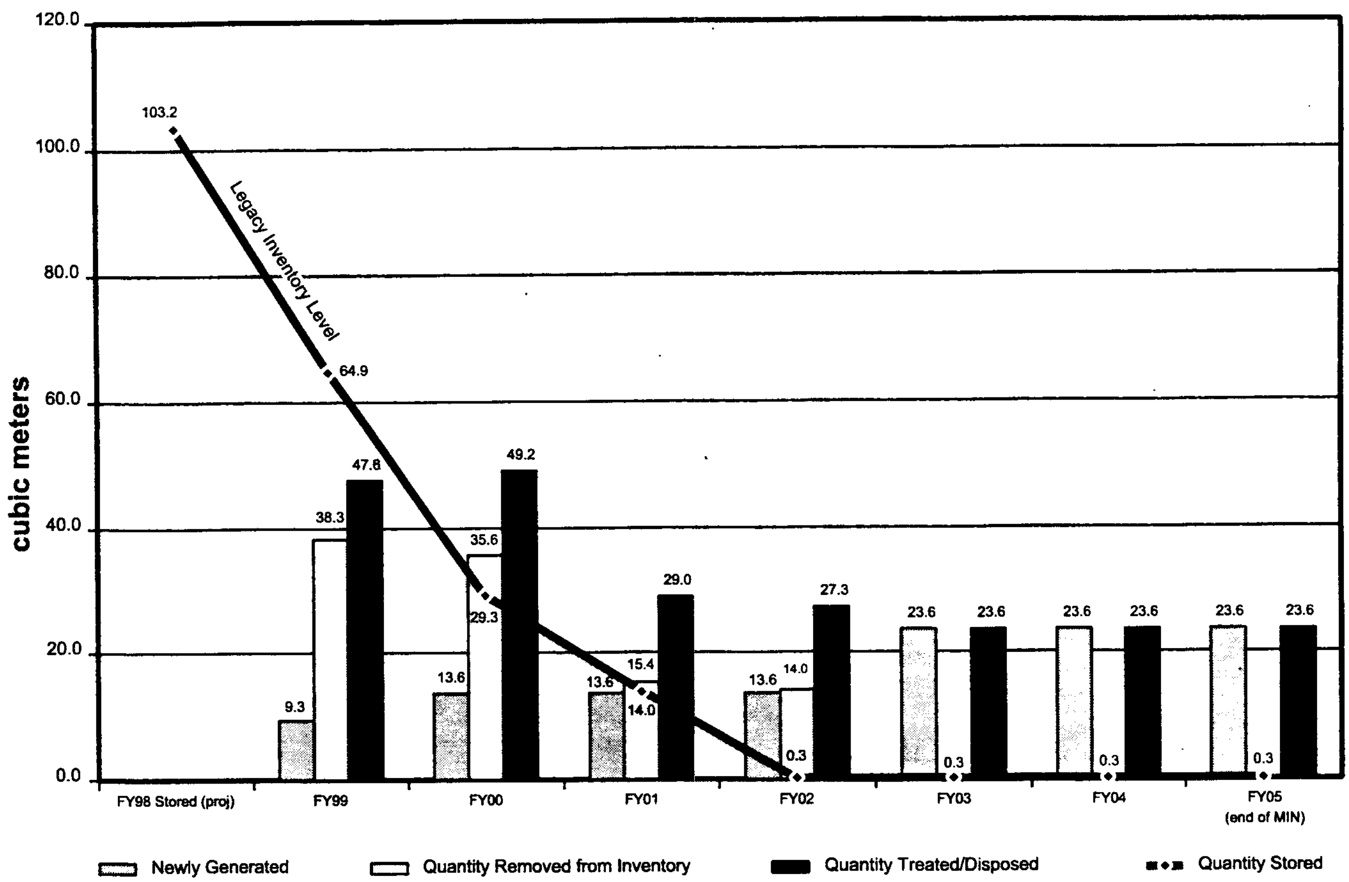
Table 4.14–1. Demographic Profile of the Population in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
POPULATION					
1996 Population (Est.)	526,614	83,264	13,584	60,214	683,676
1990 Population	480,577	63,319	10,285	45,235	599,416
Population Change from 1990 to 1996	46,037	19,945	3,299	14,979	84,260
RACE (1990)					
Percent of Total Population					
White	76.9	68.6	87.0	77.5	76.2
Black	2.7	1.5	0.4	1.1	2.4
Native American	3.4	19.7	1.2	2.9	5.0
Asian/Pacific Islander	1.5	0.8	0.2	0.4	1.4
Other[a]	15.5	9.4	11.1	18.1	14.9
Percent Minority (1990)	44.2	48.8	39.5	54.3	45.4
Ethnicity (1990)					
Hispanic	178,310	17,372	3,892	22,733	222,262
Percent of Total Population	37.1	27.4	37.8	50.3	37.1
AGES (1990)					
Percent Under 18	26.1	32.0	32.1	30.8	27.2
Percent 65 and Over	10.5	10.1	11.4	10.1	10.4
Percent Between 18 and 65	63.4	57.9	56.5	59.1	62.4
EDUCATION (1990) PERSONS 25 YEARS AND OLDER					
Percent High School Graduate or Higher	82.1	79.3	72.6	73.3	81.0
Percent Bachelor's Degree or Higher	26.7	19.1	10.9	12.1	24.5
MONEY INCOME (1989)					
Total Income ($1,000)	6,511,338	686,948	92,051	463,387	7,753,724
Median Household Income ($)	27,382	28,950	19,619	24,312	27,392
Per Capita Income ($)	13,594	10,849	8,950	10,244	12,935
Percent of Persons Below Poverty Line (1989)	14.6	15.6	21.1	19.0	15.1

Sources: Census 1995, 1997a; MRGCOG 1997a; UNM 1997a

ROI: region of influence

[a] According to the Bureau of the Census, in the 1990 Census, the "Other" category included persons identifying themselves as multiracial, multiethnic, mixed, interracial, or a Spanish/Hispanic origin group (such as Mexican, Venezuelan, Latino, Cuban, or Puerto Rican).



Source: UNM 1997b

Figure 4.14–2. 1995 Population Estimates and Projections to 2010

Population increases are projected for each of the four counties from 1995 through 2010, with the total region of influence population increasing by 27 percent.

related children under 18 years of age. In 1989, for example, the official poverty threshold for a family of four was $12,674. In 1989, 21 percent of the state population was identified as in poverty or designated as having low income (Census 1996).

4.14.3.2 Economic Base

SNL/NM is the fifth-largest private employer in New Mexico and the third largest in the ROI. Its direct economic impact on the ROI is substantial even after deducting procurement and wage/salary payments made outside the ROI. For FY 1997, the SNL/NM payroll for the ROI was $417 M for 6,824 full-time personnel (DOE 1997j). During the same year, SNL/NM spent approximately $309 M in procurements (Figure 4.14–3) in the ROI (DOE 1997j). Therefore, $726 M ($417 M + $309 M) in direct income was available for households and businesses to create jobs and make additional purchases of products and services inside or outside the ROI. Table 4.14–2 lists employment and income in the ROI.

The total number of employed civilian workers in the ROI in 1996 was 331,800 (363,192 in 1997 [DOE 1998j]). In 1996, Sandoval, Torrance, and Valencia counties had a combined overall average unemployment rate of 5.8 percent, which was higher than Bernalillo county (5.3 percent) and the ROI as a whole (5.4 percent) (Table 4.14–2) (UNM 1997c). Torrance county had the highest unemployment rate (8.9 percent). Employment changes at SNL/NM could have a greater socioeconomic effect on Bernalillo and Torrance counties (Figure 4.14–3), where members of the SNL/NM workforce comprise a higher percentage of the county population and civilian labor force in comparison to the other counties.

The pattern of employment and income are different from county to county. During 1996, employment and per capita income were highest in Bernalillo county, followed in descending order by Sandoval, Valencia, and Torrance counties (Table 4.14–2).

In 1995, service industries comprised the largest employment sector in Bernalillo county (108,172 employees

$1.4 Billion Total SNL Expenditures

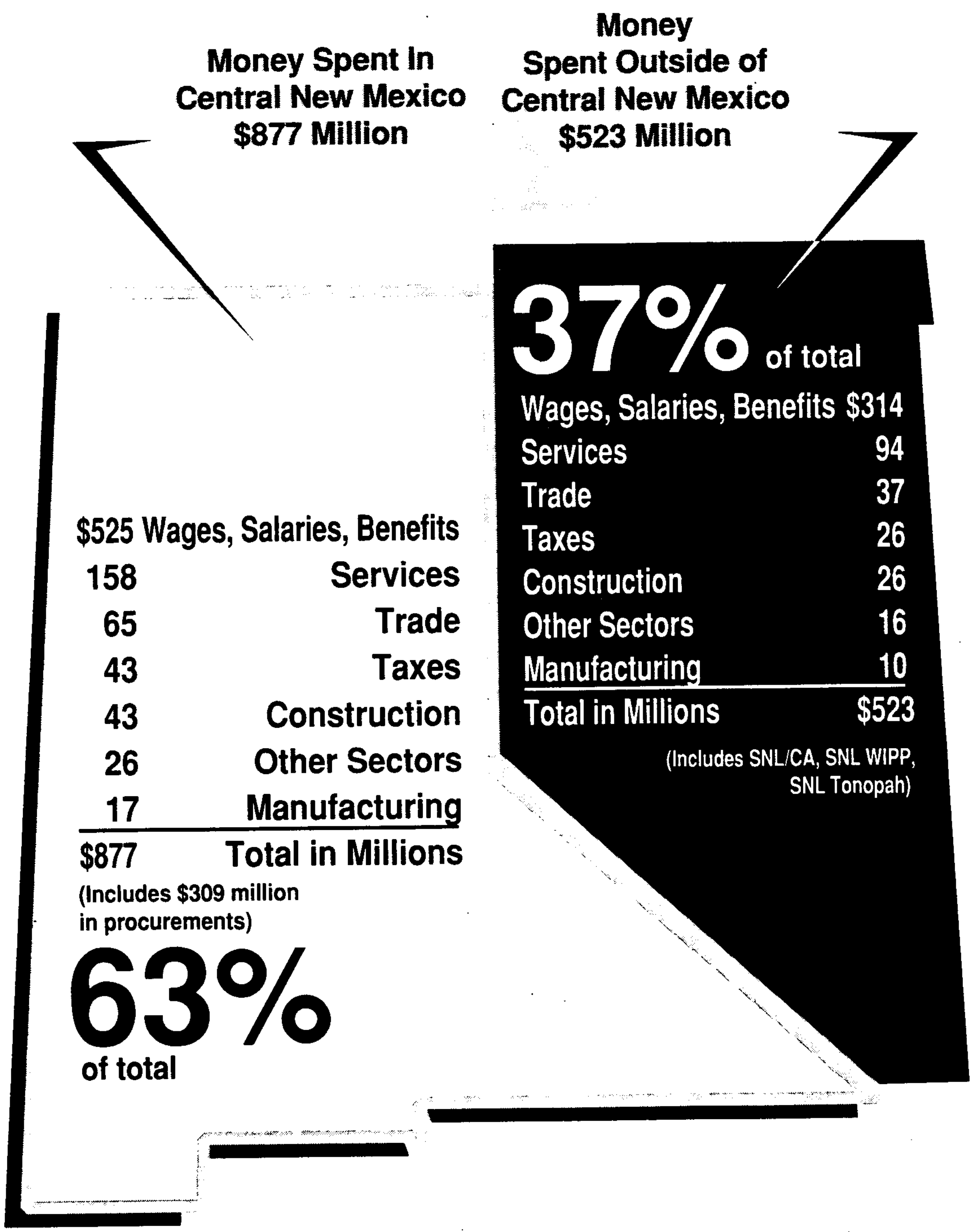


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Figure 4.14–3. Total Operating and Capital Budget at SNL

Of the total operating and capital budget for SNL for FY 1996, $877 M was spent in central New Mexico and $523 M was spent outside of central New Mexico.

Table 4.14–2. Employment and Income Profile in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
LABOR FORCE 1996					
Number of Workers	281,408	38,101	5,668	25,587	350,764
Employed	266,434	35,986	5,162	24,218	331,800
Percent Unemployed	5.3	5.6	8.9	5.4	5.4
SNL/NM WORK FORCE 1997					
Number of Workers	5,846	311	160	336	6,653[a]
Percent of Total SNL/NM Work Force[a]	85.7	4.6	2.3	4.9	97.5
Percent of 1996 Population	1.1	0.4	1.2	0.6	1.0
PERSONAL INCOME (BEA)					
Total Personal Income 1995 ($1,000)	11,901,977	1,387,695	183,339	898,055	14,371,066
Per Capita ($)	22,718	17,349	14,229	15,622	21,341
SNL/NM Net Wages and Salaries (FY 1996) ($1,000) (Not Including Benefits)	366,712	19,509	10,037	21,077	417,335

Sources: SNL/NM 1997h; UNM 1997c, d
BEA: Bureau of Economic Analysis
FY: fiscal year
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
[a] Total SNL/NM workforce was 6,824 on April 13, 1997, of which 171 employees lived outside the ROI. Thus, only 6,653 workers are shown on this table.

or 40.6 percent), of which the health, engineering, management, and business sectors were the largest contributors. Retail trade accounted for another 21.9 percent, followed by manufacturing (8.9 percent) and construction (8.3 percent) (Figure 4.14–4). Manufacturing was the largest employment sector in Sandoval county in 1995 with 41.6 percent, followed by the retail trade and service industries sectors accounting for 21 percent and 17.2 percent, respectively. The retail trade sector provided the most employment in Torrance county (44.2 percent) and Valencia county (34.6 percent), followed by the service sector in both counties (22.6 percent and 33.2 percent, respectively) (Census 1997b).

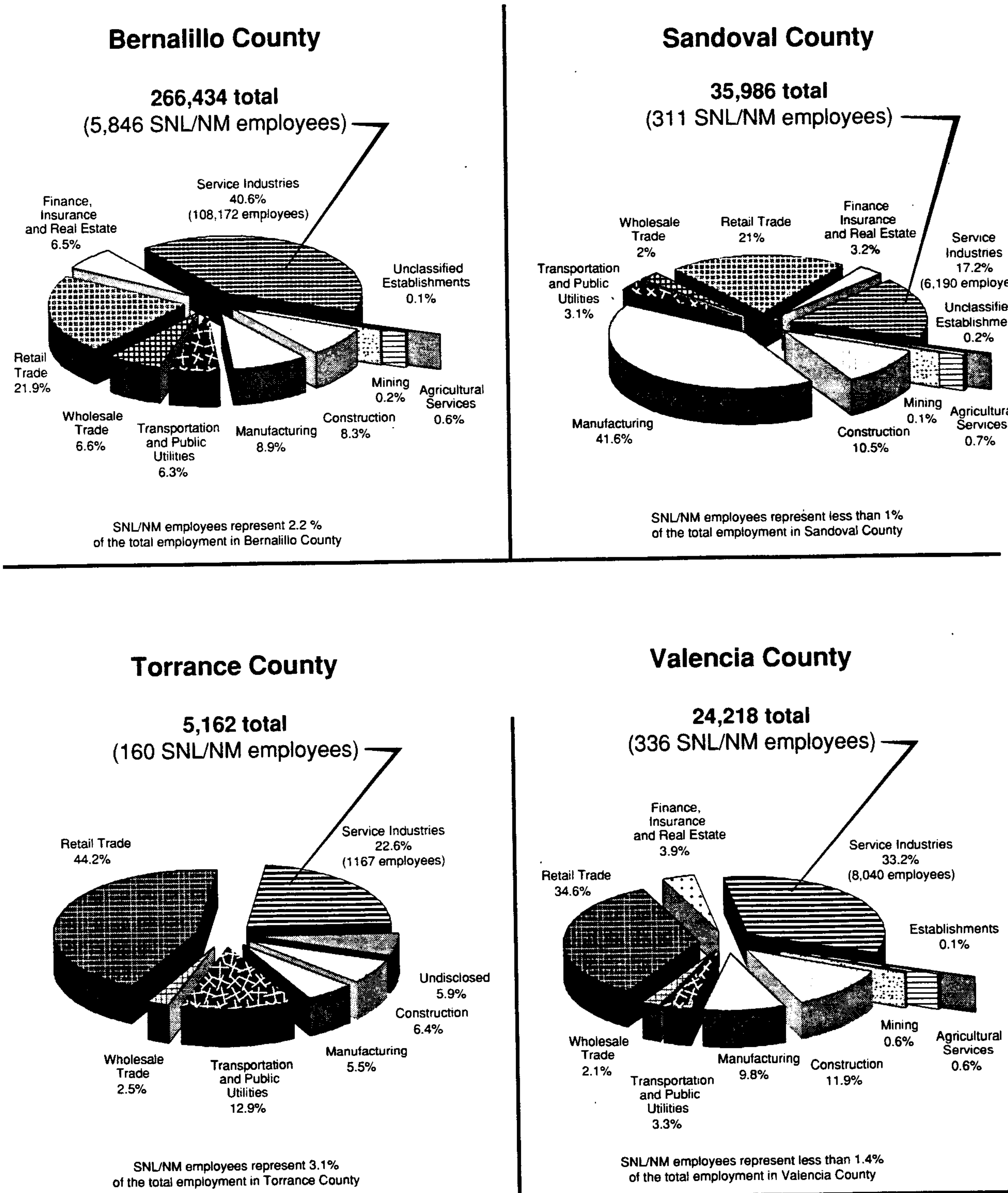
The total operating and capital budget for SNL/NM for FY 1996 was approximately $1.4 B ($1.38 B in 1997), of which an estimated $877 M ($840.5 M in 1997) was spent in central New Mexico. SNL/NM expenditures by major sectors for FY 1996 were personnel, including benefits ($525 M); services ($158 M); trade ($65 M); government ($43 M); construction ($43 M); other sectors ($26 M); and manufacturing ($17 M) (Figure 4.14–4). As Figure 4.14–3 illustrates, $523 M of the $1.4 B was spent outside of New Mexico and $314 M was spent on salaries, wages, and benefits. In FY 1996, $94 M of SNL/NM expenditures went for services, $37 M for trade, $26 M for government, $26 M for construction, $16 M for other sectors, and $10 M for manufacturing (DOE 1997j).

The flow of income and expenditures (such as procurements) from SNL/NM also generates direct revenue to state and local governments in the form of taxes, fees, and government services. In 1996, SNL/NM paid $43 M in revenue (mainly state and local taxes, fees, and government services) in New Mexico. An additional $26 M was paid in taxes to other government entities (outside New Mexico).

NMSU prepares an annual analysis of SNL/NM's economic impact on the state of New Mexico and the four-county ROI. In their analysis, NMSU employs an economic model that incorporates buying and selling linkages among regional industries and measures the impact of SNL/NM's expenditure of money in the ROI.

The NMSU model produces three multipliers. The first multiplier is used to calculate overall economic activity, the second calculates income, and the third calculates employment. These multipliers provide information needed

EMPLOYMENT



Source: Census 1997b

Figure 4.14–4. 1995 Employment in Four-County Region of Influence

The largest employment sectors in the four-county region of influence are service (Bernalillo), manufacturing (Sandoval), and retail (Torrance and Valencia).

to estimate SNL/NM's economic impact. The overall economic activity multiplier identifies the extent to which SNL/NM relies directly and indirectly on the ROI economy to provide materials, services, and labor it requires to conduct its operations. It also identifies the extent to which respending by businesses and industries occurs in the ROI. Income and employment multipliers make possible the identification of not only the direct impacts of an activity on income and jobs but also the indirect (business) and induced (household) effects (DOE 1997j).

SNL/NM operations in the ROI have substantial influence on the economy. The total funding for SNL was approximately $1.4 B in FY 1996. Using an overall economic activity multiplier of 2.75 (adjusted for central New Mexico) yields a total economic impact of $3.9 B within the ROI. Assuming $486 M net additional personal income ($525 M gross personal income) and using the 2.21 income multiplier, the total personal income was slightly less than $1.1 B in FY 1996, or approximately 8 percent of the personal income generated in the ROI. SNL/NM workers living in the ROI received approximately $417.3 M in net wages and salaries in FY 1996. For every job at SNL/NM, an estimated additional 2.46 jobs were created in the ROI, which means that the 6,653 average employment level in FY 1996 resulted in an additional 16,366 jobs. In effect, nearly 1 out of every 14 jobs in the ROI was created or supported by SNL/NM, or 23,019 out of 331,800 (DOE 1997j).

4.14.3.1 Housing and Community Services

Table 4.14–3 lists the total number of occupied housing units and vacancy rates in the ROI. In 1990, the ROI contained 246,561 housing units, of which 225,289 were occupied. The median value of owner-occupied units was $85,300 in Bernalillo county, which is higher than the other three counties and nearly twice the median value of units in Torrance county. Coincidentally, the vacancy rate was lowest in Bernalillo county (7.8 percent) and highest in Torrance county (24.8 percent). While both Bernalillo and Sandoval counties issued a high number of new housing permits between 1990 to 1992, Sandoval county had the highest percentage of permits in relation to the existing stock in 1990 (Census 1995).

Community services include public education and health care (hospitals, hospital beds, and doctors). In 1990, student enrollment totaled 165,719 in the ROI (Census 1995). Ninety-two percent of these students attended public schools. Community health services and facilities are concentrated in Bernalillo county.

SNL/NM is actively involved in the surrounding communities including the city of Albuquerque, Bernalillo county, and neighboring pueblos. SNL/NM is active with the following committees, boards, and/or organizations: Albuquerque Economic Development; Citizens Advisory Board for SNL/DOE; Greater Albuquerque Chamber of Commerce; and the United Way (SNL/NM 1997a). Other activities include work with educational institutions, community associations, and government agencies.

Measuring SNL/NM's Economic Impact on the ROI

A multiplier is a factor used to calculate the incremental effect of changes, in dollars spent or jobs created or lost, at SNL/NM. For example, the overall economic activity multiplier is used to calculate the total economic activity generated in the ROI for each $1 spent by SNL/NM. The income multiplier is used to calculate the total income generated in the ROI for each $1 of income paid to workers at SNL/NM. The employment multiplier is used to calculate the total number of generated jobs in the ROI for each job created at SNL/NM.

NMSU identified the following multipliers in their FY 1996 analysis (FY 1997 is in parentheses):

Overall Economic Activity Multiplier

- $1 spent by SNL/NM generates an additional $1.75 ($1.98), for a total overall economic impact of $2.75 ($2.98) in the ROI.

Income Multiplier

- $1 income from SNL/NM for workers generates another $1.21 ($1.32), for a total impact on income of $2.21 ($2.32) in the ROI.

Employment Multiplier

- 100 jobs created at SNL/NM generates another 246 jobs (264), for a total impact of 346 (364) jobs in the ROI.

Sources: DOE 1997j, 1998j

Table 4.14–3. Housing and Community Services in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
HOUSING (1990)					
Total Units	201,235	23,667	4,878	16,781	246,561
Occupied Housing Units	185,582	20,867	3,670	15,170	225,289
Median Value ($)	85,300	69,600	46,500	72,100	NA
Vacant Units	15,653	2,800	1,208	1,611	21,272
Vacancy Rate	7.8	11.8	24.8	9.6	8.6
New Housing Building Permits (1990-1992)	6,147	1,492	NA	490	NA
Percent of 1990 Housing Stock	3.1	6.3	NA	2.9	NA
PUBLIC EDUCATION (1990)					
Total School Enrollment	133,386	17,092	2,793	12,443	165,719
Elementary or High School	82,555	12,815	2,390	9,325	107,085
Percent Public	91.5	93.4	98.5	95.6	92.1
COMMUNITY HEALTH CARE (1991)					
Hospitals	10	0	0	0	10
Hospital Beds	1,726	0	0	0	1,726
Physicians (1990)	1,585	51	3	21	1,660

Source: Census 1995
NA : not available
ROI: region of influence

4.15 ENVIRONMENTAL JUSTICE

4.15.1 Definition of Resource

Presidential EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations. Identifying minority and low-income populations is based on demographic and economic census information presented in *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* 59 FR 7629, (SNL 1997f). The following sections summarize the information presented in that report.

4.15.2 Region of Influence

The population within a 50-mi radius around SNL/NM was considered in this evaluation because most resource areas have an ROI with the 50-mi radius, and none of them (with the exception of the four-county region for socioeconomics) has an ROI that extends beyond 50 mi. Minority populations living up to a 50-mi radius of SNL/NM, which exceed 49 percent of the population according to census data (Figure 4.15–1), were evaluated regarding health and environmental effects from activities at SNL/NM . Similarly, where low-income population exceeded 21 percent of the general population (Figure 4.15–2), the effects from activities at SNL/NM were analyzed. Figure 4.15–3 shows areas of high environmental justice concern located near KAFB main gates (SNL 1997f). The figure presents a composite assessment of both minority and low income populations as presented in *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/ New Mexico* (SNL 1997f).

4.15.3 Affected Environment

4.15.3.1 Identifying Minority and Low-Income Populations

For this SWEIS, minority populations are considered to be all *people of color,* except white people who are not Hispanic. In 1990, 49 percent (51 percent by 1996) of New Mexico's population was minority (Census 1998). Neighborhoods having minority population percentages exceeding the minority population percentage of 49 percent are identified on a block-by-block basis, with clusters of blocks known as block groups.

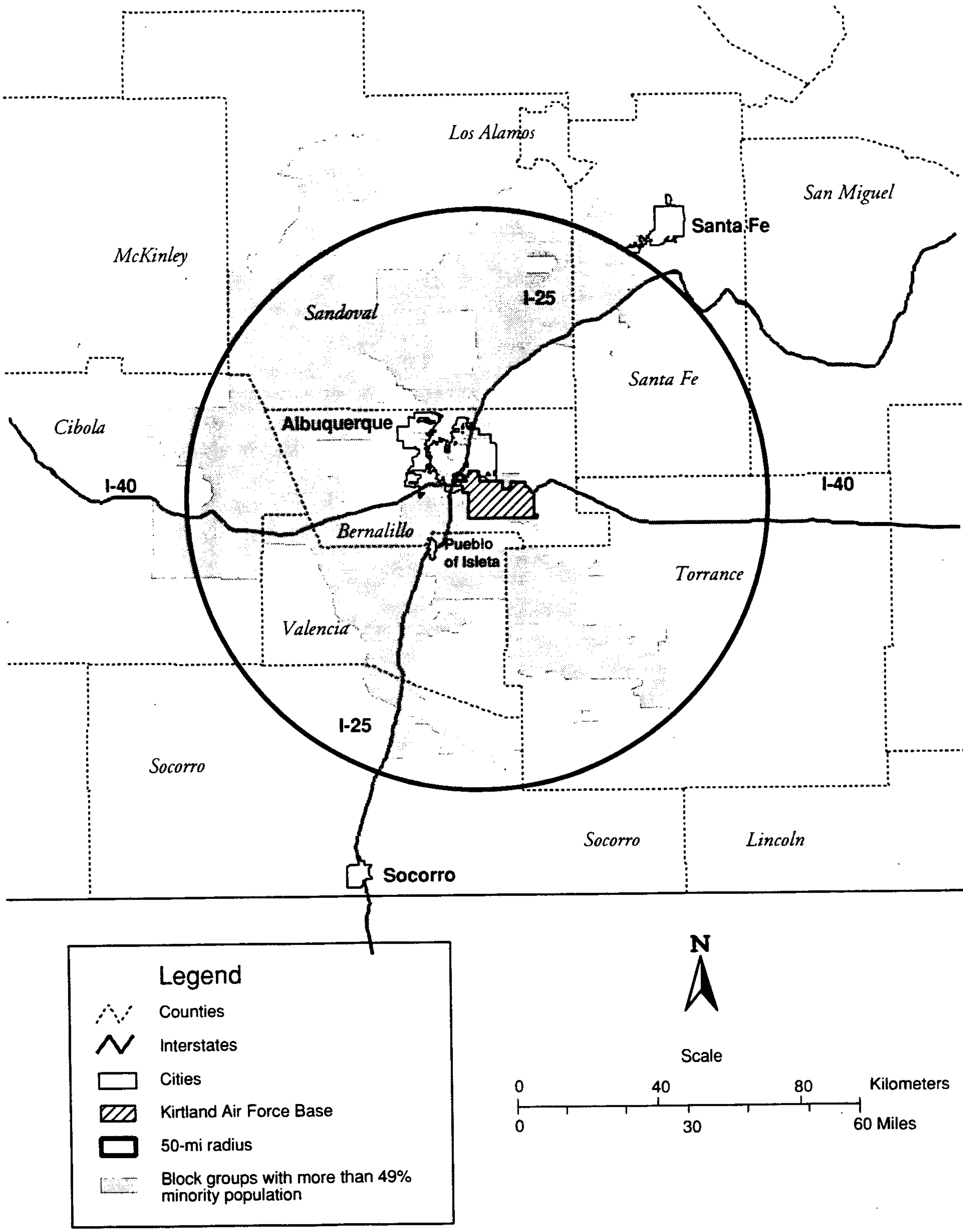
The Bureau of the Census characterizes persons in poverty (low-income persons) as those whose incomes are less than a statistical poverty threshold. The threshold is a weighted average based on family size and age of family members. For instance, the 1990 census threshold for a family of four was based on a 1989 household income of $12,674 (Census 1990). By 1996, the household income threshold rose to $16,036 (Census 1997c). In 1989, 21 percent of New Mexico's population was listed in poverty or designated as having low income (Census 1996). By 1996, the estimated percentage stood at 24 percent (Census 1997c). In this analysis, low-income block groups (same as above) occur where the low-income population percentage in the block group exceeds the poverty percentage for the state of New Mexico. Figures 4.15–1 and 4.15–2 show the percentages of minority populations and low-income individuals, respectively, living within a 50-mi radius of SNL/NM. This area is similar, but not identical to, the four-county socioeconomic ROI discussed in Section 4.14.

4.15.3.2 Minority Populations

Block groups containing fewer than 49 percent minority individuals were not considered minority block groups (SNL 1997f). According to 1990 census data, approximately 280,360 minority individuals from an approximate total population of 609,500 reside in the 50-mi ROI. This represents 46 percent of the total ROI population (SNL 1997f). Figure 4.15–1 shows the census block groups containing minority individuals.

Approximately 228,800 persons identified themselves as being of Hispanic origin, which represent approximately 37.5 percent of the ROI population (SNL 1997f). Areas of Hispanic population lie generally in historic settlement patterns west of Interstate 25, in areas called the North Valley and South Valley. In the North Valley, Los Ranchos de Albuquerque has a higher-than-state-average Hispanic concentration. Old Town, the original center of Albuquerque, also has a higher-than-state-average Hispanic concentration. The highest Hispanic concentration is in the South Valley (SNL 1997f).

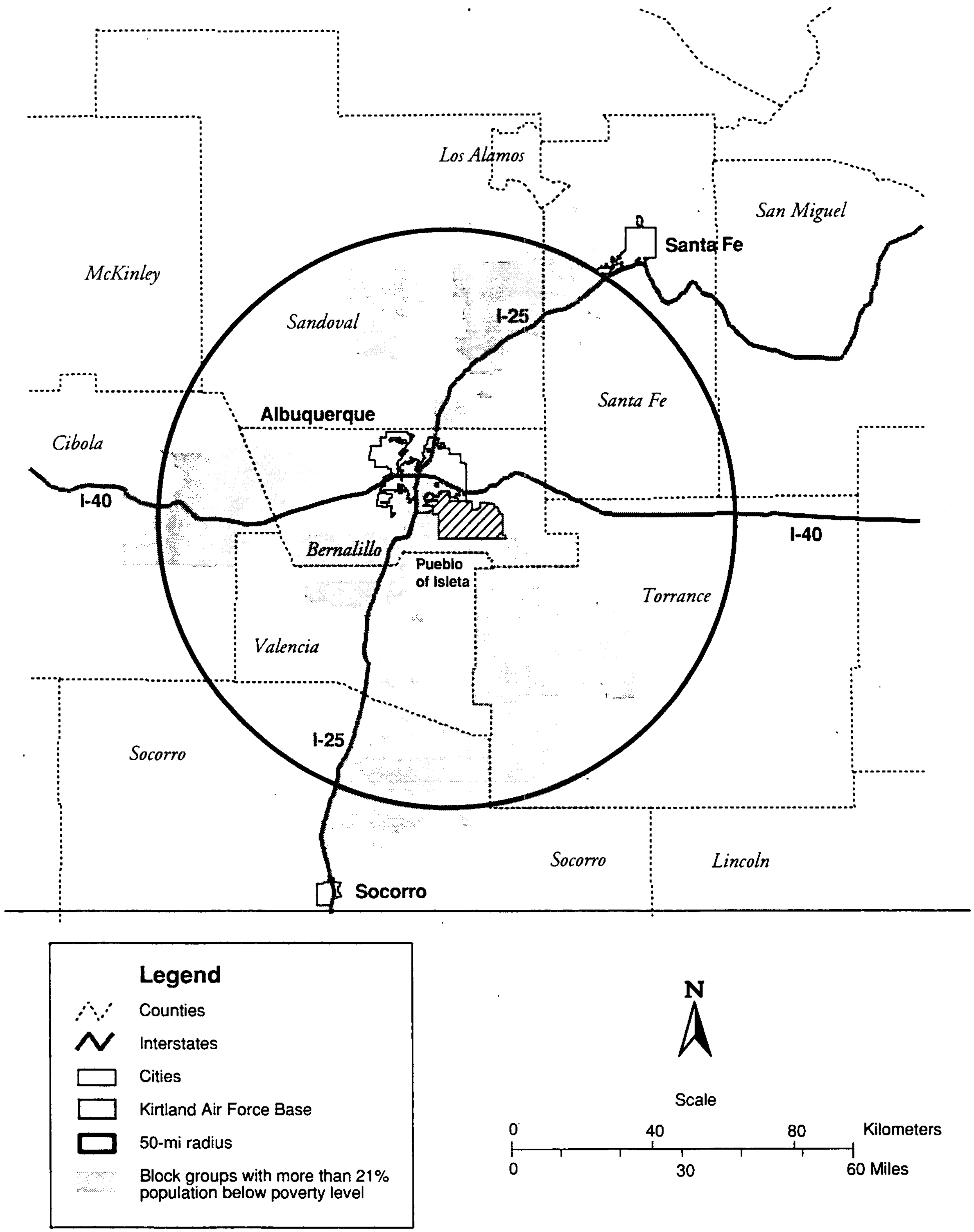
Approximately 29,840 persons identified themselves as "American Indians," which represent approximately 5 percent of the ROI population (SNL 1997f). The ROI contains 11 pueblos or reservations and 2 joint-use areas. The Pueblo of Isleta and Isleta Pueblo Trust Lands are adjacent to the southern boundary of KAFB. In addition, the Pueblo of Isleta represents the largest landholding of a minority population adjacent to KAFB (SNL 1997f).



Source: SNL 1997l

Figure 4.15–1. Minority Population

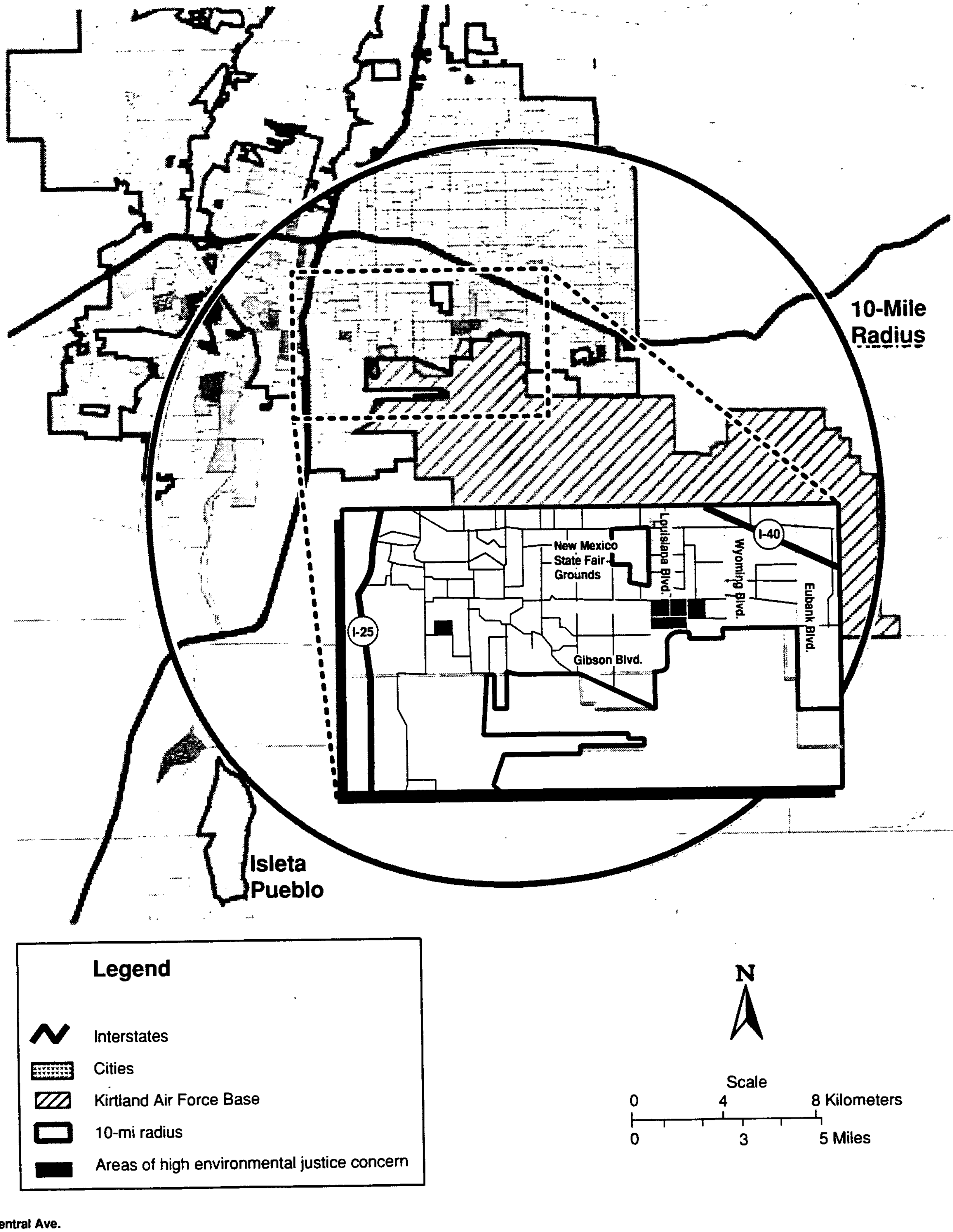
Block groups with more than 49 percent minority population were identified within a 50-mi radius of SNL/NM.



Source: SNL 1997f

Figure 4.15–2. Low-Income Population

Block groups with more than 21 percent low-income population were identified within a 50-mi radius of SNL/NM.



Source: SNL 1997f

Figure 4.15–3. Environmental Justice Areas

Five block groups (see inset) with potential high environmental justice concern are located near KAFB.

Another 8,025 persons identified themselves as being "Asian or Pacific Islander," and approximately 14,600 persons identified themselves as being "Black," which represent approximately 1 and 2 percent, respectively, of the ROI population. The highest concentrations of both these groups reside in base housing on or near KAFB. Several smaller Black communities also exist west of KAFB, just beyond the city's airport (SNL 1997f).

An estimated 91,600 persons identified themselves as "Other," which represent approximately 15 percent of the ROI population. Statewide, 190,350 persons identified themselves as "Other." Of those people, approximately 186,970 (98 percent) were of Hispanic origin (SNL 1997f). This phenomenon occurs because many Hispanics do not consider themselves to be "White," a category they perceive as designated for European-Americans. According to the Bureau of the Census, the "Other" category includes persons identifying themselves as multiracial, multiethnic, mixed, interracial, or of a Spanish/Hispanic origin group (such as Mexican, Venezuelan, Latino, Cuban, or Puerto Rican). Concentrations of "Other" populations to the west of SNL/NM are in Hispanic neighborhoods. The distribution of "Other" minority individuals near SNL/NM mirrors the distribution of Hispanic individuals (SNL 1997f).

4.15.3.3 Low-Income Populations

Approximately 85,330 persons were identified as being low income, which represent approximately 14 percent of the ROI population (SNL 1997f). Figure 4.15–2 shows the census block groups containing more than 21 percent population below the poverty level.

This distribution of low-income population has a strong correlation to minority populations of Blacks, Native Americans, and Hispanics. For example, the high concentrations of low-income populations west of Albuquerque, shown in Figure 4.15–2 (near the 50-mi radius boundary), indicate the Pueblo of Laguna and its outlying Native American villages. Similarly, portions of the Pueblo of Isleta, south of the city, have high percentages of low-income individuals. To the southeast of SNL/NM, the rural Hispanic villages of Tajique, Torreon, and Escobosa are also low-income. To the north of SNL/NM, high concentrations of low-income populations are located in the Pueblos of Jemez, San Felipe, Santo Domingo, and Cochiti, as well as in the rural Hispanic villages of La Cienega and Jemez Springs (SNL 1997f).

High concentrations of low-income populations occur west of SNL/NM, along the Rio Grande, in the predominantly Hispanic South Valley neighborhoods. In addition, small pockets of low-income populations reflect the locations of Black neighborhoods such as the Kirtland Addition and the South Broadway/East San Jose area (SNL 1997f).

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CHAPTER 5

Environmental Consequences

Chapter 5 provides information on the methods of analysis applied in the Site-Wide Environmental Impact Statement (SWEIS) and the results of analyses for Sandia National Laboratories/New Mexico (SNL/NM). The chapter begins with an introduction and a summary of the impact assessment methodologies that have been applied. It continues with descriptions of the impacts of the No Action, the Expanded Operations (the U.S. Department of Energy's [DOE's] Preferred Alternative), and the Reduced Operations Alternatives. For each alternative, impacts are presented by resource area (for example, infrastructure, land use, geology and soils) or topic area (for example, waste generation, transportation, environmental justice). Addressed later in this chapter are mitigation measures, irreversible and irretrievable commitments of resources, unavoidable adverse environmental impacts, and relationships between short-term uses of the environment and long-term productivity.

5.1 INTRODUCTION

Chapter 5 provides an analytical comparison of the environmental impacts associated with the alternatives.

Types of Impacts

Direct Impacts

These are effects that are caused by the action and occur at the same time and place. Examples of these would be the elimination of original land use due to the erection of a building or change of land use. Direct impacts may cause indirect impacts, such as ground disturbance resulting in resuspension of dust and decreasing visibility.

Indirect Impacts

These are effects that are caused by the action or by direct impact, occur later in time or are farther removed in the distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use (such as population density or growth rate and related effects on air and water and other natural systems, including ecosystems).

Cumulative Impacts

These are effects that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Section 5.2 contains a summary discussion of the methodologies used to assess potential impacts to that aspect. Detailed methodologies, analyses, and supporting data are provided in resource-specific appendixes A through H. Section 5.3, No Action Alternative; Section 5.4, Expanded Operations Alternative (the DOE's Preferred Alternative); and Section 5.5, Reduced Operations Alternative are formatted so that, within each alternative, the discussion is divided into the following resource and topic areas:

- Land Use and Visual Resources
- Infrastructure
- Geology and Soils
- Water Resources and Hydrology
- Biological and Ecological Resources
- Cultural Resources
- Air Quality
- Human Health and Worker Safety (including Accidents)
- Transportation (including Accidents)
- Waste Generation
- Noise and Vibration
- Socioeconomics
- Environmental Justice

For comparison purposes, environmental emissions and other potential environmental effects are presented with regulatory standards or guidelines, as appropriate. However, for *National Environmental Policy Act 1969* (NEPA) purposes, compliance with regulatory standards is not necessarily an indication of the significance or severity of the environmental impact.

Several resource-specific evaluations have also been performed that address the consequences and risks associated with the DOE's operations at SNL/NM. Each evaluation has a unique scope and purpose. Figure 5.1–1 illustrates how the facility-based assessments and SWEIS-specific evaluations and consultations flow into the SNL/NM SWEIS.

This chapter also provides a discussion of mitigation measures (Section 5.6), unavoidable adverse impacts (Section 5.7), the relationship between short-term uses and long-term productivity (Section 5.8), and the irreversible or irretrievable commitment of resources (Section 5.9). A discussion of cumulative impacts is presented in Chapter 6.

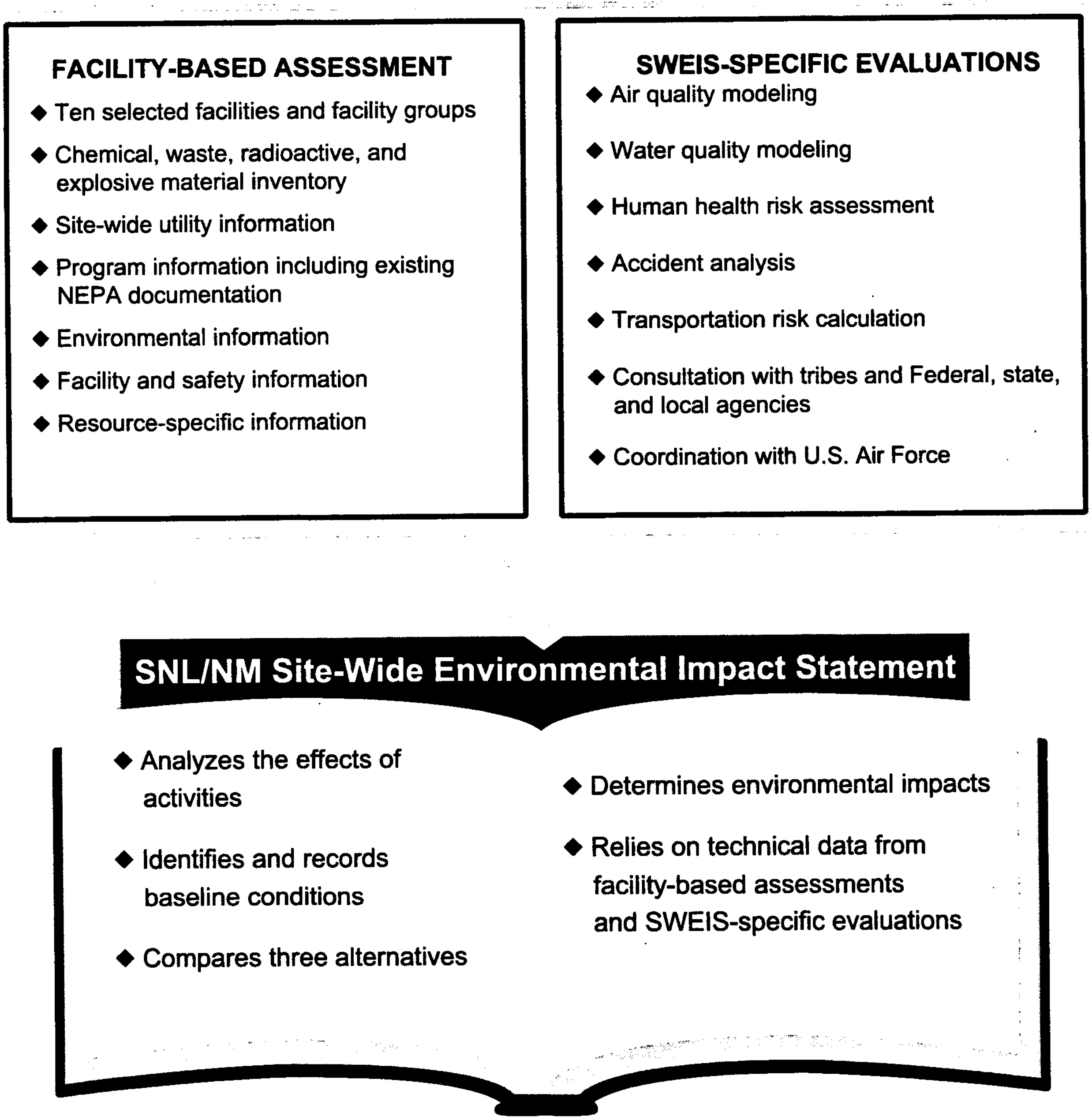

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Figure 5.1–1. Data and Analytical Contributions to the SNL/NM Site-Wide Environmental Impact Statement

The SWEIS is related to many other DOE resource-specific studies.

5.2 METHODOLOGY

Following are brief descriptions of the impact assessment approaches used in the SWEIS for addressing potential impacts of SNL/NM operations under the No Action, Expanded Operations, and Reduced Operations Alternatives. The *Sandia National Laboratories Site-Wide Environmental Impact Statement Final Methodologies for Impact Analysis* (TtNUS 1998e) provides in-depth information concerning the assessment methodologies used in the SWEIS.

5.2.1 Land Use and Visual Resources

A comparative methodology was used to determine impacts to SNL/NM land use. Facility operations and any construction or modification activities associated with each alternative were examined and compared to existing land use conditions. Impacts, if any, were identified as they relate to changes in land ownership and use classifications, extent and size figures, alternative or conflicting uses, and accessibility concerns.

The analysis of visual impacts was also comparative and consisted of a qualitative examination of potential changes in visual resources. The method of assessing a visual resource was based on the U.S. Forest Service (USFS) Scenery Management System (SMS). The SMS combines aspects of scenic attractiveness and landscape visibility to establish a series of six scenic classes. These classes indicate the degree of public value for a landscape area and serve as guidelines for future landscape changes. The higher the scenic class (on a scale where 1 is highest), the more important it is to maintain the highest scenic value. The scenic classes are 1-2, 3-4, and 5-6, corresponding to high public value, moderate public value, and low public value, respectively.

Aspects of visual modification examined included site development or modification activities that could alter the visibility of SNL/NM structures or obscure views of the surrounding landscape, changes in surrounding land cover that could make structures more or less visible, and air or light pollution associated with operations that could influence visibility factors in the area.

5.2.2 Infrastructure

Incremental changes to SNL/NM facilities and infrastructure were assessed by comparing the support requirements of the alternatives to current site infrastructure utility demands (water and electricity) based on projected facility square footage requirements and available capacities. Site-wide utility usage was adjusted for contributions from the selected facilities. Impacts were considered on a wide variety of structures and systems used by SNL/NM, including infrastructure support provided by Kirtland Air Force Base (KAFB), and assessment was focused on infrastructure, facilities, services, and utility systems. Four infrastructure facilities (steam plant, Radioactive and Mixed Waste Management Facility [RMWMF], Hazardous Waste Management Facility [HWMF], and Thermal Treatment Facility [TTF]) were specifically evaluated for impacts as representative of SNL/NM (see Section 2.3).

5.2.3 Geology and Soils

Geology and soils analyses encompassed three distinct areas: seismic, soil contamination, and slope stability. The consequences of potential seismic activity at SNL/NM are addressed within the accident analysis sections (5.3.8.2, 5.4.8.2, and 5.5.8.2) and Appendix F.

The soil contamination analysis considered the potential for human contact of near-surface (the top 6 inches to 1 ft) contaminated soils and limitations on future land use of these areas. The analysis examined the types of sites where soil contamination could be present (environmental restoration and outdoor testing areas) and site characteristics. Soil contaminant concentrations were projected under each alternative and compared with criteria for future designated land use.

The slope stability analysis examined the location of SNL/NM facilities relative to areas with potentially unstable slopes. SNL/NM facilities near these slopes were identified using a map generated from a geographic information system (GIS) showing slopes of at least 10 percent. The 10 percent value was selected as a conservative screening criterion based on the dry site soil conditions and lack of previous slope stability problems at SNL/NM. For each SNL/NM facility identified, field observations were conducted to support a qualitative evaluation of the effects of SNL/NM activities on these slopes.

5.2.4 Water Resources and Hydrology

Water resources and hydrology analyses focused on four distinct areas: groundwater quality, groundwater quantity, surface water quality, and surface water quantity.

The groundwater quality analysis determined to what extent contamination from SNL/NM sites in the unsaturated and saturated zones would limit the potential use of groundwater, particularly as drinking water. Unsaturated zone and groundwater contamination sites that have not been removed, are planned for removal, or are final or proposed no further action (NFA) sites were characterized in terms of their contaminants, concentrations, and extent. Where information was available, contaminant migration through the unsaturated zone beneath the contaminant source was characterized in terms of flow and transport parameters. A *MODFLOW/MODPATH* model maintained by the Environmental Restoration (ER) Project was used to simulate the path of contaminants from the water table beneath the source in the downgradient direction (DOE 1997a). This trajectory modeling was used with a one-dimensional (1-D)/three-dimensional (3-D) flow/ transport model to determine the maximum portion of the aquifer (area and extent) that would exceed applicable water quality criteria.

The groundwater quantity analysis examined future SNL/NM water use projections, evaluating potential impacts of groundwater withdrawal. Using records of local groundwater withdrawals and water level measurements from 1985 through 1996, a simple linear relationship between withdrawal and drawdown was established. The method is described in Volume II, Appendix B.2. This linear relationship was used with projections of groundwater withdrawals from KAFB (includes SNL/NM), Ridgecrest, and Mesa del Sol wells under each alternative to estimate future aquifer drawdown. Impacts of drawdown were evaluated for existing water supply wells, springs, and land subsidence.

The surface water quality analysis examined the potential for future storm water runoff contamination in Tijeras Arroyo. Tijeras Arroyo water quality measurements at the point where the arroyo crosses the KAFB boundary were examined and compared with New Mexico Water Quality Control Commission (NMWQCC)-listed constituents and standards for designated use (general standards, livestock watering, and wildlife habitat) (NMWQCC 1994). The analysis examined changes in potential SNL/NM contributions to surface water contamination under the three alternatives and the likelihood of these changes affecting regulatory compliance at the downstream exit point of Tijeras Arroyo from KAFB.

Effects of SNL/NM facilities on surface water quantity were analyzed based on the incremental contribution of SNL/NM to Rio Grande flow from storm water runoff and wastewater discharge. The SNL/NM contribution to storm water runoff was determined by calculating the difference between estimated natural runoff (10 percent of rainfall) and an assumed 100 percent runoff from the SNL/NM area covered by buildings and parking lots. Using flow measurements from the Montessa Park gaging station in Tijeras Arroyo, a portion of total Tijeras Arroyo flow was attributed to SNL/NM, based on the percentage of watershed area covered by SNL/NM facilities. This portion was added to the projected wastewater discharge quantities (wastewater is discharged to the Rio Grande after treatment at the Southside Water Reclamation Plant) for each alternative and compared with total Rio Grande flow. Potential impacts of this additional water quantity to the Rio Grande are discussed qualitatively.

5.2.5 Biological and Ecological Resources

A qualitative analysis addresses the impacts of the activities under each alternative to biological and ecological resources. The methodology focused on those biological resources with the potential to be appreciably affected, and for which analyses assessing alternative impacts were possible. Biological resources include biological communities, biodiversity, habitat, and ecological processes. Among these resources are the vegetation, wildlife, aquatic resources, and sensitive species that are present or use SNL/NM and contiguous areas. The potential sources of impacts to biological resources that were considered include noise, outdoor tests, hydrologic changes affecting availability of water to plants and animals, erosion, hazardous materials releases and radiological releases from normal operations, and security measures that restrict access to SNL/NM.

The biological data from earlier projects, wetlands surveys, and plant and animal inventories of portions of KAFB were reviewed to identify the locations of plant and animal species and wetlands. Lists of sensitive species potentially present on KAFB were obtained from the U.S. Fish and Wildlife Service (USFWS) (USFWS 1998), the New Mexico Department of Game and Fish (NMDGF 1997), the USFS (USFS 1990), and the New Mexico Energy, Minerals, and Natural Resources Department; Forestry and Resources Conservation Division (NMEM&NRD 1995).

Activities and potential releases identified under the three alternatives were reviewed for their potential to affect plants, animals, and the sensitive species under Federal and New Mexico laws and regulations. Potential beneficial and negative impacts to plants and animals were evaluated for gain, loss, disturbance, or displacement. Impacts to wetlands were evaluated to determine if their areal extent would change. Monitoring data on selected small mammal, reptile, amphibian, bird, and plant species were reviewed for radionuclide and metal contamination (SNL/NM 1997u). Data from the ER Project were reviewed for impact to biological resources (DOE 1996c).

5.2.6 Cultural Resources

Potential impacts to cultural resources were assessed under the No Action, Expanded Operations, and Reduced Operations Alternatives. Cultural resources include prehistoric archaeological sites, historic sites, and traditional cultural properties (TCPs). Information used for impact assessment was derived from the results of systematic cultural resource inventories on KAFB, review of literature concerning TCPs and traditional uses of the area, and consultations with 15 Native American tribal governments and the New Mexico State Historic Preservation Officer (SHPO).

Data on potential SNL/NM activities occurring under the three alternatives were used to analyze impacts to resources (SNL/NM 1998a). The results of consequence analyses for hydrology, transportation, infrastructure, and land use were used to determine the potential for other impacts to cultural resources. The types of effects, or actions leading to effects, evaluated include the following:

- New construction
- Demolition
- Vibration
- Visual impact
- Radiation releases
- Hazardous material releases
- Maintenance
- Restricted access
- Explosive testing debris and shrapnel
- Hydrologic changes
- Erosion or soil movement
- Off-road vehicle traffic
- Unintended fires and fire suppression

Potential impacts to cultural resources can fall into four broad categories, called "Criteria of Effect and Adverse Effect" (36 Code of Federal Regulations [CFR] §800.9), as defined in the implementing regulations for the *National Historic Preservation Act* (NHPA), as amended (16 United States Code [U.S.C.] Section [§] 470). These categories consist of 1) destruction or alteration; 2) isolation and restriction of access; 3) introduction of visible, audible, or atmospheric elements out of character with the resource; and 4) neglect leading to deterioration and vandalism. The locations of known cultural resources were compared to the areas of potential effect from SNL/NM activities. The potential for impacts from these activities to cultural resources was then assessed.

5.2.7 Air Quality

5.2.7.1 Nonradiological Air Quality

Nonradiological air quality impacts were determined by modeling site emissions of criteria and chemical pollutants for the 1996 baseline conditions, plus those pollutant sources expected to become operational by 2008. The site-specific emissions were modeled in accordance with U.S. Environmental Protection Agency (EPA), state of New Mexico, and city of Albuquerque guidelines. The EPA-recommended *Industrial Source Complex Short-Term Model, Version 3 (ISCST3)* was selected as the most appropriate model to perform the air dispersion modeling analysis from stationary continuous emission sources. *ISCST3* and the available hourly meteorological data for 1994 through 1996 were used in the assessment of criteria pollutant air quality. The maximum concentrations of the seven criteria pollutants included in the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) and the New Mexico Ambient Air Quality Standards (NMAAQS) (20 New Mexico Administrative Code [NMAC] 2.3) were assessed, including carbon monoxide, lead, nitrogen dioxide, total suspended particulates (TSP), particulate matter smaller than 10 microns in diameter (PM_{10}), sulfur dioxide, and ozone. Ambient air monitoring data were used to supplement modeled pollutant concentrations for those pollutants for which no emission data were available.

The New Mexico Air Quality Bureau approved the Ozone Limiting Method (OLM) to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions. The OLM was employed to estimate nitrogen dioxide concentrations in cases where the modeled nitrogen oxides concentration is greater than the NMAAQS for nitrogen dioxide. The modeled 24-hour average nitrogen oxides concentration resulting from nitrogen oxides emissions from SNL/NM exceeds the NMAAQS for nitrogen dioxide. As a result, the OLM was implemented.

Evaluation of chemical pollutant air quality consisted of modeling chemical pollutant emissions derived from the Chemical Information System (CIS), CheMaster, and

Hazardous Chemicals Purchased Inventory (HCPI) databases. The modeling was performed using the model *ISCST3*, the hourly meteorological data used for the criteria pollutant assessment, chemical purchase data, and chemical release assumptions.

Receptor locations for the criteria and chemical pollutant modeling included the maximum offsite concentration location, public access areas, hospitals, and schools. The maximum criteria pollutant concentrations at receptor locations were compared with the NAAQS and NMAAQS to determine compliance with standards, while the chemical pollutant concentrations were compared with health guidelines derived from occupational exposure limits (OEL) divided by 100 and unit cancer risk factors for 10^{-8} risk levels in lieu of established regulatory ambient air quality standards. Chemical pollutants of concern were identified through a progressive series of screening steps, each step involving fewer pollutants, which were screened by methods that involved more rigorous and realistic emission rates and modeling parameters than the step before. Chemicals that failed the screening process were referred to the Human Health risk assessment. This approach, consistent with EPA guidance, focused detailed analyses only on those chemicals of concern that have the potential to cause adverse health effects.

Analysis of the contribution of mobile sources (vehicular traffic) entering SNL/NM was performed using the *Mobile Source Emission Factor Model (MOBILE 5a)* to estimate mobile source emissions of carbon monoxide (EPA 1994). Assessment of air quality also included modeling the criteria and chemical emissions from fire testing facilities using the *Open Burn/Open Detonation Dispersion Model (OBODM)* developed by the U.S. Army and the EPA (Bjorklund et al. 1997).

Maximally Exposed Individual

The maximally exposed individual is referred to as the MEI. This is a hypothetical member of the general public assumed to be located outdoors in a public area where the radiation dose is highest. This individual is assumed to be an adult who is exposed to the entire plume in an unshielded condition. The impacts on the MEI are, therefore, greater than the impacts to any member of the public located onsite or offsite.

5.2.7.2 Radiological Air Quality

Radiological emissions from routine SNL/NM facility operations were evaluated on the basis of dose to the maximally exposed individual (MEI) and collective dose to the general population within 50 mi of SNL/NM. This evaluation was compared to the standards in the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61). NESHAP standards limit the radiation dose that a member of the public may receive from radiological material released to the atmosphere from normal operations to 10 mrem per year. The emissions from all SNL/NM facilities were reviewed. Those facilities that did not contribute more than 0.01 mrem per year (0.1 percent of the NESHAP limit) to the MEI were excluded. Ten facilities exceeding the threshold were included in the dose impact evaluation: Annular Core Research Reactor (ACRR), Defense Programs (DP) configuration; ACRR, medical isotopes production configuration; Sandia Pulsed Reactor (SPR); Hot Cell Facility (HCF); RMWMF; Mixed Waste Landfill (MWL); High-Energy Radiation Megavolt Electron Source III (HERMES III); Radiographic Integrated Test Stand (RITS); Neutron Generator Facility (NGF); and Explosive Components Facility (ECF).

The radiological impacts of normal operations were based on estimated radionuclide emission rates and were calculated using the EPA-approved *Clean Air Assessment Package (CAP88-PC)* computer model (DOE 1997e). *CAP88-PC* conservatively calculates radiological impacts extending up to 50 mi.

Two dose quantities were calculated with the *CAP88-PC* model: the effective dose equivalent from external sources and the committed effective dose equivalent from internal sources. The external dose represents exposure from airborne radiation emissions or exposure from the ground, such as standing on ground that is contaminated with radioactive material. The pathways for internal exposure include ingesting food products contaminated by airborne radiation. Although the SNL/NM site does not contain any agricultural production, agricultural data beyond the site boundary to a 50-mi radius were considered in the impact evaluation.

Potential MEIs were identified as receptor locations. These receptor locations were selected based on distance, direction, and wind speed and direction from each modeled facility. The total dose was calculated at each of the receptor locations from each of the modeled facilities. The receptor with the highest combined dose from all facilities was identified as the MEI and compared with regulatory standards. The collective dose to the population within 50 mi of SNL/NM was also determined. The methodology for assessing MEI and collective population dose impacts is further discussed in Section 5.2.8, below.

5.2.8 Human Health and Worker Safety

Normal Operations
(See Section 5.2.9 for Accidents)

An analysis of environmental conditions related to SNL/NM routine operations under each alternative and an assessment of the release of hazardous materials by way of different transport pathways were used to identify possible exposure pathways of concern to receptor locations within the SNL/NM vicinity. All environmental releases of chemicals and radionuclides with the potential to adversely impact public health or worker health and safety were evaluated for human health risk. The health risk assessment process is a series of steps associating environmental conditions with potential health effects resulting from contact with the contaminants in the environment, as illustrated in Figure 5.2.8–1.

An initial assessment identified potential sources at SNL/NM as emissions from stacks and open burning, radiological material transportation, and existing environmental contamination. Exposure pathways analyzed include inhaling affected ambient air, ingesting food products affected by radiological air releases, direct radiation exposure from radioactive air emissions and ground deposition, and direct radiation exposure from radioactive materials shipments. Human health risk calculations used exposure information derived from analysis of nonradiological air quality, radiological air quality, and transportation of hazardous material.

A receptor's exposure to a chemical contaminant was expressed in terms of chronic daily intake (CDI) or Lifetime Average Daily Dose (LADD). The numerical approach for CDI calculated potential chronic exposures averaged over a lifetime from noncarcinogenic chemicals and related them as a ratio to the EPA-derived health risk factors known as reference doses. The ratio estimates the increased risk that an individual exposed to that compound could develop an adverse health effect. The numerical approach for LADD estimated potential chronic exposures to carcinogenic chemicals and associated them with the EPA-derived health risk factor for carcinogens known as cancer slope factors (CSF). The daily intake was multiplied by the health risk CSF to estimate the increased likelihood of an individual getting cancer in his or her lifetime from that exposure.

The radiological dose assessment looked at appropriate health risk estimators for excess latent cancer fatalities (LCFs), nonfatal cancers, and excess genetic disorders. The risk estimators used are recommended by the International Commission on Radiological Protection (ICRP 1991) and are promulgated in Federal guidance. Dose to the individual was converted to the increase in lifetime risk of fatal cancer, nonfatal cancer, and genetic disorders. Population collective dose was converted to the additional number of LCFs, nonfatal cancers, and genetic disorders in the population assessed.

To account for multiple pathways, a composite cancer risk for an individual member of the public, due to both carcinogenic chemicals and radiological exposures, was derived by adding the radiological MEI cancer risk with the excess lifetime cancer risk (ELCR) due to chemical exposure. Two scenarios were developed expressing composite risk: the risk at the radiological MEI receptor location was evaluated for the contribution added by chemical exposures at the same location; and a worst-case composite risk was calculated, assuming the radiological MEI risk is hypothetically combined with the upper-bound value for cancer risk from chemicals, even though these concentrations occur at different locations.

Radiological doses to the radiation worker population were evaluated using the historic dosimetry data available for 1992 through 1996. Nonradiological impacts to workers were evaluated using occupational illness and injury data, occurrence reports, and industrial hygiene investigation reports available for the same period.

The SNL/NM illness/injury rate per year under each alternative is expected to remain consistent with the average illness/injury rate calculated for 1992 through 1996. Estimating the number of illnesses and injuries per year was based on projected changes in the total number of workers under each alternative multiplied by the "5-year average" illness/injury rate.

The same approach was used to estimate radiation workers' annual workforce collective dose. Estimating the annual workforce collective dose was based on the projected changes in the number of radiation workers under each alternative multiplied by the "5-year average" annual workforce collective dose. Annual workforce collective dose was converted to total number of fatal cancers in the radiation worker population from one year's dose.

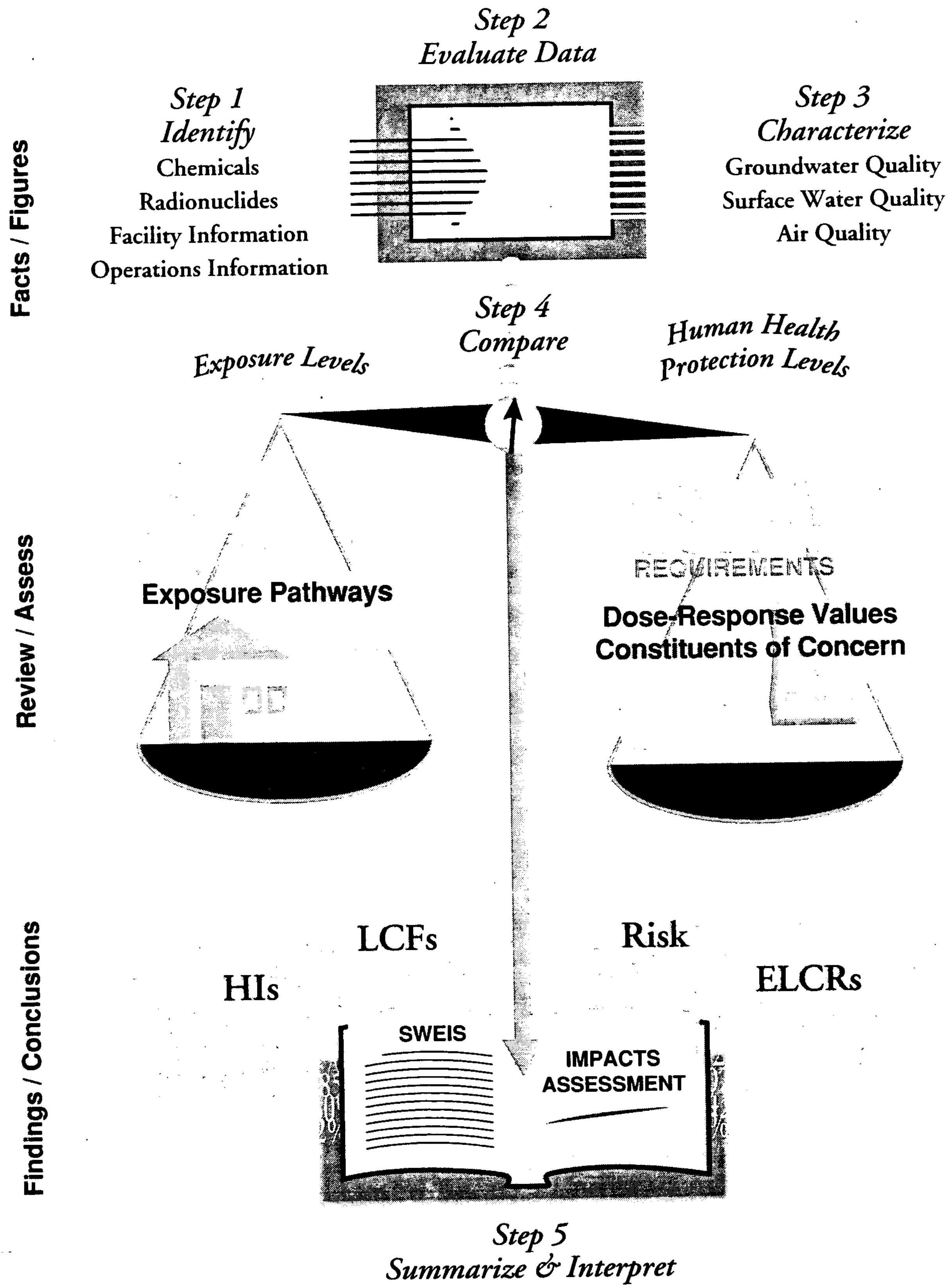

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Figure 5.2.8–1. The Health Risk Assessment Process

The health risk assessment process is a series of steps associating environmental conditions with potential health effects.

Maximum worker dose and average worker dose under each alternative are expected to be consistent with data collected in base year 1996 (see Section 4.10).

5.2.9 Accident Analysis

The requirements for accident analysis are set forth by the DOE (DOE 1993b). DOE guidance for accident analysis allows a graded approach that analyzes accidents at a level of detail that is consistent with the magnitude of the potential impacts. The Department requires that potential hazards be considered if they can lead to accidents that are reasonably foreseeable; that is, there is a mechanism for their occurrence and their probability of occurrence is generally greater than one chance in a million per year ($1x10^{-6}$). Accidents that are less frequent may also be considered if they could result in high consequences and provide information important to decision-making. Although the impacts of all potential accidents are not required, the accident analysis is required to evaluate a sample of reasonably foreseeable accidents, to demonstrate the range of potential impacts. These accidents would include both low-frequency–high-consequence and high-frequency–low-consequence events.

The accident impacts described in this section were developed as a result of detailed studies of selected SNL/NM facilities that included

- meetings with facility managers; environment, safety, and health coordinators; and/or safety personnel to identify major potential hazards and identify safety documentation applicable to the SWEIS;
- facility visits and tours to identify potential hazardous situations, gain an understanding of the mechanisms that could cause an accident, and obtain information for the development of accident scenarios; and
- reviews of facility safety documentation, including safety assessments (SAs), hazard assessment (HA) documents, process hazard surveys or studies, safety analysis reports (SARs), environmental impact statements (EISs), environmental assessments (EAs), hazardous material databases, environmental monitoring reports permits, and other source documents prepared by SNL/NM for the SWEIS.

The information and data obtained during these activities were used extensively for assessing hazards at SNL/NM facilities, developing accident scenarios, and estimating accident impacts (TtNUS 1998k).

Preliminary screenings of SNL/NM activities and operations were conducted to select facilities and operations to be evaluated. Because of the relatively large number of activities and operations at SNL/NM facilities and the large number of potential accident scenarios that could be postulated, further screening was performed to eliminate low-hazard activities and operations that would result in small consequences to receptors.

Facility SARs analyze accidents that have multiple conservative assumptions, resulting in the highest consequences. Radiological accidents generally represent accidents affecting the facility or the experiment being performed that contain radioactive materials. For accident scenarios involving stored materials, the accidents represent the maximum quantities that could be involved. Similar conservative assumptions also hold for nonradiological accidents.

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 LCFs. For chemical releases, the impacts were evaluated in terms of chemical concentrations in relation to emergency response planning guideline (ERPG) levels for specified workers and the public (AIHA 1997). The potential for accidents whose impacts are measured in units other than LCF and chemical concentrations were also addressed.

The impacts of accidents were measured in terms of the effects for six types of human receptors: 1) 14 core receptors at various onsite and offsite locations; 2) receptor locations at the KAFB boundary at the 16 compass points; 3) the MEI, who has the highest reported dose of either core receptors or boundary receptors; 4) the offsite population within 50 mi; 5) a noninvolved worker at 100 m; and 6) involved workers (generally in the immediate vicinity of the accident).

The estimated impacts of accidents can be affected by unavoidable uncertainties in the analyses. These uncertainties can be attributed to modeling techniques, source-term estimates, release fractions, health effects estimators, accident scenario definitions, meteorological data, population estimates, and similar causes. Several actions were taken to minimize the effects of uncertainties. These included the use of approved methodologies, approved and verified models, formally documented data in approved reports, conservative data estimation practices, and formal quality assurance reviews. The effects of any remaining uncertainties were further minimized when accident impacts for alternatives were compared on a relative, rather than absolute, basis.

Many of the accident scenarios excluded the effects of mitigation measures such as filtration or scrubbing of the effluent prior to release to the environment. Some chemical storage containers are equipped with internal flow restrictors that would limit the uncontrolled release of their contents. Also, emergency procedures, sheltering, and evacuation would reduce the extent of human exposures.

5.2.10 Transportation

Transportation impacts were addressed by examining onsite and offsite transportation activities involving radioactive, chemical, and explosive materials and wastes, including assessing existing transportation facilities and modes of transport. Both incident-free exposures and accident exposures to workers and the public were analyzed. Regional traffic impacts related to the alternatives were also addressed. The analysis presents a summary of the regulatory framework as it applies to transportation activities and considers current transportation procedures.

The analysis includes assessing impacts of local transportation; incident-free radiological dose to the crew and public; radiological dose (consequences) due to potential accidental release of radioactivity for a given accident (category VII); nonradiological impact due to traffic fatalities; and LCFs due to potential vehicle emissions of air pollutants from offsite transportation of materials and waste. The nonradiological traffic fatalities were calculated based on unit risk factors (fatalities per kilometer of travel for crew and public) developed from national statistics for highway accident-related deaths (SNL 1986). The radiological impacts were calculated using the *RADTRAN4* model developed at SNL/NM and documented by Neuhauser and Kanipe (SNL/NM 1992a). The LCFs due to vehicle emissions were calculated by using unit risk factors (fatalities per kilometer of urban travel) developed by SNL/NM (1982). The transportation impacts due to the movement of materials and wastes between SNL/NM and other sites would be bounding compared to the transportation impacts due to onsite transfers or movement of the materials and wastes (see Appendix G). Therefore, a detailed impact analysis was performed considering offsite transport of the materials and wastes. The details of this offsite transportation analysis are presented in Appendix G. Overall impact was evaluated in terms of total lifetime fatalities due to offsite transportation of materials and waste from SNL/NM operations.

Activity Multipliers

The activities proposed under the alternatives would potentially impact the types and quantities of material used and transported at SNL/NM. The activity scenarios from the SNL/NM Facility Information Manager were used to project inventories for facilities based on activities at the facilities. The selected existing facilities represent the types of operations that will occur at SNL/NM over the next 10 years. These activities primarily relate to test shots, production levels, and/or manpower estimates for these selected facilities. These activities have been converted to unitless numbers that have been normalized so that a site-wide aggregate multiplier for each alternative could be developed. In turn, these multipliers were used to develop projections for the waste management and transportation consequence analysis. The operations at new facilities were not considered for the multiplier because the start-up of these operations reaching their planned production levels would artificially inflate the multiplier and not truly reflect the anticipated activity levels at SNL/NM. The details of the activity multipliers are presented in Appendix A.

5.2.11 Waste Generation

The waste generation analysis examined potential impacts associated with waste generation activities of SNL/NM, including low-level waste (LLW), low-level mixed waste (LLMW), transuranic (TRU) waste, mixed transuranic (MTRU) waste, hazardous waste, and process wastewater. The ongoing waste management practices relating to generating, handling, treating, and storing wastes are described. The analysis also presents a summary of the regulatory framework as it applies to waste management and a summary of current and projected waste generation activities. Selected facilities or activities that generate waste were evaluated for changes in the baseline quantity of waste generated as a result of the proposed alternatives. SNL/NM treatment and storage facilities were evaluated for any impacts on their capabilities to manage wastes before transportation to offsite disposal. The analysis of potential impacts considered physical safety, regulatory requirements, and security measures associated with storage capacity, personnel safety, and treatment capacity.

A quantity projected under the No Action Alternative for 2003 and 2008 represents the maximum quantity projected for any given year during the 1998-2003 and 2004-2008 5-year time frames. Waste volume estimates for 2003 and 2008 are considered to be conservative and bounding based on current annual projections.

For each selected facility, a waste quantity projected under the Expanded Operations Alternative represents the maximum possible waste generation level, and thus the bounding level of operation. This applies to all waste types (including LLW, LLMW, and *Resource Conservation and Recovery Act* (RCRA) hazardous waste).

A quantity projected under the Reduced Operations Alternative represents the projected quantity of waste generated during any given year as a result of maintaining programmatic capabilities across SNL/NM at minimum operational levels based on selected facilities.

5.2.12 Noise and Vibration

The noise and vibration analysis describes the noise sources at SNL/NM by activity and location and qualitatively discusses the impacts of these noise sources. Direct and indirect impacts of the alternatives and compliance with applicable regulations are addressed. The number of noise events projected for each alternative from tests of high explosives, tests using rocket motors, tests producing sonic booms, tests involving large-caliber weapons, as well as increased noise from aircraft, vehicular traffic, and industrial sources were compared with the available baseline data. A qualitative discussion of baseline noise at SNL/NM presents examples of dBA sound levels that are typical of short-term noise impacts from SNL/NM test activities. Estimated sound levels are presented for area locations as examples of the impacts from SNL/NM test activities.

5.2.13 Socioeconomics

The socioeconomic analysis measured the incremental effects from changes in expenditures, income, and employment associated with the three alternatives at SNL/NM and their overall effect on the region of influence (ROI). The ROI, as described in Chapter 4, is the four-county central New Mexico region around SNL/NM, including the city of Albuquerque, where 97.5 percent of SNL/NM employees and their families live, spend their wages and salaries, and use their benefits.

Spending by SNL directly affects the ROI in terms of dollars of expenditures gained or lost for individuals and businesses, dollars of income gained or lost to households, and the number of jobs created or lost. Changes in expenditures by SNL (that is, dollars spent for capital goods and services in the ROI) directly affect the number of jobs created and amount of income received by individuals and businesses who provide SNL with required goods and services. In addition, by spending their income in the ROI, SNL/NM employees and their families also directly affect the number of jobs created and amount of income received by individuals and businesses in the ROI who provide them with goods and services. Changes in employment at SNL/NM directly affect the overall economic and social activities of the communities and people living in the ROI. Additionally, businesses and households in the ROI respend SNL/NM money, which creates, in turn, indirect and induced socioeconomic effects from SNL/NM operations. Every subsequent re-spending of money by businesses and households in the ROI is another tier of indirect and induced socioeconomic effects originating from SNL/NM operations.

Economic activity (expenditures), income, and employment multipliers are factors used in calculating the incremental effect of changes in socioeconomic conditions at SNL/NM. These multipliers were developed by New Mexico State University (NMSU) and are presented in *The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico, Fiscal Year 1996* (DOE 1997j). The 1997 report (update) was reviewed; however, 1996 remained the representative year for analyzing socioeconomic impacts because overall impacts remained stable.

Following are the selected socioeconomic impact areas examined:

- *Demographics*—evaluating the impact of the alternatives on the ROI's demographics;
- *Economic base*—evaluating the impact of the alternatives on the ROI economy; and
- *Housing and community services*—evaluating the impact of the alternatives on housing availability and services in the ROI

5.2.14 Environmental Justice

The potential for disproportionately high and adverse human health or environmental impacts from the proposed alternatives on minority and low-income populations was examined in accordance with Executive Order (EO) 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629). Both the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997) and the *Guidance* *for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (EPA 1998d) provide guidance for identifying minority and low-income populations and determining whether the human health and environmental effects on these populations are disproportionately high and adverse.

The environmental justice analysis presents selected demographics and identifies the locations of minority and low-income populations living in the ROI of a 50-mi radius around SNL/NM (see Section 4.15.2). For the purposes of consistency and conservative analysis, data were extracted from *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* (SNL 1997f). In this report, minority and low-income populations within the ROI were identified at the U.S. Bureau of the Census block-group level, which allows for potential localized impact analysis.

In New Mexico, the minority population in 1990 was approximately 49 percent (51 percent by 1996) of the total state population (Census 1998). In accordance with the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997), all block groups with a percent minority population greater than 49 percent were identified as being minority.

Because ROIs vary by resource area, an environmental justice impact evaluation was conducted by individual resource area. The environmental justice analysis considered impacts to minority populations and low-income populations in the ROI. Resource areas having ROIs smaller than 50 mi and not having substantial impacts were assumed to have inconsequential impacts beyond the smaller ROI. Resource areas were evaluated on an individual basis with respect to minority populations and low-income populations. Several resource areas evaluated individually water resources, cultural resources, and transportation.

Twenty-one percent of the state population in 1989 was considered to be living below the poverty level (Census 1996). Therefore, for analysis purposes, all block groups with a poverty percentage greater than 21 were identified as being low-income. Environmental justice mpacts were assessed and compared to the analysis presented for the general population by resource area for each of the alternatives. Environmental justice-related impacts are only present if the impacts to minority or low-income populations are disproportionately high and adverse in comparison to the general population.

5.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, ongoing DOE and interagency programs and activities at SNL/NM would continue at currently planned levels in support of assigned missions. This would include any activities that the DOE has approved and that have existing NEPA documentation. Sections 5.3.1 through 5.3.13 describe how this alternative would affect the resource or topic areas evaluated in the SWEIS.

5.3.1 Land Use and Visual Resources

The implementation of the No Action Alternative would not affect the existing land use patterns or visual resources at SNL/NM facilities on KAFB. Sections 5.3.1.1 and 5.3.1.2 discuss these resource areas in relation to the No Action Alternative.

5.3.1.1 Land Use

The extent of DOE land and U.S. Air Force (USAF)-permitted acreage currently available for use by SNL/NM on KAFB would remain the same. Due to DOE-wide consolidation efforts and general guidance to return real estate that exceeds the Department's needs, the acquisition of additional land would be limited. One real estate transaction involving the acquisition of approximately 4 ac from the city of Albuquerque is ongoing (see Section 4.3.3.7). In general, the technical areas (TAs), which encompass over 2,800 ac of DOE property, would not change. In addition, the SNL/NM use of more than 5,900 ac on KAFB, permitted by the USAF to the DOE, would continue with periodic modifications due to the expiration of permits and the initiation of new or modified requests. The continued operation of the 10,000-ft sled track in TA-III would require continuation of leases for land adjacent to KAFB as safety buffer zones. The lease with the Pueblo of Isleta for more than 6,300 ac would remain in effect. The renewal of the lease with the state of New Mexico for more than 2,700 ac is in negotiation. SNL/NM operations would remain consistent with industrial research park uses and would have no foreseeable effects on established land use patterns or requirements. Planned SNL/NM facilities, expansions, and upgrades referred to in the *1998 Sites Comprehensive Plan* (SNL 1997a) would not require changes to current land ownership or classification status because the DOE would place such facilities in or near existing facilities, in disturbed or developed areas, or on land under DOE control.

At locations on permitted land where operations would be declining or shut down by the "owning" organization, SNL/NM would continue to hold the sites to conduct periodic safety checks and complete any ER actions (Section 5.3.3.1). Before returning land, SNL/NM would be responsible for conducting any demolition work and restoring it to its condition when originally acquired from the USAF (SNL 1997a).

5.3.1.2 Visual Resources

As stated above, the No Action Alternative would not adversely change the overall appearance of the existing landscape, obscure views, increase the visibility of SNL/NM structures, or otherwise detract from the scenic perspectives of existing and planned residential developments adjacent to KAFB. New SNL/NM facilities, expansions, and upgrades would be planned at or near existing facilities in areas with common scenic quality. Efforts initiated by SNL/NM to incorporate campus-style design are expected to continue. This style contains established principles and design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. The guidance covers building massing, facades, colors, building orientation and entries, traffic circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. These efforts would be consistent with the generally high concern for scenery due to the number of observers and users in and around the area.

Limited operations at outdoor testing facilities in the Coyote Test Field and the Withdrawn Area would continue; however, no additional development is anticipated that would alter visual resources. Some testing activities would be conducted producing smoke and dust of variable quantity and duration, but these conditions would be periodic and short-term and would not change the visual characteristics of the area. Where decommissioning, demolition, or ER activities are planned, actions would be taken such as backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its state when originally acquired by SNL/NM.

5.3.2 Infrastructure

Descriptions of important infrastructure-related services (such as maintenance), utilities (such as electricity), and facilities (such as the steam plant) are provided in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a), and the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). Potential incremental changes to SNL/NM services, utilities, and facilities were reviewed for each alternative. The analysis focused on incremental changes for site-wide utility demands and for the selected infrastructure facilities, the steam plant, RMWMF, HWMF, and TTF.

Regarding site-wide utility demands, most SNL/NM facilities do not meter utility use. However, annual site-wide utility demands are known and were used, in part, to make projections for this alternative (SNL/NM 1998c). These projections were made by identifying representative base years for each specific utility and calculating usage based on square footage presented in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). These site-wide demand calculations were made independent of data collected on the selected facilities identified in Chapter 2. Site-wide utility demand estimates are presented in Chapter 3, Table 3.6–1. The assumptions used are detailed in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a). Any incremental changes from the base year in utility demands for the selected facilities were taken into account by adjusting site-wide demand accordingly, as presented in Table 5.3.2–1.

Analysis of four specific facilities in the selected infrastructure facility group (Section 2.3.4) was straightforward, relying on the information presented in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a). Projected throughput was compared to reported operational capacities as presented in Table 5.3.2–2. Air emissions from the steam plant are addressed in Section 5.3.7.1, radioactive air emissions are addressed in Section 5.3.7.2, and SNL/NM site-wide and specific facility waste generation is addressed in Section 5.3.10.

Implementation of the No Action Alternative would not affect current demands on infrastructure (described in Section 4.4). Water consumption would increase from 440 M gal per year to 463 M gal per year by 2008. However, SNL/NM has committed to a 30 percent reduction in water use by 2004. Table 5.3.2–1 shows the water use projections for the No Action Alternative and for a conservation-based scenario. The conservation-based scenario has water use decreasing from 440 M gal to 308 M gal per year before 2008. In Section 5.3.4, water use is conservatively analyzed at the 440 to 463 M gal per year projection. SNL/NM would generate approximately 280 to 304 M gal of wastewater per year. If the water use reduction effort is successful, a reduction in wastewater discharge would also occur (see Table 5.3.2–1). Annual electrical consumption would decrease from 197,000 to

Table 5.3.2–1. Annual SNL/NM Utility Usage and Capacities Under the No Action Alternative[a]

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	FY 2003 USAGE	FY 2008 USAGE	SYSTEM CAPACITY[b]	USAGE[c] AS PERCENT OF CAPACITY
WATER USE					
Site-wide Demand[d]	440 M gal	430 M gal	417 M gal	2.0 B gal	21-22
Selected Facilities/ Facility Groups[e]	0 M gal	23.6 M gal	45.6 M gal	NA	
TOTAL	**440 M gal**	**454 M gal**	**463 M gal**	**2.0 B gal**	**22-23**
Conservation-Based Scenario[f]	**440 M gal**	**352 M gal**	**308 M gal**	**2.0 B gal**	**15-22**
WASTEWATER DISCHARGE					
Site-wide Demand[d]	280 M gal	273 M gal	265 M gal	850 M gal	32-33
Selected Facilities/ Facility Groups[e]	0 M gal	16.9 M gal	39.0 M gal	NA	
TOTAL	**280 M gal**	**290 M gal**	**304 M gal**	**850 M gal**	**33-36**
Conservation-Based Scenario[f]	**280 M gal**	**224 M gal**	**196 M gal**	**850 M gal**	**23-33**
ELECTRICAL USE					
Site-wide Demand[d]	197,000 MWh	192,000 MWh	186,000 MWh	1,095,000 MWh[g]	17-18
Selected Facilities/ Facility Groups[e]	0 MWh	225 MWh	225 MWh	NA	
TOTAL	**197,000 MWh**	**192,225 MWh**	**186,225 MWh**	**1,095,000 MWh**[g]	**17-18**
NATURAL GAS USE					
Site-wide Demand[d, h]	475 M ft^3	464 M ft^3	450 M ft^3	2.3 B ft^3	21-22
Selected Facilities/ Facility Groups[e, i]	0 M ft^3	0 M ft^3	0 M ft^3	NA	
TOTAL	**475 M ft^3**	**464 M ft^3**	**450 M ft^3**	**2.3 B ft^3**	**21-22**

Table 5.3.2–1. Annual SNL/NM Utility Usage and Capacities Under the No Action Alternative[a] (concluded)

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	FY 2003 USAGE	FY 2008 USAGE	SYSTEM CAPACITY[b]	USAGE[c] AS PERCENT OF CAPACITY
MISCELLANEOUS					
Fuel Oil[i, j]	7,000 gal	7,000 gal	7,000 gal	Not limited by infrastructure	NA
Propane[h, i]	383,000 gal	374,000 gal	362,000 gal	Not limited by infrastructure	NA

Sources: DOE 1997k; SNL 1997a; SNL/NM 1998a, c; USAF 1998a
B: billion
ft³: cubic feet
FY: fiscal year
gal: gallon
M: million
MW: megawatt
MWh: megawatt hour
NA: Not applicable
psi: pounds per square inch
[a] Base Year is 1996 or 1997, the most representative of usage; not necessarily the same as in Chapter 4.
[b] Capacity means the actual or calculated maximum amount of water, wastewater, or other resource that can be used, discharged, or consumed.
[c] Usage means the actual or calculated annual amount of water, waste water, or other resource used, discharged, or consumed.
[d] Prorated based on the following square footage: base year = 5.266 M; FY 2003 = 5.143 M; FY 2008 = 4.986 M
[e] Base-year site-wide demand usage was assumed to include selected facilities/facility groups; however, any changes in selected facilities' projected future usage were used to adjust site-wide demand for bounding purposes.
[f] SNL/NM expects to reduce water use by 30% based on 1996 usage of 440 M gal. Thus, between 2004 and 2008, SNL/NM water use would be 308 M gal per year. Wastewater would be similarly reduced.
[g] Based on 125-MW rating.
[h] Estimated based on 60 psi.
[i] No adjustments were reported in SNL/NM 1998a.
[j] Fuel oil is used in emergency situations at the steam plant and is not dependent upon square footage.

Table 5.3.2–2. Annual Throughput[a] and Capacities Under the No Action Alternative for the Infrastructure Facility Group

FACILITY[d]	BASE YEAR 1997	FY 2003	FY 2008	SYSTEM CAPACITY	THROUGHPUT AS PERCENT OF CAPACITY
Steam Plant (steam produced)[e]	544 M lb	544 M lb	544 M lb	3.33 B lb[b]	16
HWMF (waste handled)[e]	203,000 kg	192,000 kg	196,000 kg	579,000 kg[c]	33-35
RMWMF (waste handled)[e]	1.6 M lb	2.1 M lb	2.1 M lb	2.7 M lb	59-78
TTF (waste handled)[e]	Minimal	336 lb	336 lb	7,300 lb[b]	5

Source: SNL/NM 1998b
B: billion
ft³: cubic feet
HWMF: Hazardous Waste Management Facility
kg: kilogram
lb: pound
M: million
RMWMF: Radioactive Mixed Waste Management Facility
TTF: Thermal Treatment Facility
FY: fiscal year
[a] Throughput means the amount of steam produced or waste handled.
[b] Permit capacity
[c] This is the capacity for single shift work with current employment level, not permit capacity.
[d] See Section 2.3 for discussion on how these facilities were selected.
[e] See Table 3.6–1, "Infrastructure" category.

186,000 MWh. Projections of annual consumption of natural gas, fuel oil, and propane are also presented in Table 5.3.2–1.

Table 5.3.2–1 shows water use and wastewater discharge increasing through fiscal year (FY) 2008, while electrical use and natural gas use decrease during the same period. This seemingly inconsistent effect is related to the fact that electricity and natural gas typically provide lighting and work environment control on a 24-hour basis regardless of activity level. This 24-hour support involves heating, steam distributing, air conditioning, and ventilating facilities, including maintaining clean room conditions and laboratory fume hoods. Thus, reducing square footage would drive a reduction in electrical and natural gas use. In contrast, water use and wastewater discharge are people-dependent and would potentially increase despite a reduction in square footage.

Projected utility consumption rates would likely fluctuate annually due to weather. The projected reduction in square footage is part of a facility strategic investment plan currently underway at SNL/NM (SNL 1997a). The minor changes in square footage are a result of removing substandard structures.

Under the No Action Alternative, current infrastructure resources are capable of accommodating SNL/NM facility requirements and no major additional infrastructure facilities are proposed to be built. Operational levels of SNL/NM buildings, services, communications, maintenance programs (including upgrades, repairs, and limited renovations), roads, material storage, and waste storage activities would remain compatible with system requirements. SNL/NM maintains an active decontamination and decommissioning (D&D) program that identifies and removes from active service outdated or substandard facilities. An overall reduction in the number of active facilities would reduce the overall impacts to SNL/NM infrastructure. Specific details on these systems and programs are presented in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). Many of these activities are common to all alternatives and are discussed in Section 2.3.3. Additional details on land use and water resources are provided in Sections 5.3.1 and 5.3.4, respectively. Traffic-related impacts are presented in Section 5.3.9. KAFB utility usage is specifically discussed in Section 6.4.

Four specific infrastructure facilities were analyzed for impacts (Figure 5.3.2–1), including the steam plant. Steam production would continue at 544 M lb per year, which represents 16 percent of capacity. While production capacity can expand, distribution capacity has some limitations. The steam distribution system in a portion of TA-I is 40 years old and is in poor condition. In addition, the main trunk steam line is in poor condition and operates at maximum capacity (SNL 1997a). Furthermore, three of the five boilers have reached or exceeded their design life. A study to upgrade or replace the steam plant was completed in 1998. The study recommended the upgrade begin in FY 2004; however, no decision has been made to upgrade the boilers (SNL/NM 1998b).

The other three infrastructure facilities are waste management facilities (Figure 5.3.2–1). The HWMF would manage approximately 195,000 kg of waste per year by 2008 (Table 5.3.2–2). Annual radioactive and mixed waste management would increase to 2.7 M lb per year by 2008 at the RMWMF. The TTF would process small quantities of explosive wastes. Small fluctuations would occur during normal operations due to operational scheduling and shifts in priorities. ER Project wastes are discussed in Section 5.3.10 by waste category.

5.3.3 Geology and Soils

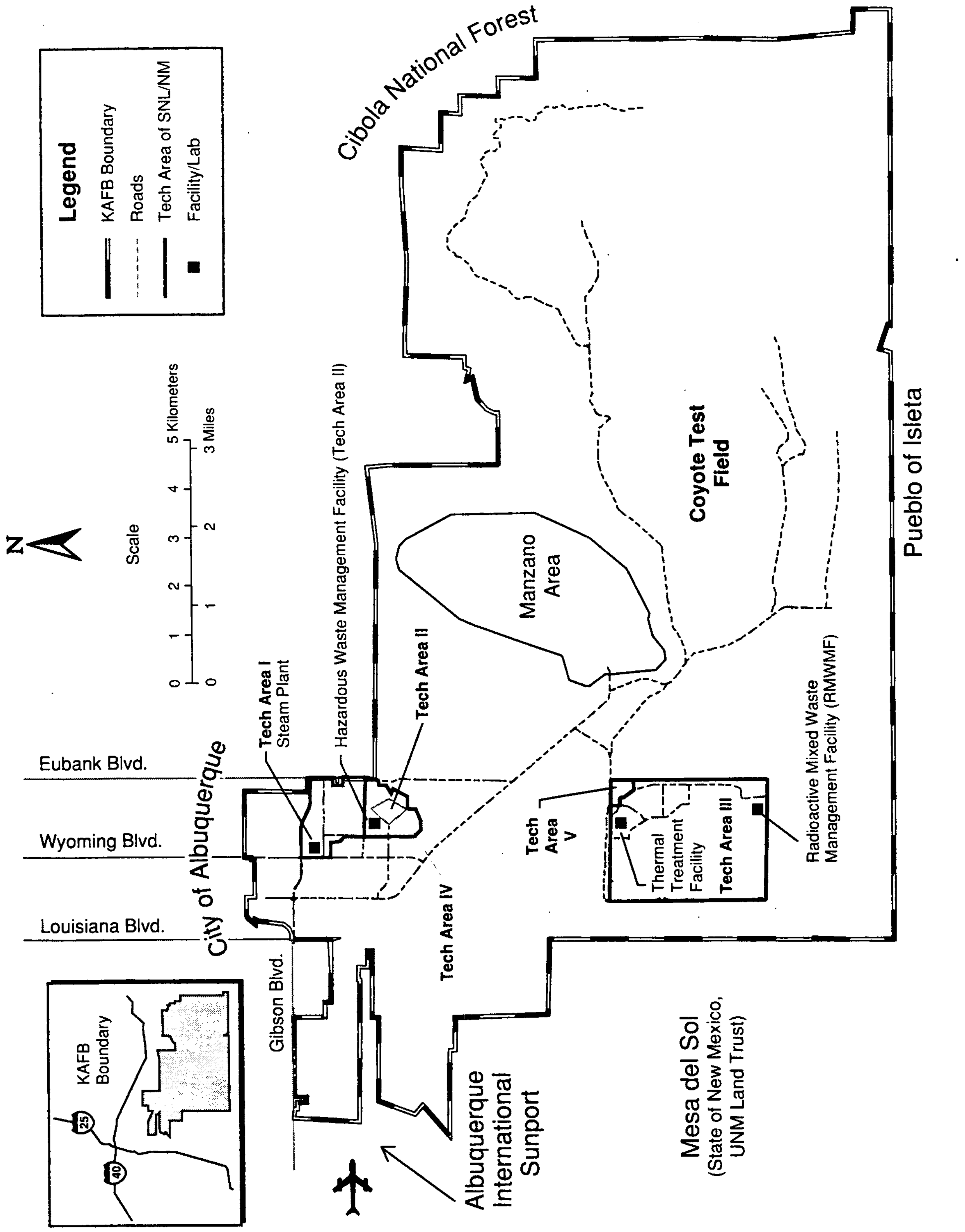
Minimal impacts due to soil contamination would be possible, as discussed in Section 5.3.3.1. A brief summary is available at the end of Section 5.3.3.1. Similarly, it would be extremely unlikely to cause impacts on slope stability, as discussed in Section 5.3.3.2.

5.3.3.1 Soil Contamination

The term soil contamination, as used in the SWEIS, is the presence of any toxic, hazardous, or radioactive substance in the near-surface soil (nominally, the upper 6 inches to 1 ft) that is not naturally occurring. Determining whether concentrations of substances, particularly metals, are contamination and not naturally occurring, is often problematic. See the text box in Section 5.3.7 "What is Background Concentration?" for a discussion on contamination and naturally occurring substances.

Near-surface soils have the potential for direct contact with humans. Onsite workers could contact these soils, although workers in contaminated areas (such as environmental restoration sites) would be subject to health and safety plans. However, analyses indicate no significant risk to the general public (DOE 1996c).

Indirect pathway effects, such as soil contamination as an intermediary to groundwater or surface water contamination, are considered in Section 5.3.4.



Source: SNL/NM 1997j

Figure 5.3.2–1. Selected Infrastructure Facilities/Facility Groups

Four selected SNL/NM infrastructure facilities/facility groups were analyzed for potential impacts.

Soil contamination at SNL/NM occurred as the result of past operations and may be occurring from ongoing operations in outdoor testing areas and radioactive material management areas. The cleanup of these soils is performed to a level that meets the health risk-based standards corresponding to the intended future uses of the site. Intended land uses are typically residential, recreational, or industrial. Soil cleanup levels are set so that the health risk to an individual using the site for its intended purpose is acceptable. Exposure levels used in the risk analysis are use-dependent. Such factors as typical time spent indoors and outdoors, amount of soil incidentally ingested, volume of air breathed while onsite, and ingestion of food grown onsite (for residential) affect the exposure and thus the residual concentrations the cleanup must meet. Remediation action levels and residual radiation site cleanup levels are based on these risk analyses.

ER Project Sites

As of August 1998, the ER Project at SNL/NM had identified 182 sites with soil contamination from past and continuing operations. Because contamination levels pose no threat to human health or the environment, the DOE has proposed no further action for 122 of 182 sites to the New Mexico Environment Department (NMED). Of these 122 sites, 48 have been approved. The remaining 74 sites are being evaluated by the NMED and may require additional characterization or some cleanup.

Inactive Sites

Of the 60 remaining sites (182 minus 122), approximately 40 are inactive sites that are undergoing further characterization or cleanup. These sites will be cleaned up to levels appropriate for future use, either as recreational or industrial sites. The Future Use, Logistics, and Support Working Group (consisting of SNL/NM, DOE, EPA, NMED, and members of the public) has agreed upon future use. Remediation of these sites was analyzed in the ER Project EA (DOE 1996c), which is described in Section 1.8.5 and incorporated by reference. All inactive sites, with the exception of subsurface contamination at the Chemical Waste Landfill (CWL), are scheduled for cleanup by 1999 (SNL 1997d). The ER Project is scheduled for completion between FY 2003 and FY 2005, depending on budget availability.

Active Sites

Of the 60 remaining sites, 20 are active. These include outdoor testing facilities, several oil spills, and storage areas. Although many of these sites may have very low levels of contamination that would normally allow them to be proposed for no further action, ongoing and potential future activities at the sites may necessitate remediation. The NMED and SNL/NM are discussing how and when characterization and cleanup activities would be completed in the future when operations cease at the active sites.

Potential soil contamination from continuing operations has been identified at four test facilities in TA-III and the Coyote Test Field: the Terminal Ballistics Complex, Sled Track Complex, Aerial Cable Facility, and the Lurance Canyon Burn Site. All of these sites are listed as active ER Project sites.

The Terminal Ballistics Complex in TA-III (ER Project Site 84) has had projectile tests conducted using lead and depleted uranium (DU) as both projectile and target materials. A total of 50 point sources and 6 small area sources were cleaned up at this site during a voluntary corrective measure of radioactive surface contamination (SNL 1997e). After the corrective measure, the maximum residual radionuclide activity at this site was 31.1 pCi of uranium-238 per g of soil (compared with an average background value of 1.4 pCi/g). A preliminary risk assessment using *Residual Radioactivity (RESRAD)*, a computer modeling program, indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the industrial land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

The Sled Track Complex in TA-III (ER Project Sites 83 and 240) has had DU, beryllium, and lead fragments released from high velocity impact tests. A total of 1,601 point sources and 33 area sources were cleaned up during a voluntary corrective measure of radioactive surface contamination (SNL 1997e). After the corrective measure, the maximum residual radionuclide activity at this site was 28.3 pCi of uranium-238 per g of soil (compared with an average background value of 1.4 pCi/g). A preliminary risk assessment using *RESRAD* indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the industrial land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

The Aerial Cable Facility at the Coyote Test Field (ER Project Site 81) could introduce small amounts of lead, beryllium, and DU into the soil from weapons test units that could break open on impact. This has occurred twice since operations began at this site in 1971. Each time, almost all of this material was collected and properly disposed of. A radiological survey of the site indicated no elevated radiation except for naturally occurring material in rock outcrops (SNL 1997e).

The Lurance Canyon Burn Site (ER Project Site 65) has the potential for test object rupture and subsequent release of DU. Pretest and posttest sampling of the test object and surrounding area is used to confirm the integrity of the test. It is estimated that once every 10 years, less than 25 kg of DU would be released over a 1,000-ft^2 area (that is, a 35-ft-diameter circle), resulting in a soil concentration of about 7,000 µg of DU per g of soil (SNL/NM 1998a). As with all of the above sites, a release of concern such as this one would be decontaminated and cleaned up on an interim basis by trained personnel in accordance with DOE policies. The area surrounding the Lurance Canyon Burn Site, including ER Site 94, the explosive item burner within the Burn Site, was surveyed and remediated as part of a voluntary corrective measure (SNL 1997e). Fifty-four point sources and 14 area sources were cleaned up; the maximum residual activity at the site was 35.8 pCi of uranium-238 per g of soil (compared with an average background value of 2.3 pCi/g). A preliminary risk assessment using *RESRAD* indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the recreational land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

Radioactive Material Management Areas

As of May 1998, there were 68 radioactive material management areas at SNL/NM. These are primarily indoor laboratories where radioactive materials are used in manufacturing processes or research. The Drop/Impact Complex is an outdoor radioactive material management area where sealed assemblies containing DU are tested. Impact velocities at this facility are much lower than those that would normally result in rupture and release of DU. There have been no recorded releases of DU to the environment at this facility.

Summary of Soil Contamination

In summary, known locations of soil contamination at inactive sites are planned for cleanup by 2004. Cleanup will be to levels appropriate for designated future uses. Soil contamination at active sites is monitored, and SNL/NM conducted periodic voluntary cleanups to ensure that potential human health effects are within proposed standards for the designated future land uses. The NMED and SNL/NM are discussing how and when future further characterization and cleanup activities would be completed when operations cease at the active sites.

5.3.3.2 Slope Stability

Slope stability depends on a variety of factors, including soil type, soil moisture, and load. With unloaded natural slopes that have reached a state of equilibrium over a period of years, slope failure almost invariably involves partial saturation of the sliding mass of soil by groundwater (Spangler & Handy 1973). Slope failure most commonly occurs in clay-rich soils, where platy minerals align to form a shear surface (Bromhead 1986). The arid desert climate, combined with the predominance of loamy (mixed clay, silt, sand, and organic matter) rather than clayey soils, tends to reduce the likelihood of slope failure in the SNL/NM area (SNL/NM 1997a). There are no known instances of slope failure at SNL/NM.

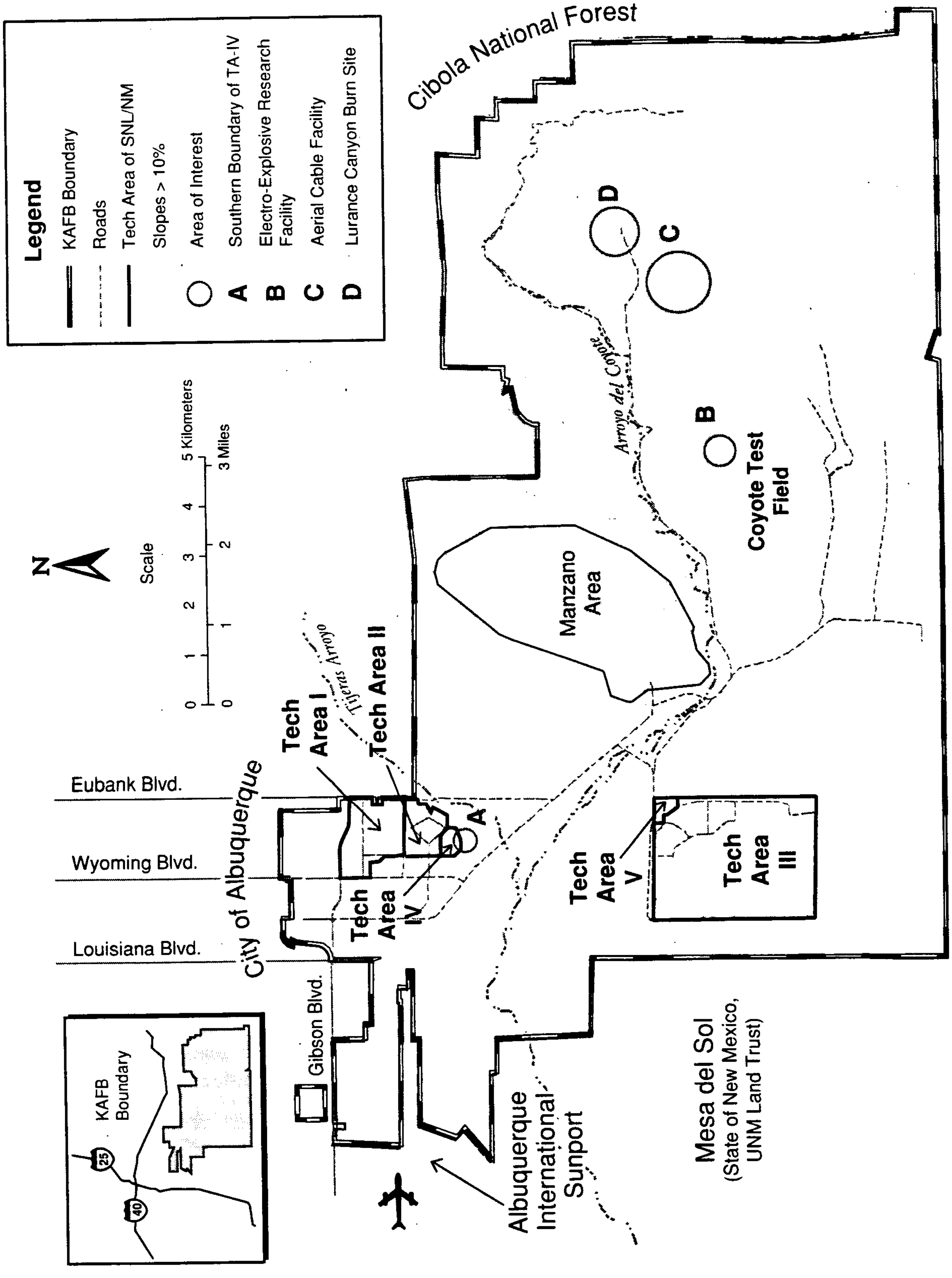
An analysis of slope stability was conducted to determine whether SNL/NM activities could cause destabilization of slopes, thereby affecting other resources, such as cultural resource sites, if such resources were present. The types of slope destabilizing activities evaluated were vibrations, surface disturbances, and burning.

A GIS-generated slope map was combined with an overlay map of SNL/NM structures to determine which SNL/NM facilities are near 10 percent or greater slopes (Figure 5.3.3–1). The 10-percent slope map simply provides a tool to identify which SNL/NM facilities are closest to slopes, so they can be evaluated on an individual basis. Ten percent is not a threshold for whether a slope is stable or unstable. The stability of slopes is heavily dependent on additional factors such as soil type, soil thickness, moisture content, and vegetation. Ten percent or greater slopes are generally confined to the Manzanita Mountains and foothills, the Manzano Area, and along the banks of arroyos.

Four areas were identified for further analysis based on Figure 5.3.3–1: the southern boundary of TA-IV, the Aerial Cable Facility, the Lurance Canyon Burn Site, and the Electro-Explosive Research Facility. These areas were evaluated using field observations of facility configuration, vegetation, evidence of erosion, and any other factors that could contribute to slope destabilization.

Southern Boundary of TA-IV

Along the southern boundary of TA-IV, five SNL/NM facilities are housed in buildings within 100 ft of a graded-



Source: SNL/NM 1997j

Figure 5.3.3–1. SNL/NM Facilities Near 10 Percent or Greater Slopes

SNL/NM facilities that are near 10 percent or greater slopes are generally confined to the Manzanita Mountains and foothills, the Manzano Area, and along the banks of arroyos.

fill slope above the main Tijeras Arroyo escarpment. (More complete descriptions of these facilities are provided in Chapter 2.)

- The SATURN and the Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) facilities are both located in Building 981. SATURN simulates the radiation effects of nuclear countermeasures on electronic and material components. SPHINX is used to measure X-ray-induced photocurrents from short pulses in integrated circuits and thermostructural response in materials.
- The Repetitive High Energy Pulsed Power (RHEPP)-I facility in Building 986 supports the development of technology for continuous operation of pulsed-power systems.
- The Z-Machine facility in Building 983 generates high intensity light-ion beams for the inertial confinement fusion program and high energy/density weapons physics program for stockpile stewardship.
- The HERMES III facility in Building 970 provides gamma-ray effects testing for component and weapons systems development, helping to ensure operational reliability of weapons systems in radiation environments caused by nuclear explosions.

The foundations of these buildings sit in natural ground (gravelly, fine, sandy loams of the Embudo and Tijeras Series [SNL/NM 1997a]), although a graded-fill slope of about 30 percent exists along the periphery of TA-IV leading into Tijeras Arroyo (Winowich 1998). This graded-fill slope is approximately 30 ft high and has light vegetation (primarily grass) cover. Minor erosional channels from storm water runoff are visible along the slope surface, but these are less than 6 inches wide or deep. The areas around the buildings and extending to the edge of the slope are paved, eliminating destabilization from significant water infiltration. At the base of the graded-fill slope, a gentler, natural slope (less than 10 percent) leads toward the main channel of Tijeras Arroyo, approximately 500 ft to the south and southeast. The base of the graded-fill slope is 20 ft higher than the current Tijeras Arroyo channel; there is no evidence of erosion at this point from water running through Tijeras Arroyo. The facilities are not in a floodplain.

Under the No Action Alternative, no new activities would be conducted in this portion of TA-IV. Based on the low potential for water infiltration, the lack of slope-destabilizing activities identified at these facilities (SNL/NM 1998a), and SNL/NM experience to date, the likelihood of slope failure at this location is remote.

Aerial Cable Facility

The Aerial Cable Facility provides a controlled environment for high velocity impact testing on hard surfaces and precision testing of full-scale ground-to-air missiles, air-to-ground ordnance, and nuclear material shipping containers for certification. (A more complete description of this facility is provided in Chapter 2.) The slopes surrounding the Aerial Cable Facility exhibit numerous bedrock outcrops. No soil classification has been assigned to this area (SNL/NM 1997a), because only a thin veneer of soil overlies the bedrock. Medium to heavy juniper-dominated vegetation is present in areas with this thin soil cover. Activities at the Aerial Cable Facility can result in hot missile debris causing brush fires in the downrange impact area (SNL/NM 1998a). Evidence of one such burn (approximately 1 ac) was noted during the May 1998 reconnaissance. (Section 5.3.8 discusses other impacts associated with accidental burns.) However, there is no evidence of landslides or recent erosion in the burn area or other areas surrounding the facility.

Under the No Action Alternative, more tests would be conducted at the Aerial Cable Facility, with some types of tests doubling from their 1996 base-year frequency. However, based on the predominance of bedrock slopes and lack of evidence of slope instability (even in the burned area), the likelihood of slope failure at this location is remote.

Lurance Canyon Burn Site

Safety tests of various hazardous material shipping containers, weapon components, and weapon mockups in jet propulsion (JP)-8 aviation fuel fires, propellant fires, and wood fires are conducted at the Lurance Canyon Burn Site. (A more complete description of this facility is provided in Chapter 2.) The site is located in a canyon at the junction of two arroyos in the Manzanita Mountains. The facility sits on relatively level ground in the canyon bottom. Surrounding slopes have numerous bedrock outcrops. No soil classification has been assigned to this area (SNL/NM 1997a), as only a thin veneer of soil overlies the bedrock. Medium to heavy juniper-dominated vegetation is found in areas with soil cover. Adjacent arroyo channels are graded or have escarpments less than 3 ft high. The facility is graded with minor slopes and little vegetation. There is no visible evidence of landslides or erosion.

Under the No Action Alternative, testing at the Lurance Canyon Burn Site would continue at 1996 base-year levels. Based on the predominance of bedrock slopes and lack of evidence of slope instability, and because no slope-destabilizing activities have been identified at this facility (SNL/NM 1998a), the likelihood of slope failure at this location is remote.

Electro-Explosive Research Facility

The Electro-Explosive Research Facility has been used for the past five years for developing electromagnetic launch technology. The main building (Building 9990) is a concrete structure now used as a control, instrumentation, and shop facility. Two metal buildings house electromagnetic launchers and propulsion experiments. Although the main building was originally constructed for explosives testing, explosives are no longer stored or used at the site. Projectiles are launched at high velocity by magnetic fields, not propellants, a distance of 600 to 800 yards eastward to the adjacent hillside for projectile diagnostics, study of exterior ballistics, and technology demonstration (SNL/NM 1994a).

The main building and bunkers of this facility are located in a canyon in foothills of the Manzanita Mountains. The main building abuts a hill. Surrounding slopes are covered with grass and minor juniper vegetation. Bedrock outcrops indicate that the soil cover is thin, although soils in this area are assigned to the Salas Series (typically very gravelly loam and stony soils). There is no visible evidence of landslides or erosion. Based on the predominance of bedrock slopes and lack of evidence of slope instability, the likelihood of slope failure at this location is remote.

Summary of Soil Stability

In summary, the four areas identified for further analysis were unlikely to pose a slope failure problem.

5.3.4 Water Resources and Hydrology

5.3.4.1 Groundwater Quality

Sites with potential or known groundwater contamination at SNL/NM are Sandia North (an ER Project designation for groundwater investigations of sites in TA-I and TA-II), the Mixed Waste Landfill (MWL), locations in TA-V, the Lurance Canyon Burn Site, and the CWL (SNL 1997d) (Figure 5.3.4–1). Information on the types and concentrations of potential contamination at these sites is presented in Section 4.6.1. Measurements (see Appendix B, Tables B.1–1 and B.1–2) indicate that some contaminants at some of these sites exceed the maximum contaminant levels (MCLs) contained in federal drinking water standards (40 CFR Part 141). MCLs are the levels of contaminants allowed in public drinking water systems, which are set by the EPA to provide protection from adverse health effects. MCLs are used in this analysis only as a frame of reference for evaluating groundwater quality. Existing institutional controls prevent access to this groundwater. Investigation or remediation of these sites is ongoing as part of the ER Project.

Sandia North

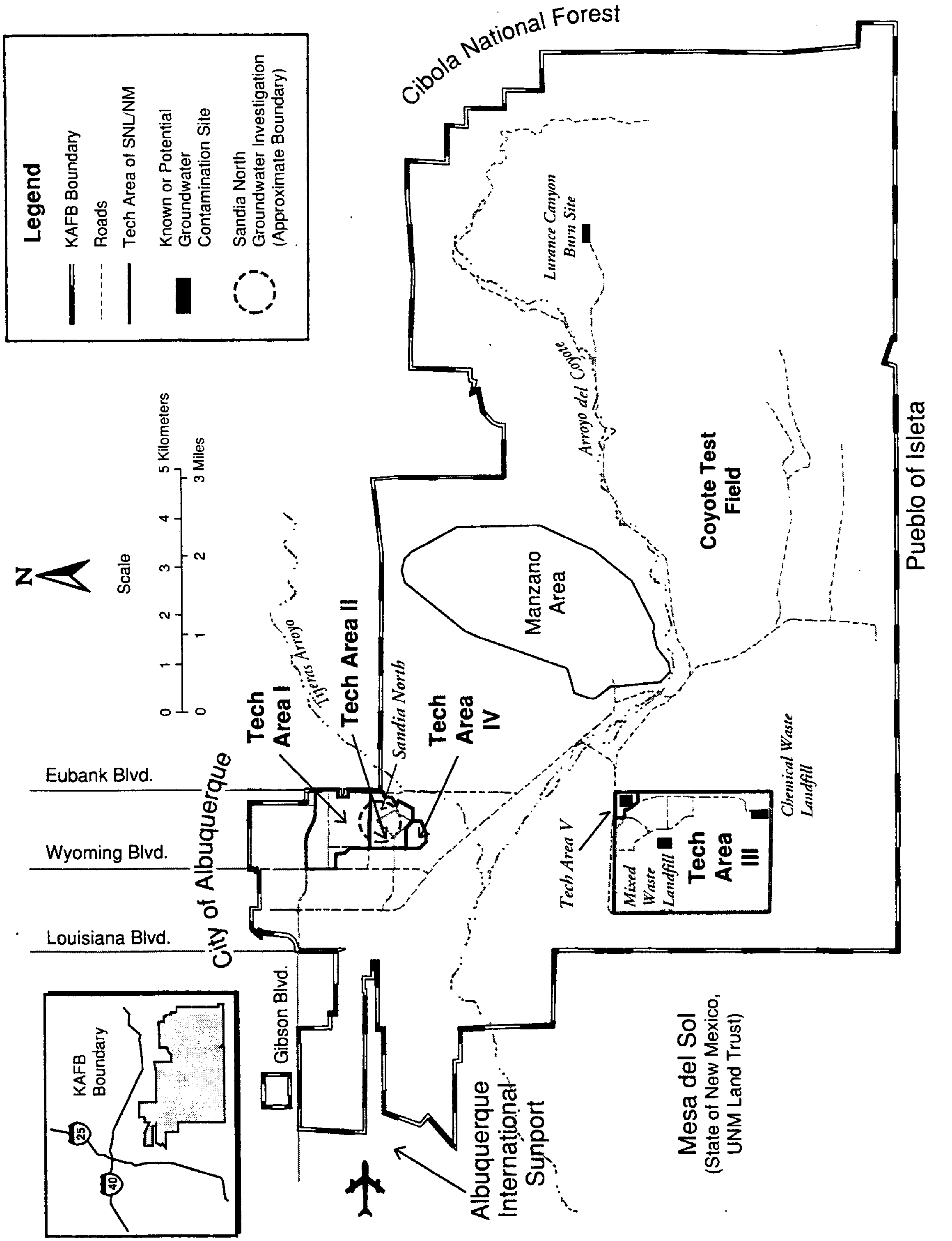
Current uncertainty regarding the nature of contamination sources and local hydrogeology at Sandia North precludes projections of future impacts at this time. As information is developed, SNL/NM will be projecting impacts and formulating mitigating measures to prevent such impacts. These formulations and, ultimately, site remediation actions will be performed under SNL/NM's ER Project and will be overseen by the NMED.

Mixed Waste Landfill

Tritium has been found in soil moisture to a depth of 120 ft below the MWL. The maximum tritium activity at this depth was 2.9 pCi/g, which, for 4.6 percent volumetric moisture content and a soil density of 1.8 g/cm^3 (SNL/NM 1996h), corresponds to a soil moisture concentration of 1.135x10^5 pCi/L. Assuming the tritium that has migrated the farthest is from the earliest release (1959), and using a linear time-distance relationship, this tritium will not reach the water table for 105 years from the time of the above measurement (1995). With a half-life of 12.3 years, the resulting tritium concentration in this soil moisture, when it reaches the aquifer (prior to dilution by aquifer water), would be 310 pCi/L, which is a factor of about 60 less than the MCL of 20,000 pCi/L. A similar calculation for the maximum measured soil concentration of 20,670 pCi/g, found at a depth of 26 ft, results in an estimated concentration upon reaching the aquifer (prior to dilution by aquifer water) of about 4,000 pCi/L, a factor of 5 less than the MCL. SNL/NM has removed broken and subsided concrete caps at the MWL to reduce the possibility of infiltration of precipitation into underlying wastes. The waste pits where the concrete caps were removed were backfilled with soil to ground surface. Site remediation is budgeted and planned to be completed in 2001.

TA-V

The likely sources of the nitrate and trichloroethene (TCE) contamination shown in Table 4.6–1 at TA-V are septic tanks and leachfields. These septic tanks and leach



Source: SNL 1997d, SNL/NM 1997j

Figure 5.3.4–1. Sites with Potential or Known Groundwater Contamination

Sites with potential or known groundwater contamination are located at TAs-I, -II, -III, and -V and the Lurance Canyon Burn Site.

fields have been closed and waste and contamination from these sites have been removed. Disposal is now to the sanitary sewer.

TCE contamination in TA-V groundwater is unlikely to pose a threat to human health or the environment, based on analytical modeling conducted for the *Summary Report of Groundwater Investigations at Technical Area V, Operable Units 1306 and 1307* (SNL/NM 1999c). This modeling assumed the nearest potential downgradient receptor was a hypothetical residence located near the proposed Mesa del Sol subdivision, approximately 9,000 ft west of TA-V, at the KAFB boundary. Results indicated that no contaminant concentrations at this receptor would exceed the remedial action standards or even 10 percent of the preliminary remediation goals. Therefore, the DOE believes there is minimal potential for risk to future residents at the KAFB boundary and minimal impact to human health.

Lurance Canyon Burn Site

Elevated nitrate and low levels (below MCLs) of toluene, ethylbenzene, and xylenes are present in groundwater beneath the Lurance Canyon Burn Site (SNL/NM 1998hh). Toluene, ethylbenzene, and xylenes are components of fuel oil, and appear to be related to operations at the Lurance Canyon Burn Site. The source of contamination is being investigated.

Groundwater in this vicinity is found beneath a layer of alluvium, in fractured bedrock, under semiconfined to confined conditions. Contaminants could be transported downgradient within the fractured bedrock; however, the regional aquifer is 7 mi away. There is no impact to existing potable water supplies beyond the immediate area of the Burn Site.

Chemical Waste Landfill

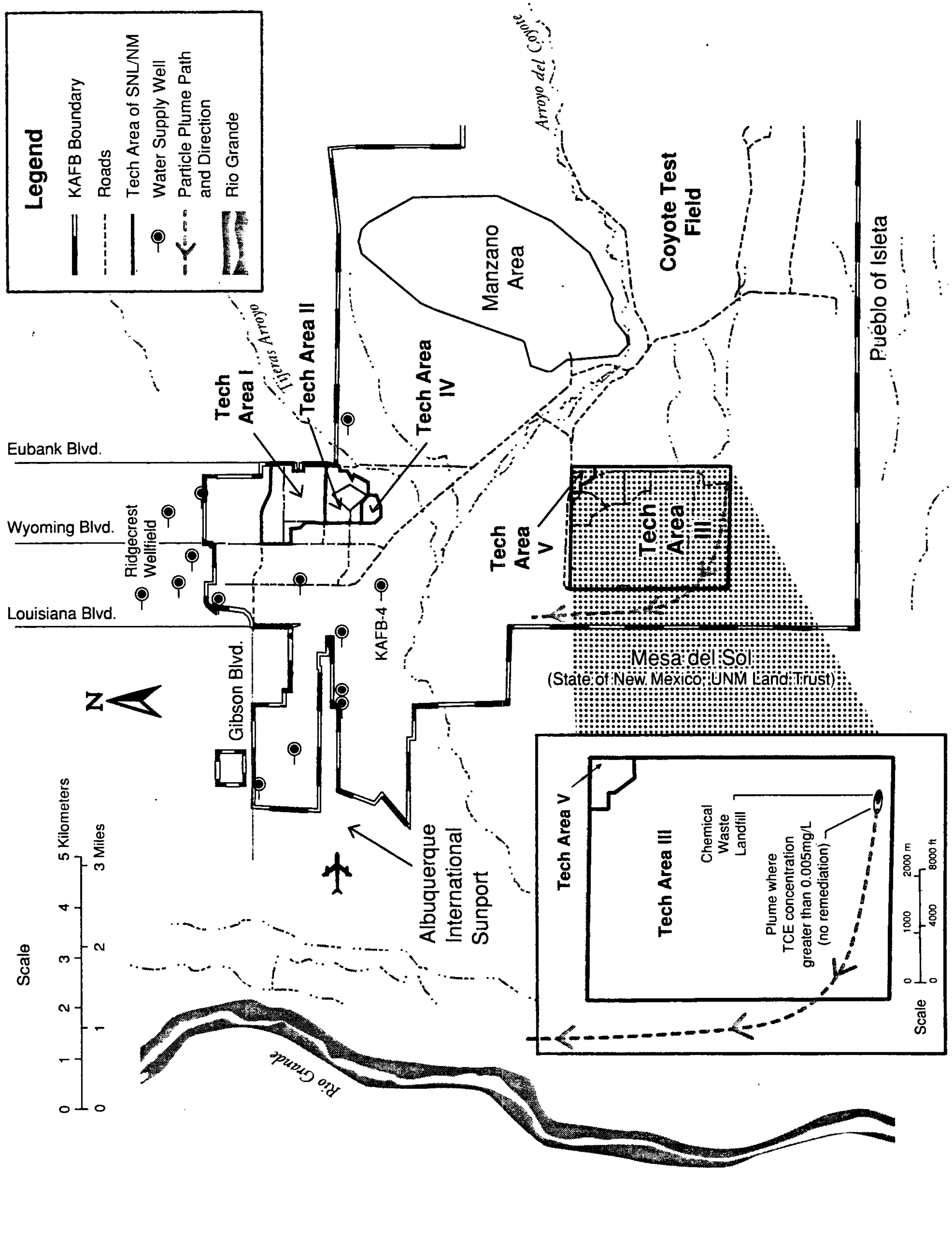
A study was performed for the SWEIS to consider the ultimate fate of the primary CWL contaminants (see Appendix B, Tables B.1–1 and B.1–2). The study used the *Multimedia Environmental Pollutant Assessment System (MEPAS)* model (PNL 1989), described in Appendix B, to estimate the downgradient concentrations of chromium and TCE in the aquifer.

The site conditions used in the modeling are described in detail in Appendix B. The source and unsaturated zone parameters represent the site directly beneath the CWL, in the region of vertical contaminant transport. The saturated zone parameters represent the site along the projected groundwater flow path, from the CWL to the nearby municipal well field (Ridgecrest), located approximately 7 mi north of the CWL (DOE 1997a). The nearest downgradient drinking water supply well, KAFB-4, located approximately 4 mi north of the landfill, also lies along this flow path (Figure 5.3.4–2) (SNL/NM 1995d).

TCE presently in the groundwater is attributed to vapor phase transport of TCE volatilizing in the unsaturated zone (SNL/NM 1995d). Appendix B contains a discussion on the derivation of the vapor source term, which was calculated as 33 g per year into the uppermost saturated layer. This uppermost saturated layer is a silty clay layer, approximately 40 ft thick, through which the downward (vertical) movement occurs at a pore velocity of 0.03 ft per year and horizontal movement occurs at a pore velocity of 0.07 ft per year. Horizontal movement toward the drinking water wells would be predominantly through the underlying sandy aquifer. Appendix B describes the model's assumptions, inputs, and results.

The model results indicate that the maximum concentrations in the sandy aquifer (through which the potential contaminants would be transported from the landfill and from which the drinking water wells draw their water) would be an order of magnitude less than drinking water standards. The maximum downgradient distance from the source within which the 0.005 mg/L MCL would be exceeded is 410 ft, corresponding to an aquifer area of 1.7 ac (Figure 5.3.4–2). After remediation, planned for completion by 2001, downgradient concentrations would be expected to decline quickly. The maximum downgradient distance within which the MCL would be exceeded would decrease to 190 ft after 50 percent remediation, to 3 ft after 90 percent remediation (the remediation efficiency objective), and would not exceed the MCL for a remediation efficiency of 95 percent. Concentrations in the silty clay layer immediately below the TCE source would continue to exceed the MCL, at a level up to 0.05 mg/L, decreasing in response to source remediation. Table 5.3.4–1 summarizes the model results. The MCL concentration at its farthest downgradient extent will be reached approximately 5 years after introduction into the sandy layer and will begin to decrease approximately 10 years thereafter as a result of source remediation.

The aquifer is presently not being affected from unsaturated zone transport of liquid organic phase TCE. Measurements have recently been taken that indicate degradation of this TCE to smaller chlorinated



Sources: SNL/NM 1997a, j

Figure 5.3.4–2. Projected Extent of Chemical Waste Landfill Trichloroethene Contamination Above Maximum Contaminant Level

The maximum calculated extent of TCE contamination above 0.005 mg/L is 410 ft from the CWL.

Table 5.3.4–1. Estimated Concentrations of Vapor-Phase Trichloroethene and Chromium in the Aquifer Beneath the Chemical Waste Landfill

CONTAMINANT	AMOUNT OF CONTAMINANT AVAILABLE FOR MOVEMENT (kg)	DRINKING WATER STANDARD (mg/L)	TIME OF MAXIMUM DOWNGRADIENT STANDARD EXCEEDANCE (YEARS FROM REACHING AQUIFER)	MAXIMUM DISTANCE FROM SOURCE AT WHICH STANDARD IS EXCEEDED (ft)[a]	MAXIMUM AREA OVER WHICH STANDARD IS EXCEEDED (ac)[a]
Trichloroethene Prior to Remediation	31,000	0.005	5[b]	410	1.7
Chromium[a, c]	9	0.100	-	0	0

Source: 40 CFR Part 141
ac: acres
ft: feet
kg: kilograms
MCL: maximum contaminant level
mg/L: milligrams per liter
[a] Assumes no remediation
[b] Reduced below MCL at this distance due to remediation 5 years from first exceedance
[c] Not projected to reach water table
Note: See Appendix B for details regarding calculations

compounds including dichloroethane (Ardito 1998), which would result in undetectable concentrations of TCE in the water table (Appendix B).

Chromium was disposed of in the form of chromic acid, and presently resides totally in the unsaturated zone, to a depth of up to 75 ft below ground level. Although not presently affecting the saturated zone, this chromium may reach the saturated zone in the future. The EPA has conducted studies that show that hexavalent chromium is frequently reduced to trivalent chromium in the environment (Palmer & Puls 1994). Trivalent chromium has relatively low toxicity and very low mobility. The EPA has also indicated that hexavalent chromium can be expected to adsorb to soil, although not as strongly as trivalent chromium (EPA 1996b). This SWEIS conservatively assumes that the chromium would remain in its original hexavalent state and would not undergo soil adsorption (SNL/NM 1995d). Appendix B contains a description of the parameters used to conduct the analysis. The highest levels of chromium in the aquifer would be expected 7,900 years in the future, 1 m from the edge of the source, at a concentration of 0.005 mg/L.
This concentration is a factor of 20 less than the MCL of 0.100 mg/L. Table 5.3.4–1 summarizes these modeling results.

The modeling of the CWL performed for this SWEIS is intended to provide a general estimate of future concentrations of TCE and chromium. It is not intended to substitute for SNL/NM ER Project modeling that may be performed to determine proper procedures for remediation.

Summary of Groundwater Impacts

Although there appears to be no immediate or long-term threat to human health through contamination of the water supply, there is short-term, localized degradation of the aquifer beneath the CWL from vapor-transported TCE. The area of degradation will decrease once cleanup near the ground surface begins to remove the source of the contamination. The presence, concentration, and location of this contamination are independent of any of the alternatives analyzed in the SWEIS. The contamination is a result of past waste management practices. Appropriate cleanup measures, developed in cooperation with the NMED, will proceed regardless of the alternative selected. Because of its effect on the aquifer, groundwater contamination at the CWL is identified as an adverse impact in the SWEIS.

5.3.4.2 Groundwater Quantity

The effects of continued SNL/NM groundwater usage on the aquifer in the KAFB vicinity were investigated. Projected usage under the No Action Alternative was compared with recent (1985-1996) usage and the associated changes to groundwater levels were estimated from recent trends.

Appendix B contains information showing historical pumpage rates from onsite KAFB wells and from Ridgecrest, the nearby Albuquerque well field. Future groundwater levels in the vicinity of KAFB are expected to be most dependent on pumpage from these wells.

Table 5.3.4–2 shows the recent and projected groundwater withdrawals. The proposed Mesa del Sol development (NMSLO 1997) was included in the projections because it would be a potential major contributor to groundwater usage in the vicinity of KAFB for the analysis period. The projected groundwater withdrawals were compared with historical withdrawals in order to establish a linear relationship for projecting future aquifer drawdown, which is also included in Table 5.3.4–2. SNL/NM groundwater use would account for 3 ft (11 percent) of drawdown over the 1998 to 2008 period. The distribution of the projected groundwater level declines in the vicinity of KAFB is indicated on Figure 5.3.4–3. Appendix B describes the method of projection, which includes considerations of population growth and the city of Albuquerque's goal of 30-percent reduction in per capita water use. SNL/NM's influence on drawdown would decrease with distance from KAFB. A one-dimensional Theis equation, assuming a 500 ft-thick aquifer and a hydraulic conductivity of 40 ft/day (Appendix B), indicates that 1 ft per yr or less of water level decline would be expected beyond 3 mi of KAFB wells from combined KAFB and SNL/NM water pumpage.

The city of Albuquerque San Juan/Chama Project is projected to begin operation in 2004 (COA n.d. [a]). The project will allow the city of Albuquerque, including Mesa del Sol, to meet its normal water demands from Rio Grande water. Groundwater withdrawals will be used only to supplement these normal demands. All of the city wells will remain online and ready for operation. Which wells will be operated (and how often and how much) has not yet been determined. Therefore, the San Juan/Chama Project has not been included in this analysis. It is expected that the Ridgecrest and Mesa del Sol well withdrawals would be substantially less than quantities used in this analysis.

Potential impacts of continued aquifer drawdown were identified and evaluated for the SWEIS. These were: exceedance of water rights (owned by KAFB); effects on well operations; effects on Pueblo of Isleta wells; effects on springs; and potential for land subsidence.

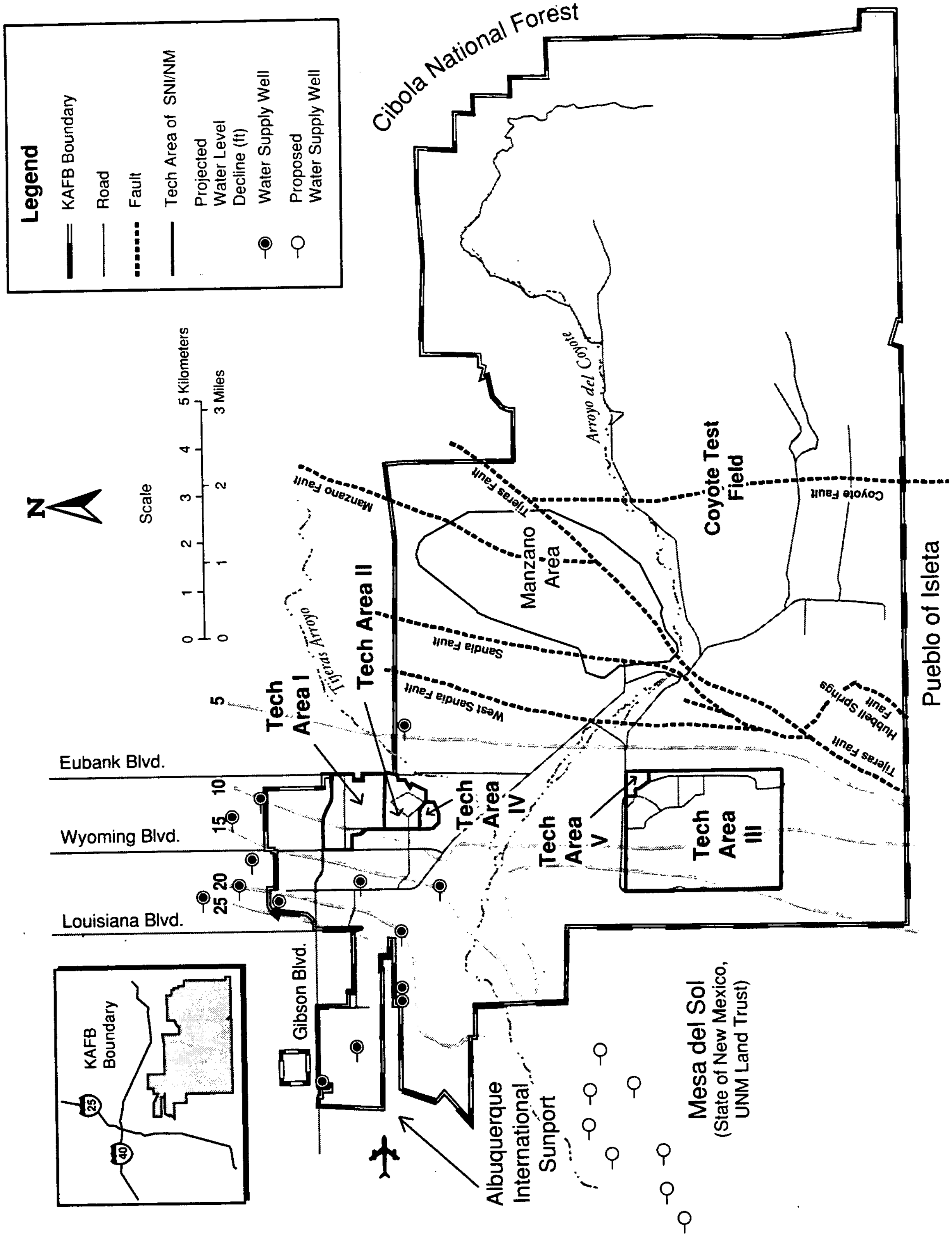
The maximum recent KAFB annual withdrawal was 235.7 M ft^3 (1992) (USGS 1995). KAFB withdrawals have been and are projected to remain significantly below the 278.7 M ft^3 per yr allowed by KAFB water rights (Bloom 1972).

KAFB area wells are typically screened from the water table surface to about 500 ft below the water table (USAF 1975, 1983). The wells are designed specifically for declining water levels with long screens and movable pumps. When groundwater levels drop below the pump, the pump can be lowered until it is submerged again. The pumps are typically installed about 80 ft beneath the water surface and are lowered when they are 20 ft below the water surface. Pumping wells located in areas projected to have 28 ft of decline over the 10-year period,

Table 5.3.4–2. Projected Groundwater Use and Water Level Declines in the Vicinity of KAFB

KAFB AREA CONTRIBUTOR	QUANTITY OF WATER WITHDRAWN IN 10 YEARS (1998 to 2008) (M ft^3)	MAXIMUM DRAWDOWN OVER 10-YEAR PERIOD (1998 to 2008) (ft)	PERCENT OF TOTAL DRAWDOWN CONTRIBUTION NEAR KAFB[a] (%)
Ridgecrest (city of Albuquerque)	3,243	16.8	61
KAFB (exclusive of SNL/NM)	829	4.3	15
SNL/NM	605	3.1	11
Mesa del Sol	683	3.5	13
TOTAL	**5,355**	**27.7**	**100%**

Source: SNL/NM 1998c [see also Appendix B, Table B.2–3]
ft: feet
ft^3: cubic feet
KAFB: Kirtland Air Force Base
M: million
SNL/NM: Sandia National Laboratories/New Mexico
Note: See Appendix B for details regarding calculations.
[a] Local effect (basin-wide effect is less than 1 percent.)



Sources: NMSLO 1997; SNL/NM 1997a, j

Figure 5.3.4–3. Projected Decline in Albuquerque-Belen Basin Groundwater Levels

During the period from 1998 to 2008, groundwater levels at KAFB are projected to decline as much as 28 ft, 11 percent of which would be from SNL/NM water use.

1998 to 2008 would require pump lowering in 22 years. If water was not being withdrawn for SNL/NM use, then the pumps would need to be lowered every 24 years. KAFB has also recently installed two new wells, (early June 1998), KAFB-15 and -16, in the northwest portion of the site. These wells are screened over a 1,000-ft interval from the water table surface, (approximately 500 ft below ground surface) to 1,500 ft below ground surface.

SNL/NM operations would not be expected to have an impact on Pueblo of Isleta wells. The Pueblo of Isleta boundary is approximately 6 mi from the nearest KAFB water supply well. Of the 1-ft water level decline projected at this boundary, up to 1 inch per year (11 percent) would be attributed to SNL/NM operations.

The effect of local drawdown on spring flow was also considered. However, all local springs are east of the fault zone, an area in which groundwater levels are not affected by pumping in the vicinity of KAFB.

The possibility of subsidence due to excess withdrawal was also investigated. The threshold for subsidence has been estimated as 260 to 390 ft of aquifer drawdown (Haneberg 1995) and recently refined to 330 to 490 ft (Haneberg 1997). Adding the almost 28 ft of maximum projected drawdown in the vicinity of KAFB to the basin-wide maximum of 160 ft (USGS 1993), which is actually located about 1 mi north of KAFB (about 2 mi north-northeast of TA-I), suggests that the projected water withdrawal would not result in land subsidence. The potential impacts described above would tend to diminish at greater distances from KAFB.

Summary of Groundwater Quantity Impacts

Although this analysis indicates that no immediate effects of the projected water level decline over the 1998 to 2008 period would be expected, SNL/NM water use would continue to contribute to the depletion of the aquifer. Because the rate of basin-wide groundwater withdrawal significantly exceeds the recharge rate, all groundwater users contribute to this depletion to some degree. SNL/NM's local drawdown effect would be measurable (3 ft over the 1998 to 2008 period), accounting for 11 percent of groundwater decline in the northern portion of KAFB under the No Action Alternative. Because of the magnitude of the effect on local water level decline, SNL/NM's groundwater withdrawal is identified as an adverse impact in the SWEIS.

5.3.4.3 Surface Water Quality

During storm events in 1994 and 1995, SNL/NM collected 32 surface water samples from onsite arroyos (Figure 5.3.4–4). A summary of analytical results from these samples is presented in Section 4.6.2. Contaminants of concern, which include dissolved metals, explosives, and radionuclides, were found only at trace concentrations (SNL/NM 1996g). Of greatest importance to the SWEIS analysis are four surface water samples collected from Tijeras Arroyo within 1 mi of its exit point from KAFB (Figure 5.3.4–4). These samples, collected on July 20 and August 22, 1995, are downstream from all SNL/NM facilities and operations. They represent two different kinds of runoff events: Tijeras Arroyo runoff from the July 20th storm event did not reach the Rio Grande, whereas, the August 22nd storm event had the largest daily average flow measured in Tijeras Arroyo (14 ft^3 per second at the farthest downstream gaging station) of the three days during 1995 when flow reached the Rio Grande (USGS 1998). Therefore, these samples are the best available indicators of what contaminants could reasonably be transported offsite to ultimately enter the Rio Grande approximately 7 mi farther downstream. These sample results show no contaminants above NMWQCC limits for the state-designated Tijeras Arroyo uses (livestock watering and wildlife habitat) (Table 5.3.4–3) (NMWQCC 1994). Furthermore, the August 22nd flow was only 2 percent of the 712 ft^3 per second measured at the nearest upstream gaging station on the Rio Grande for the same date; any contaminants in Tijeras Arroyo storm water runoff would likely be significantly diluted upon reaching the Rio Grande.

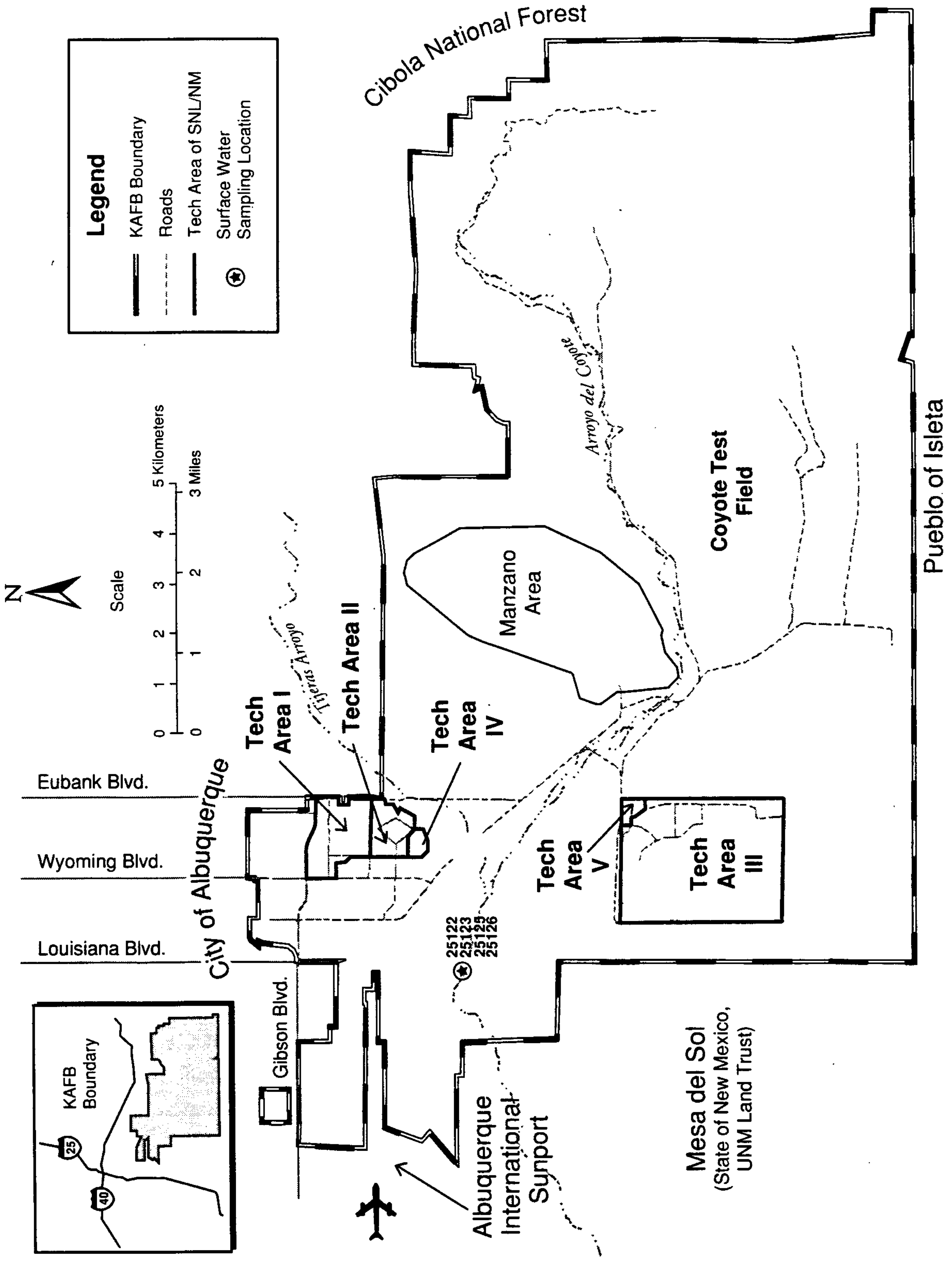
Potential Sources of Surface Water Contamination

Environmental Restoration Project Sites

Cleanup actions planned, underway, or completed at eight ER sites within 0.5 mi of Tijeras Arroyo or Arroyo del Coyote are intended to remove any potential source of surface water contamination, and the cleanup activities themselves are not expected to negatively affect surface water quality (DOE 1996c). The ER Project is scheduled for completion between FY 2003 and FY 2005, depending upon budget availability, with no projected variation in schedule under the No Action Alternative.

Permitted Storm Water Discharge

Surface water sampling results indicate storm water runoff from SNL/NM facilities in TAs-I, -II, and -IV



Sources: SNL 1995c, SNL/NM 1997j

Figure 5.3.4–4. Surface Water Sampling Locations at Tijeras Arroyo

Four surface water samples were collected from Tijeras Arroyo near the exit point from KAFB.

Table 5.3.4–3. Tijeras Arroyo Storm Water Sampling Results Near Downstream Boundary of KAFB (New Mexico Water Quality Control Commission-Listed Contaminants)

PARAMETER	UNITS	SAMPLING LOCATIONS[a]				NMWQCC LIMIT[b]
		25122	25123	25125	25126	
Aluminum	mg/L	0.67	0.048	ND	ND	5.0
Arsenic	mg/L	ND	ND	ND	ND	0.2
Boron	mg/L	NA	NA	NA	NA	5.0
Cadmium	mg/L	ND	ND	ND	ND	0.05
Chromium	mg/L	ND	ND	ND	ND	1.0
Cobalt	mg/L	ND	ND	ND	ND	1.0
Copper	mg/L	ND	0.01	ND	ND	0.5
Lead	mg/L	ND	ND	ND	ND	0.1
Mercury (total)	mg/L	ND	ND	ND	ND	0.000012[c]
Selenium	mg/L	ND	ND	ND	ND	0.002[c]
Vanadium	mg/L	ND	0.006	ND	ND	0.1
Zinc	mg/L	0.16	0.003	ND	ND	25.0
Radium-226, -228	pCi/L	NA	NA	NA	NA	30.0
Tritium	pCi/L	NA	NA	NA	NA	20,000
Gross alpha	pCi/L	NA	NA	NA	NA	15

Sources: NMWQCC 1994, SNL/NM 1996g
mg/L: milligrams per liter
NA: not analyzed
ND: not detected
NMWQCC: New Mexico Water Quality Control Commission
pCi/L: picocuries per liter
[a] Locations shown in Figure 5.3.4–4
[b] Limit for livestock watering use
[c] Limit for wildlife habitat (most stringent)

does not contribute contaminants to Tijeras Arroyo. Under the No Action Alternative, no new activities are forecast in TAs-I, -II, or -IV that would cause contamination of storm water runoff (SNL/NM 1998a). The projected increase in SNL/NM staffing, 5 percent over current levels under the No Action Alternative (Section 5.3.12), could lead to runoff of additional organic compounds (primarily oil and grease) from vehicles in parking lots. The most recent storm water monitoring shows oil and grease concentrations ranging from 0.6 to 1.4 mg/L (SNL 1997d). Although there are no quantitative National Pollutant Discharge Elimination System (NPDES) or state limits for oil and grease, these concentrations are near detection limits. A 5-percent increase in these values would be of no environmental consequence, especially considering dilution that would occur in Tijeras Arroyo during periods of runoff.

Outdoor Testing Facilities

A slight increase in outdoor testing activities is projected under the No Action Alternative, and some types of tests may double (SNL/NM 1998a). However, controls are in place to minimize the amount of soil contamination that could occur during these tests, including posttest surveys and material removal (SNL 1997e). Because no surface water radionuclide concentrations have been detected above background under current test levels, contamination is not anticipated under test levels projected for the No Action Alternative.

5.3.4.4 Surface Water Quantity

Storm Water Runoff

By calculating the difference between runoff that would occur from a natural surface and an impervious surface, the net contribution of SNL/NM to runoff can be established. The percentage of rainfall that runs off natural surfaces at SNL/NM is estimated at 10 to 35 percent (SNL/NM 1997a), varying with factors such as slope, vegetation, and soil type. For this analysis, the increase in storm water runoff at SNL/NM was estimated by assuming that 100 percent of rainfall would run off areas with buildings and parking lots. Although the actual runoff percentage would be less because of pooling and evaporation of water on these surfaces, the 100-percent assumption provides a maximum estimate (greatest environmental effect) for the SNL/NM contribution to surface water quantity. The lower estimate of 10 percent was used for natural runoff, also to provide a maximum estimate of the SNL/NM contribution to storm water runoff. The calculations used in this analysis are shown in Appendix B.

The developed (impervious) area of SNL/NM is estimated to be 0.72 mi^2. This analysis indicates that SNL/NM contributes no more than 5 percent of the flow in Tijeras Arroyo. The maximum increase in annual surface runoff due to the presence of SNL/NM is estimated to have ranged from approximately 100,000 to 700,000 ft^3 from 1993 through 1995. These flows represent small fractions (0.0001 to 0.001 percent) of the annual Rio Grande flow above its confluence with Tijeras Arroyo.

Under the No Action Alternative, only minor net changes in building and parking lot areas would be anticipated. Annual variations in SNL/NM surface runoff would be likely; however, the overall impact would be minimal.

Discharge to Sanitary Sewer

During 1996, 37.4 M ft^3 (280 M gal) of SNL/NM process and sanitary sewage water were discharged to the city of Albuquerque's Southside Water Reclamation Plant (SNL/NM 1997a). This water, which is treated and then discharged to the Rio Grande, 0.7 mi upstream of the river's confluence with Tijeras Arroyo, contributes approximately 0.06 percent to the 60.5-B-ft^3 annual average flow (upstream of the water reclamation plant) measured from 1993 through 1995 (USGS 1998).

Under the No Action Alternative, annual discharge to the sanitary sewer would be expected to increase slightly from the 1996 level to 40.6 M ft^3 (304 M gal). This would result in a contribution to Rio Grande flow of 0.07 percent. SNL/NM management has committed to a 30-percent reduction in water use by 2004 (SNL/NM 1997a). A decrease in the quantity of water discharged to the reclamation plant would be expected under this plan.

Based on this analysis, the total annual contribution of water to the Rio Grande from SNL/NM, including surface water runoff and discharge to the Southside Water Reclamation Plant, would be between 40.7 and 41.3 M ft^3 under the No Action Alternative. The vast majority of this contribution (40.6 M ft^3) would come from discharge to the water reclamation plant. The total SNL/NM contribution would be approximately 0.07 percent of the average annual Rio Grande flow. No discernible effects to the Rio Grande would be likely from the quantity of SNL/NM water discharged.

5.3.5 Biological and Ecological Resources

Implementation of the No Action Alternative would cause minimal impacts to biological and ecological resources. The ROI for biological resources consists of KAFB, the Withdrawn Area, buffer zones associated with operations in TA-III, and any adjacent lands that the No Action Alternative would affect.

Biological resources could be influenced by construction activities or outdoor operations that result in noise, projectiles, off-road vehicular traffic, unintended fires, and plumes of smoke. Radionuclides or chemicals could also be released from potential accidents or normal operations.

SNL/NM operations in TAs-I, -II, and -V would continue to occur primarily within buildings. Under the No Action Alternative, any proposed construction was analyzed and approved in separate NEPA documents (see Section 1.7): *Environmental Assessment for the Processing and Environmental Technology Laboratory* (DOE 1995d); *Environmental Assessment for Operations, Upgrades, and Modifications in SNL/NM Technical Area IV,* (DOE 1996g); *Neutron Generator/Switch Tube (NG/ST) Prototyping Relocation Environmental Assessment,* (DOE 1994a); and the *Environmental Assessment for the Radioactive and Mixed Waste Management Facility,* (DOE 1993a). Small areas of vegetation would be removed as a result of some of these projects, but the viability of the plant communities would not be affected. Proposed activities would likely result in the local displacement of wildlife; however, the impact would be minimal and temporary.

Wildlife species at KAFB are representative of those present in the areas surrounding KAFB. From observation, wildlife appears to have become accustomed to the noise and activities that currently exist. Data from raptor surveys at KAFB support this observation, because some raptor species at KAFB return to the same nest sites each year. For example, the western burrowing owl and Swainson's hawk migrate to KAFB to breed in the same nests (USAF 1997b).

A 1997 raptor survey was conducted for the USAF as part of its Management Strategies on KAFB and the Withdrawn Area of the Cibola National Forest. A total of 59 raptors were observed (USAF 1997b). Burrowing owls constituted 49 percent of the observations. No peregrine falcons were observed in the survey.

The USFS completed its ecosystem management plan for the Withdrawn Area in March, 1996 (USFS 1996). This study confirmed that there has been no positive identification of a peregrine falcon to date.

Outdoor activities at TA-III and the Coyote Test Facility would continue to affect small localized areas. At the Aerial Cable Facility, 2.2-lb antitank skeet warheads would continue to be detonated. Small fragments of explosive test debris and shrapnel would potentially be dispersed over a 1,200-ft radius (SNL/NM 1998a). Such debris would have a minimal impact on the mortality or distribution of plants and animals. At the Lurance Canyon Burn Site, tests using fire are conducted in outdoor pools, the largest of which is 1,800 ft^2 (SNL/NM 1998a). Normal operations at these sites would potentially result in unintended fires of limited areal extent. As a result, a temporary loss of vegetation would occur. A few one-seed junipers and grasses would potentially be lost in a fire. Desert shrubs are only marginally affected by fire (Dick-Peddie 1993). Perennial grasses appear to recover from fire less effectively than shrubs or forbs (Dick-Peddie 1993). However, the immediate effects on perennial grasses may last only 1 or 2 years (Cable 1967). Although relationships between fire and vegetation are complex, it is unlikely that fires or their suppression have had much effect on the scrublands or nonmontane grasslands of New Mexico (Dick-Peddie 1993). Individuals of the grama grass cactus, a USFS sensitive species, would possibly be destroyed in a fire, but seeds would survive (PSL 1992). The population would recover, and the temporary impact on this species would be minimal.

Normal operations at the Lurance Canyon Burn Site would result in large plumes of carbon particulates that would extend thousands of feet into the air (SNL/NM 1998a). These smoke plumes would be of short duration and would temporarily displace birds.

Under the No Action Alternative, there would be no impact on springs or wetlands, including the Burn Site Spring, the only spring or wetland on land used by SNL/NM.

Under the No Action Alternative, the federally endangered peregrine falcon would not be affected. There would not be a loss, gain, or degradation to the habitat of peregrine falcons. While peregrine falcons are regular spring migrants along ridge lines of the Sandia and Mazano Mountains, only one probable sighting of a peregrine falcon, which was likely migrating, has been documented during surveys on the KAFB. No evidence of nesting has been found on KAFB, which has marginal nesting potential (USAF 1995d). Prey availability for any migrating falcons would also not be affected by continued and planned operations. Impacts to other protected or sensitive species, or both, would be negligible.

On August 25, 1999, the USFWS delisted the American peregrine falcon from the Federal list of endangered and threatened wildlife. The USFWS has determined that this species has recovered following restrictions on the use of organochlorine pesticides (dichloro-diphenyl-trichloroethane [DDT]) in the United States and Canada, and following the implementation of successful management activities (64 FR 46541).

Ecological risks of the DOE's ongoing environmental restoration activities were analyzed in the *Environmental Assessment of the Environmental Restoration Project at SNL/NM* (DOE 1996c). Results indicate that removing soil that has been contaminated by radioactive or hazardous materials would reduce the potential for exposure of animals and plants to these contaminants and any associated ecological risk. Corrective actions could generate contaminated dust and subsequent exposure of small mammals and plants to radionuclides, cadmium, chromium, and lead. The predicted exposures were well below the benchmark levels, above which adverse effects are a potential concern. This indicates that biota would be at minimal risk for adverse effects from contaminated dust and radiation (DOE 1996c).

Annual ecological monitoring of small mammal, reptile, amphibian, bird, and plant species at selected sites does not show significant contaminant loads of radionuclides or metals in the individuals tested (SNL/NM 1997u). This indicates that no significant contaminant loadings of radionuclides or metals would likely be found in biota traveling across the boundaries between the KAFB and the Pueblo of Isleta. Ecological risks to plants and animals would continue to be further assessed using a phased approach outlined by the EPA (SNL/NM 1998w). The exposures of indicator plant and animal species to constituents of potential ecological concern would be modeled in order to calculate hazard quotients. For example, perennial grasses, small mammals, and insects would be collected at selected ER sites and analyzed for the concentrations of selected metals, included uranium and lead (SNL/NM 1998w). No significant increases in contaminant loads of radionuclides or chemicals would be expected in plants or animals at KAFB under the No Action Alternative. Removal of contaminated soil would result in a short-term loss of vegetation and disturbance of wildlife.

Inventory and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to protect the animals, plants, and sensitive species on KAFB.

5.3.6 Cultural Resources

The implementation of the No Action Alternative would have low to negligible impacts to cultural resources due to 1) the absence of cultural resource sites on DOE-administered land, 2) the nature of the cultural resources found in the ROI (see Appendix C), 3) compliance with applicable regulations and established procedures for the protection and conservation of cultural resources located on lands administered by the DOE and on lands administered by other agencies and used by the DOE (see Section 4.8.3.2 and Chapter 7), and 4) the largely benign nature of SNL/NM activities near cultural resources. Implementation of the regulations and procedures would make unlikely any adverse impacts resulting from construction, demolition, decontamination, renovation, or ER Project activities.

No impacts would be anticipated to DOE buildings constructed during World War II or the Cold War era, some of which are eligible or potentially eligible for listing on the National Register of Historic Places (NRHP). Although some buildings on DOE-owned land have been assessed for eligibility, most have not because of their young age. Some of the buildings at SNL/NM have been proposed for decontamination, renovation, or demolition. Before any building is subjected to these activities, the DOE would assess the eligibility of the building for placement on the NRHP and, in consultation with the New Mexico SHPO, would determine if the activities would have an impact on an eligible building. This assessment would include determining measures to mitigate or avoid any potential impacts to eligible buildings.

Under the No Action Alternative, prehistoric and historic cultural resources could potentially be affected by activities performed at five SNL/NM facilities, although the potential for impact is low to negligible. These facilities consist of the Aerial Cable Facility, Lurance Canyon Burn Site, Thunder Range, Sled Track Complex, and Terminal Ballistics Complex. The first three facilities are located on land not owned by the DOE. Impacts could potentially result from three activities at these facilities: production of explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires and fire suppression. Another source of potential impact derives from the restricted access present at KAFB and individual SNL/NM facilities. Discussions of potential impacts follow and are organized by impact source.

5.3.6.1 Explosive Testing Debris and Shrapnel

One source of potential impact to cultural resources would be explosive testing debris and shrapnel (referred to as debris) produced by outdoor explosions. Such explosions could cause the impact of airborne debris on cultural materials or the presence of debris on cultural resource sites. Activities at two SNL/NM facilities—the Aerial Cable Facility and the Lurance Canyon Burn Site—would have the potential for impacts to cultural resources due to debris from outdoor explosions. The potential for impacts would be low for both facilities, as explained below.

Activities at the Aerial Cable Facility would include testing antitank skeet warheads weighing approximately 2.2 lb. During the tests, which would be conducted in target areas that have previously been disturbed, the warheads would explode, dispersing debris (SNL/NM 1998a). Studies conducted at Los Alamos National Laboratory (LANL) for explosive tests measuring up to 500 lb have shown that debris primarily tend to fall within 800 ft of the firing site and no particles fall outside 1,200 ft (DOE 1998a).

No archaeological sites are located within an 800-ft radius of the Aerial Cable Facility. One eligible archaeological site is located within a 1,200-ft radius, where debris would be likely to fall less frequently. Both the position of this site on a hill slope facing away from the facility and the surrounding vegetation would act to reduce both the velocity and amount of debris that could reach the site, thereby lowering the already low probability for impacts caused by debris. Dense pinyon and juniper trees and shrubs are present in the area, which would help protect the archaeological resource from airborne debris. Field observations conducted at this archaeological site in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects that could be attributable to flying debris and no debris was identified on the site. Based on these studies, the probability of this one archaeological site being affected by flying debris from the facility would be low.

Activities at the Lurance Canyon Burn Site could result in unintended explosions that could disperse debris. Four archaeological sites (all NRHP eligible) are located within 800 ft of the facility and three archaeological sites (two eligible and one potentially eligible) are within the 800- to 1,200-ft range. For the same reasons stated above for the Aerial Cable Facility, the potential for impacts to these sites from debris would be low. In addition, for some burn tests at the Lurance Canyon Burn Site, barriers are erected around test sites to contain fragments in the event of an unintended explosion, thereby reducing the already low potential for impacts to cultural resources. Field observations conducted at these seven archaeological sites in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects that could be attributable to debris.

5.3.6.2 Off-Road Vehicle Traffic

Off-road vehicle traffic would be another possible source of impact to cultural resources. Activities at Thunder Range would sometimes require off-road vehicle travel to place objects for object detection activities, although most targets and reflectors would be placed along existing dirt roads and would usually not require off-road travel. There is one potentially eligible archaeological site on Thunder Range near a dirt road. Off-road vehicle travel could physically affect this site; however, personnel working in the area are aware of its location and the need to avoid it. Therefore, the potential for impacts to this site would be negligible. Field observations conducted at this site in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects due to off-road vehicle travel.

5.3.6.3 Unintended Fires and Fire Suppression

Fires and fire suppression activities can cause physical damage to cultural resources. After a fire, the lack of vegetation can allow sheet-washing during rainstorms, thereby eroding exposed resources and causing further physical damage. Activities at four facilities—the Terminal Ballistics Complex, Sled Track Complex, Aerial Cable Facility, and Lurance Canyon Burn Site—would have the potential to ignite accidental outdoor brush fires. However, the potential for subsequent impacts to cultural resources would be low to negligible for a number of reasons. First, fires would be expected to occur close to the originating facility. Personnel would be aware of the potential for such fires and trained to spot and extinguish them. Second, personnel would access the fire on foot and suppress it using portable chemical extinguishers or extinguishing blankets. Third, SNL/NM and the DOE would coordinate with KAFB and the USFS monthly to review scheduled activities with regard to the current fire hazard conditions and to determine if activities should be coordinated on a day-to-day basis (when the fire hazard is high). The Terminal Ballistics Complex and the Sled Track Complex are 1 mi or more away from any known cultural resources; thus, the probability for unintended fires and fire suppression activities from these facilities to affect these resources would be negligible. The other two facilities, the Aerial Cable Facility and the Lurance Canyon Burn Site, are in areas that contain many archaeological sites, with some sites located within 1,200 ft of the facilities. However, due to the training of personnel to identify and extinguish fires quickly, access them on foot, and use fire suppression methods that minimize ground disturbance, the probability for impacts to the archaeological sites at these two facilities would remain low.

5.3.6.4 Restricted Access

Restriction of access to areas within the ROI would have positive effects on cultural resources themselves. Under the No Action Alternative, current KAFB security levels that restrict access would remain. Additional access restrictions would be enforced at specific SNL/NM facilities during various activities. These restrictions would result in an increased level of protection for cultural resources in the ROI and particularly in the facility secure zones.

Consultations to identify TCPs were conducted. Fifteen Native American tribes have been contacted to determine the presence of TCPs in the ROI. Some tribes who traditionally used the area surrounding and including KAFB consider certain categories of features to be TCPs because of their sacred or religious association with the group or their use by the group in traditional lifeways. These features, which are present in the ROI, include archaeological sites, human burials, springs and other water sources, minerals, vegetation, and animals. However, no specific TCPs have been identified through these consultations and no TCPs are currently known to exist within the ROI. Consultations will continue with some of the tribes. If specific TCPs are identified in the future, any impacts of SNL/NM activities on the TCP and any impacts of restricting access to the TCP would be determined in consultation with Native American tribes.

5.3.7 Air Quality

The implementation of the No Action Alternative would continue the nonradiological and radiological emissions (Sections 5.3.7.1 and 5.3.7.2, respectively) from SNL/NM facilities. These emissions would continue to be well within the applicable standards for public and worker health and safety.

5.3.7.1 Nonradiological Air Quality

Local, state, and Federal regulations require Federal agencies to assess the effect of their activities on ambient air quality. Under Section 176 (c) of the *Clean Air Act* (CAA), each Federal agency has an affirmative responsibility to ensure that the agency's activities conform to state implementation plans designed to achieve and maintain the NAAQS.

Air emissions were assessed for compliance with the NAAQS, and the NMAAQS, and the Albuquerque/ Bernalillo County Air Quality Control Board (A/BC AQCB) regulations for criteria pollutants and guidelines for chemical concentrations. The A/BC AQCB enacted the General Conformity Regulation in November 1994 in the Air Quality Control Regulation (20 NMAC 11.04). A final Federal rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans* was promulgated by the EPA on November 30, 1993 (58 FR 63214), and took effect on January 31, 1994 (40 CFR Parts 6, 51, and 93). This Federal rule established the conformity criteria and procedures necessary to ensure that Federal actions conform to the appropriate state implementation plan (SIP) and meet the provisions of the CAA until the required conformity SIP revision by the state is approved by the EPA. In general, the final rule ensures that all criteria air pollutant emissions and volatile organic compounds (VOCs) are specifically identified and accounted for in the SIP's attainment or maintenance demonstration. This final rule establishes the criteria and procedures governing the determination of conformity for all Federal actions, except Federal highway and transit actions ("transportation conformity"). In addition, at the state level are the provisions of *Conformity of General Federal Actions to the State Implementation Plan* passed on December 14, 1994, which echo the Federal conformity rule. These conformity regulations apply to nonattainment or maintenance areas for criteria pollutants. Bernalillo county is currently classified as a maintenance area for carbon monoxide and therefore these regulations apply to the current Federal actions at SNL/NM.

Criteria Pollutants

The nonradiological air quality for criteria pollutants at SNL/NM under the No Action Alternative is represented by 1996 baseline sources, plus those criteria pollutants sources expected to become operational by 2008. The criteria pollutants include PM_{10}, sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, TSP, and ozone. The No Action Alternative provides for SNL/NM to operate at current planned levels, which would include emission sources that are planned or under construction. These planned sources include a boiler designated by the Albuquerque Environmental Health Department (AEHD) as "insignificant," an emergency generator in Building 701 (currently under construction), and a 600-kw-capacity generator in Building 870b.

Following are the criteria pollutant sources included in the modeling analysis under the No Action Alternative:

- the steam plant,
- the electric power generator plant,
- a boiler and an emergency generator in Building 701, and
- the 600-kw-capacity generator in Building 870b.

> **"Insignificant" Source**
>
> **An "insignificant" source is a source that is listed by the Albuquerque Environmental Health Department (AEHD) or approved by the [EPA] Administrator as insignificant on the basis of size, emissions, or production rate.**
>
> Source: 20 NMAC 11.42

The Lurance Canyon Burn Site is an additional source of criteria pollutants. This source is a noncontinuous source, spatially separated from those listed above, and is, therefore, addressed separately within the fire testing facilities section that follows.

The estimated emissions of criteria pollutants under the No Action Alternative were modeled using the EPA-recommended *ISCST3* (version 97363) model to estimate concentrations of criteria pollutants at or beyond the SNL/NM boundary, including receptor locations such as public access areas (for example, the National

Atomic Museum, hospitals, and schools). Onsite hourly meteorological data from meteorological tower A15 for 1995 and 1996 and from meteorological tower A21 for 1994, 1995, and 1996, were used to perform the modeling. Figure 5.3.7–1 shows the locations of the two meteorological towers in the vicinity of TA-I.

Modeling results for nitrogen oxides using *ISCST3* for the 24-hour and annual averaging periods are 0.19 ppm (300 $\mu g/m^3$) and 0.02 ppm (28 $\mu g/m^3$), respectively. The NMAAQS standards for nitrogen dioxide for the 24-hour and annual averaging periods are 0.10 ppm (156 $\mu g/m^3$) and 0.05 ppm (78 $\mu g/m^3$), respectively. The modeling results indicate that the nitrogen oxides 24-hour concentrations exceed the NMAAQS standard for nitrogen dioxide. If the nitrogen oxides concentration is below the NMAAQS standard for nitrogen dioxide, then no further analysis is necessary to show compliance with the standard. Since the nitrogen oxides concentration is above the standard, a second step must be undertaken to show compliance. The second step implements the OLM to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions.

Receptor Location

A receptor location is a location at which any individual may be affected by SNL/NM activities.

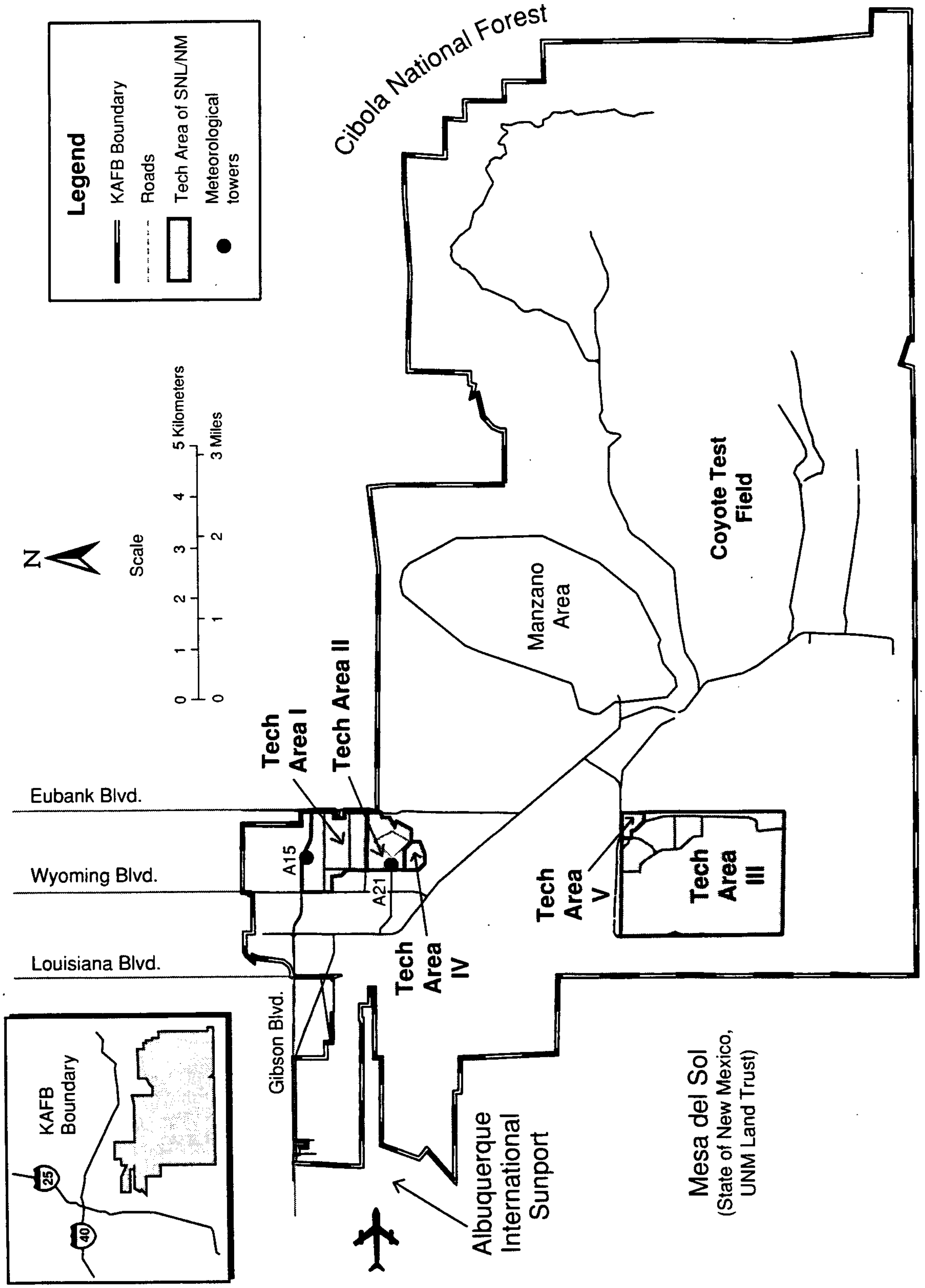
The New Mexico Air Quality Bureau has approved the OLM to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions. A detailed description of the OLM is presented in Appendix D. The OLM results in a modeled annual average concentration of nitrogen dioxide of 0.006 ppm (10 $\mu g/m^3$) and a 24-hour average concentration of 0.066 ppm (103.7 $\mu g/m^3$). The OLM requires that background nitrogen dioxide concentrations be added to the model-calculated nitrogen dioxide concentrations to obtain a representative concentration of nitrogen dioxide. The maximum 24-hour average concentration of nitrogen dioxide at the chosen background station in 1996 was 0.029 ppm (46 $\mu g/m^3$); the annual average concentration was 0.008 ppm (13 $\mu g/m^3$). The future contribution from the Cobisa Power Station, located approximately 5 mi west of SNL/NM, will add to the annual average background concentration of nitrogen dioxide at the monitoring station. The calculated maximum incremental annual average nitrogen dioxide concentration from this facility will be 1.1 $\mu g/m^3$. These values, added to the modeled values of nitrogen dioxide, are reported in Table 5.3.7–1.

Potential increases in the background for other criteria pollutants, due to the Cobisa Power Station, are also included. The maximum criteria pollutant concentrations at a public access area outside of the SNL/NM fence occurred at the National Atomic Museum. Table 5.3.7–1 presents the criteria pollutant concentrations of carbon monoxide, nitrogen dioxide, PM_{10}, TSP, and sulfur dioxide resulting from the modeling analysis, and maximum measured monitoring data for lead and ozone. In addition,

What is a Background Concentration?

Manufacturing processes may produce toxic, hazardous, and radioactive substances, either directly or as byproducts. However, many of these substances also occur naturally and can be found in air, water, and soils. Examples include: volatile chemicals produced by forests and phytoplankton; radioactive nuclides, such as uranium, radium, tritium, and beryllium, created by cosmic radiation; and all nonradioactive metals such as lead, chromium, nickel, and arsenic. In order to determine the amount of these substances in the environment resulting from human activity, it is necessary to subtract the naturally occurring or background concentrations from the concentrations measured in a finite number of environmental samples. Because background concentrations can vary substantially over an area and with depth, a difference between sample and background concentrations does not necessarily demonstrate that contaminants have been introduced into the environment.

Determining whether concentrations of metals or radionuclides are the result of contaminants introduced into the environment tends to be more problematic than situations involving volatile chemicals. Various metals and radionuclides occur naturally in measurable concentrations, and the amount of contamination introduced is often relatively small compared to the background values. To aid in the interpretation of metal and radionuclide concentrations in samples, SNL/NM conducted a study of background concentrations at KAFB (SNL/NM 1996e). Using more than 3,700 samples, SNL/NM demonstrated the variation in natural concentrations of 20 metals and 9 radionuclides in different regions of KAFB. This study was the basis for developing a set of agreed-upon maximum background concentrations with the NMED.



Source: SNL/NM 1997a

Figure 5.3.7–1. Locations of Meteorological Towers Used for Criteria Pollutant Modeling

Two meteorological towers (A15 and A21) in the TA-I vicinity were used to perform modeling for criteria pollutants.

Table 5.3.7-1. Criteria Pollutant Concentrations from SNL/NM Stationary Sources and Background with Applicable National and New Mexico Ambient Air Quality Standards Under the No Action Alternative

POLLUTANT (SNL/NM [Tons/yr])	AVERAGE TIME	NAAQS (ppm[$\mu g/m^3$])	NMAAQS (ppm[$\mu g/m^3$])	NO ACTION CONCENTRATION (ppm[$\mu g/m^3$])	BACKGROUND CONCENTRATION (ppm[$\mu g/m^3$])	TOTAL CONCENTRATION (ppm[$\mu g/m^3$])	PERCENT OF STANDARD[i]
Carbon Monoxide (18.36)	8 hours	9[8,564]	8.7[8,279]	0.08[78.4]	4.9[4,663][g]	4.98[4,741]	57
	1 hour	35[33,305]	13.1[12,466]	0.13[119]	8.0[7,613][g]	8.1[7,732]	62
Lead	Quarterly	1.5[a]	-	0.001[a,b]	-	0.001[a,b]	0.07
Nitrogen Dioxide (162.36)	Annually	0.053[83]	0.05[78]	0.006[10.0]	0.009[14.1][f,g]	0.015[24.1]	30
	24 hours	-	0.10[156]	0.066[103.7]	0.029[46][f,g]	0.096[149.7]	96
TSP (7.46)	Annually	-	60[a]	11.4[a]	30[h]	41.4[a]	69
	30 days	-	90[a]	NA	NA	NA	NA
	7 days	-	110[a]	NA	NA	NA	NA
	24 hours	-	150[a]	114.2[a]	30[h]	144.2[a]	96
PM_{10}[d] (7.46)	Annually	50[a]	-	11.4[a]	30[h]	41.4[a]	83
	24 hours	150[a]	-	114.2[a]	30[h]	144.2[a]	96
Sulfur Dioxide (1.10)	Annually	0.03[65]	0.02[44]	0.0008[1.7]	0.00005[0.12][f]	0.00085[1.82]	4
	24 hours	0.14[305]	0.10[218]	0.006[12.2]	0.0008[1.7][f]	0.006[13.9]	6
	3 hours	0.50[1,088]	-	0.01[21.1]	0.006[13.5][f]	0.016[34.6]	3
Ozone[e]	1 hour	0.12[196]	-	0.103[168][c]	-	0.103[168][c]	86
Hydrogen Sulfide	1 hour	-	0.01/12	NA	-	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03/33	NA	-	NA	NA

Sources: 20 NMAC 2.03, 40 CFR Part 50, NMAPCB 1996, SNL/NM 1997d
mg/m^3: micrograms per cubic meter
CPMS: criteria pollutant monitoring station
NA: Not Available
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: Particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] mg/m^3
[b] Highest quarterly lead monitoring data measured at the CPMS site in 1996
[c] Highest 1-hour ozone monitoring data measured at the CPMS site in 1996
[d] PM_{10} assumed equal to TSP
[e] A new 8-hour, 0.08-ppm ozone standard is replacing the previous 1-hour, 0.12-ppm ozone standard based on the most recently available 3 years of ozone data. SNL/NM might not be in compliance with this standard in the year 2000 when the EPA will designate areas that do not meet the 8-hour standard.
[f] Background concentrations resulting from operation of the Cobisa Power Station
[g] 1996 maximum background concentrations from monitoring station 2R and/or 2ZR/2ZQ.
[h] Background PM_{10} values for 24-hour and annual PM_{10} cumulative impacts (NMAPCB 1996).
[i] Represents SNL/NM contribution plus background as a percent of standard.
Note: The standards for some of the pollutants are stated in ppm. These values were converted to mg/m^3 with appropriate corrections for temperature (530 degrees Rankin) and pressure (elevation 5,400 feet) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Table 5.3.7–2. Incremental Criteria Pollutant Concentrations from SNL/NM Stationary Sources with Applicable National and New Mexico Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	NAAQS (ppm[μg/m³])	NMAAQS (ppm[μg/m³])	INCREMENTAL CONCENTRATION (ppm[μg/m³])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.03[29.7]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.2[164.7]	1.3
Lead	Quarterly	1.5[a]	-	NA	NA
Nitrogen Dioxide[b]	Annual	0.053[83]	0.05[78]	0.001[1.1]	1.4
	24 hours	-	0.10[156]	0.02[12.2]	7.8
TSP	Annual	-	60[c]	0.1[a]	< 1
	24 hours	-	150[c]	1.2[a]	< 1
PM_{10}[c]	Annual	50[a]	-	0.1[a]	< 1
	24 hours	150[a]	-	1.2[a]	< 1
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	0.0001[0.23]	< 1
	24 hours	0.14[305]	0.10[218]	0.001[2.7]	1.2
	3 hours	0.50[1,088]	-	0.007[15.1]	1.4
Ozone	Annual	-	-	NA	NA
	1 hour	0.12[196]	-	NA	NA
Hydrogen Sulfide	1 hour	-	0.01[12]	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03[33]	NA	NA

Sources: 20 NMAC 2.03, 40 CFR Part 50, NMAPCB 1996, SNL/NM 1997d
- indicates no standard for listed averaging time
μg/m³: micrograms per cubic meter
°R: degrees Rankin
ft: feet
NA: Not Available
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
OLM: ozone limiting method
PM_{10}: Particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] μg/m³
[b] The OLM was employed to calculate the nitrogen dioxide component of the nitrogen oxides concentration.
[c] PM_{10} assumed equal to TSP
Note: The standards for some of the pollutants are stated in ppm. These values were converted to μg/m³ with appropriate corrections for temperature (530°R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

the table presents the applicable Federal (40 CFR Part 50) and New Mexico state (20 NMAC 2.3) standards for each pollutant.

As shown in Table 5.3.7–1, the maximum concentrations for three criteria pollutants (nitrogen dioxide, TSP, and PM_{10}) were calculated to be within 96 percent of (or 4 percent below) the Federal and state regulatory agency standards for a 24-hour period. These standards, in general, are set to provide for an ample margin of safety below any pollutant concentration that might be of concern.

The methodology used in the criteria pollutant analysis also produces maximum concentration projections that are very conservative. For example, 100 percent of the maximum concentration of air pollutants projected for Cobisa Power Station (located 5 mi west of the National Atomic Museum) was added to the background concentration calculated for the Steam Plant location (near the museum). Also, the maximum concentrations of air pollutants, from a monitoring station measuring contributions from the surrounding community that are dominated by traffic emissions, were added to the worst-case contribution of pollutants from operating SNL/NM's diesel fuel-powered backup generators and fuel oil-powered Steam Plant boilers. Consequently, though close to the thresholds, these calculated concentrations for nitrogen dioxide, TSP, and PM_{10} are considered to be very conservative.

Table 5.3.7–2 presents the modeled incremental criteria pollutant concentrations representing only those new sources expected to become operational by 2008: an "insignificant" boiler and emergency generator in Building 701 and a 600-kw-capacity generator in Building 870b. These new sources are included in the concentrations presented in Table 5.3.7–1 and are presented separately in Table 5.3.7–2 to demonstrate the small incremental increase expected from these sources.

Table 5.3.7–1 presents carbon monoxide concentrations from stationary sources at SNL/NM, while carbon monoxide emissions from mobile (vehicular) sources are presented separately. Monitoring data best represent the combined impact of carbon monoxide emissions from these two sources, and the ambient concentrations of these pollutants are also provided in the table. On June 5, 1998, SNL/NM became subject to a new 8-hour, 0.08-ppm ozone standard, replacing the previous 1-hour, 0.12-ppm ozone standard (63 FR 31034). In the year 2000, the EPA will designate areas that do not meet the 8-hour standard based on the most recently available 3 years of ozone data available at that time (such as 1997 through 1999).

The modeling results presented in Table 5.3.7–1 indicate that the No Action Alternative criteria pollutant concentrations would be below the most stringent standards, which define the pollutant concentrations below which few adverse impacts to human health and the environment are expected. Appendix D contains the assumptions and model input parameters used to calculate the criteria pollutant concentrations presented in Table 5.3.7–1.

Mobile Sources

The model projected carbon monoxide emissions from mobile sources (motor vehicles) from SNL/NM commuter traffic, including on-base vehicles, would be 3,489 tons per year for 2005 (SNL 1996c), which is 598 tons per year below the 1996 baseline. These projections of carbon monoxide emissions are based on estimates of 13,582 vehicles per day entering SNL/NM, a 30 mi-per-day-per-vehicle average commuting distance, and 261 working days per year. The EPA mobile source emission factor model, *MOBILE5a*, was used to project emission factors for the years from 1996 through 2005. The resulting emission factors show a reduction in carbon monoxide emission rates for each successive year. The reduction is based on the model assumption that future vehicles will have inherently lower emission rates and that more stringent inspection and maintenance programs will maintain the lower rates. The trend of lower carbon monoxide emissions projected from SNL/NM would also occur for a similar mix of vehicles operating in the Bernalillo county area due to improvements in vehicle fleet emissions. Projected carbon monoxide emissions for Bernalillo county for 2005 would be 206 tons per day, or 75,190 tons per year (AEHD 1998). The contribution of carbon monoxide emissions from vehicles commuting to and from SNL/NM and from SNL/NM-operated on-base vehicles in 2005, as a percent of the total county highway mobile sources carbon monoxide emissions, would be 4.6 under the No Action Alternative.

Total carbon monoxide emissions are shown in Table 5.3.7–3. Estimates of future construction activities include use of small diesel generators, air compressors, front-end loaders, dozers, and dump trucks. Emissions for the construction activities have been estimated based on exhaust pollutant estimates for diesel construction equipment.

Table 5.3.7–3. Carbon Monoxide Emissions from SNL/NM Under the No Action Alternative (Tons per Year)

STATIONARY SOURCES	MOBILE SOURCES	CONSTRUCTION ACTIVITIES	LURANCE CANYON BURN SITE	TOTAL
18.36[a]	3,489	132	0.78[b]	3,640.14

Sources: SNL/NM 1998a, SNL 1996c

[a] Includes incremental carbon monoxide emissions from an "insignificant" boiler and emergency generator in Building 701 and a 600-kw-capacity generator in Building 870b added between 1996 and 2008.

[b] The number of tests at the Lurance Canyon Burn Site for the No Action Alternative are projected to be equal to those in 1996.

Total carbon monoxide emissions for the No Action Alternative are 598 tons per year less than the 1996 baseline, well below the 100 tons/year incremental increase above baseline that would require a conformity determination. In addition, the total carbon monoxide emissions for the No Action Alternative were found to be approximately 2.7 percent of the maintenance area's emissions of carbon monoxide. As a result, the DOE has concluded that no conformity determination is required for the No Action Alternative.

Lurance Canyon Burn Site

SNL/NM uses the Lurance Canyon Burn Site to test the responses of shipping containers, aerospace components, and other items to high-temperature conditions. Concentrations of pollutants from operations at the fire testing facilities under the No Action Alternative are represented by the emissions from the 42 tests performed during 1996. These tests consumed 10,400 gal of JP-8 aviation fuel and other aviation fuels and 16,050 lb of sawdust (or wood) (SNL/NM 1997a).

The largest of the tests, consuming 1,000 gal of JP-8 fuel, was used to represent the test with the maximum emissions for purposes of modeling. Concentrations of pollutants resulting from test emissions were calculated using the *OBODM* model (Bjorklund et al. 1997). The results for the criteria pollutants are presented in Table 5.3.7–4, along with the applicable Federal (40 CFR Part 50) and New Mexico state (20 NMAC 2.3) standards for each pollutant. Emissions of criteria pollutants resulting from activities at the Lurance Canyon Burn Site are presented in Table 4.9–2.

A total of 89 chemical pollutants resulting from the tests were also evaluated. Each of these pollutants was compared with the respective occupational exposure limit (OEL)/100 guideline, and each of the comparisons indicates that the chemical concentrations are below the guideline. Table D.1–31 in Appendix D contains the list of chemical emissions resulting from tests at the Lurance Canyon Burn Site.

Table 5.3.7–4. Criteria Pollutant Concentrations from the Lurance Canyon Burn Site with Applicable National and New Mexico Ambient Air Quality Standards Under the No Action Alternative

POLLUTANT	AVERAGE TIME	NAAQS (ppm[μg/m^3])	NMAAQS (ppm[μg/m^3])	NO ACTION CONCENTRATION (ppm[μg/m^3])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.023[21.45]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.18[171.6]	1.4
Nitrogen Dioxide	Annual	0.053[83]	0.05[78]	6.4×10^{-7}[0.001]	< 1
	24 hours	-	0.10[156]	1.18×10^{-4}[0.184]	< 1
PM_{10}[a]	Annual	50[b]	-	0.018[b]	< 1
	24 hours	150[b]	-	6.51[b]	4.3
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	4.6×10^{-7}[0.001]	< 1
	24 hours	0.14[305]	0.10[218]	1.7×10^{-4}[0.367]	< 1
	3 hours	0.50[1,088]	-	0.001[2.94]	< 1
TSP	Annual	-	60[b]	0.018[b]	< 1
	24 hours	-	150[b]	6.51[b]	4.3

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL 1997a
mg/m^3: micrograms per cubic meter
°R: degrees Rankin
ft: feet
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] PM_{10} assumed equal to TSP
[b] mg/m^3
Note: The standards for some of the pollutants are stated in ppm. These values were converted to mg/m^3 with appropriate corrections for temperature (530° R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Chemical Pollutants

Approximately 465 chemicals, including hazardous air pollutants (HAPs), toxic air pollutants (TAPs), and VOCs, were identified for evaluation from the CIS, CheMaster, and HCPI databases. These chemicals were purchased by the 12 facilities listed in Table 5.3.7–5 during 1996. The table lists all facilities that purchased chemicals at SNL/NM in 1996. Figure 5.3.7–2 shows the locations of these 12 facilities.

Hazardous chemicals purchased during 1996 are categorized into two groups: noncarcinogenic chemicals and carcinogenic chemicals. The list of 465 chemicals purchased during 1996 includes fifteen EPA-confirmed carcinogenic chemicals that were purchased by 5 facilities. The remaining chemicals are categorized as noncarcinogenic chemicals. Each group is evaluated using a screening technique based on 1/100 of the relevant OEL for noncarcinogens or 1/100 of the relevant unit risk factor for carcinogens in order to identify those chemicals of potential concern.

Occupational Exposure Limit (OEL)

The occupational exposure limit is a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. The minimum OEL obtained from four reference sources divided by a safety factor of 100 is used as the screening guideline to determine chemicals of concern (COCs).

Noncarcinogenic Chemical Screening

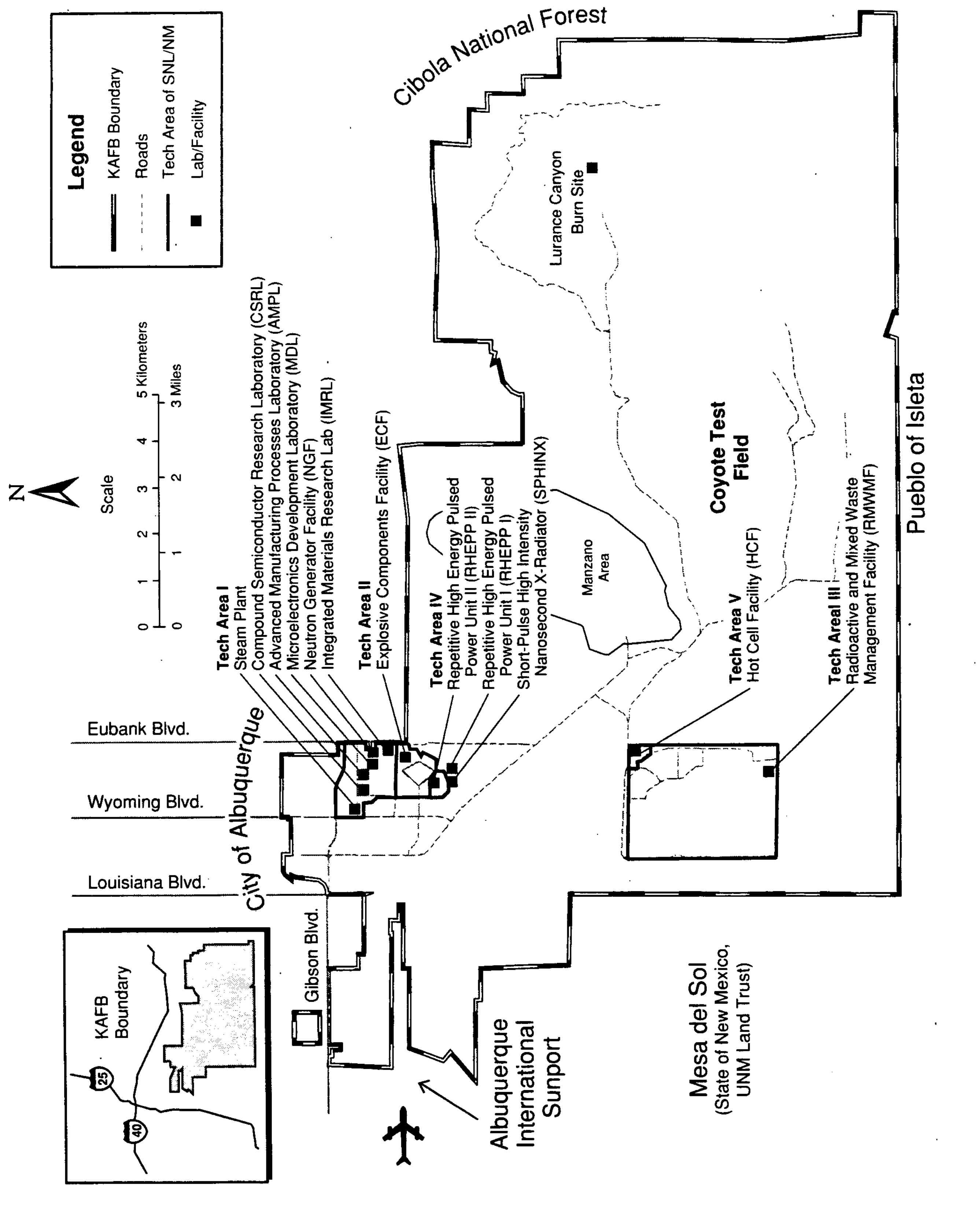
Noncarcinogenic chemicals that could cause air quality impacts at SNL/NM are identified through a progressive series of screening steps detailed in Appendix D in which each successive step reduces the number of pollutants to only those chemicals that have a reasonable chance of being chemicals of concern.

Only 30 noncarcinogenic chemicals from 5 facilities exceed the screening level based upon emission rates calculated from purchases. Only 1 of the 30 noncarcinogenic chemicals exceeded the screening level based upon facility-estimated emission rates. The human health impacts from this chemical, chromium trioxide (Building 870), are presented in Section 5.3.8. The results of the screening analysis are presented in detail in Appendix D.

Table 5.3.7–5. SNL/NM Facilities from which Chemical Emissions were Modeled

TECHNICAL AREA	BUILDING NUMBER	FACILITY NAME
I	605	Steam plant
I	858	Microelectronics Development Laboratory (MDL)
I	870	Neutron Generator Facility (NGF)
I	878	Advanced Manufacturing Processes Laboratory (AMPL)
I	893	Compound Semiconductor Research Laboratory (CSRL)
I	897	Integrated Materials Research Laboratory (IMRL)
II	905	Explosive Components Facility (ECF)
III	6920	Radioactive and Mixed Waste Management Facility (RMWMF)
IV	963	Repetitive High Energy Pulsed Power Unit II (RHEPP II)
IV	981	Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)
IV	986	Repetitive High Energy Pulsed Power Unit I (RHEPP I)
V	6580	Hot Cell Facility (HCF)

Source: SNL/NM 1998a



Source: SNL/NM 1997a

Figure 5.3.7–2. Major Chemical-Emitting Facilities at SNL/NM

Twelve SNL/NM facilities emit the majority of chemicals.

Carcinogenic Chemical Screening

Table 5.3.7–6 presents those carcinogenic chemicals with estimated emission rates greater than the screening level. Human health impacts from these 10 carcinogenic chemicals are presented in Section 5.3.8.

Summary of Nonradiological Air Quality Impacts

Under the No Action Alternative, nonradiological air quality concentrations for criteria and chemical pollutants are below regulatory standards and human health guidelines. Maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b represent a maximum of 96 percent of the allowable regulatory limit at a public access area. Thirty noncarcinogenic chemicals exceed the screening levels based upon emission rates calculated from purchased quantities, but only one noncarcinogenic chemical exceeds the screening levels based upon process engineering estimates of actual emission rates. Further analysis of this one noncarcinogenic chemical is performed in Section 5.3.8. The risks due to exposure of the 10 carcinogenic chemicals that exceeded the screening levels are evaluated in Section 5.3.8, Human Health and Worker Safety.

Unit Risk Factor

The unit risk factor is a dose response parameter used to identify lifetime carcinogenic health effects relative to the level of chemical exposure (risk per unit concentration). The unit risk factor multiplied by the exposure concentration equals the excess lifetime cancer risk. The carcinogenic chemical guideline used to screen the carcinogenic chemicals represents a lifetime cancer risk of 1.0×10^{-8}. It is calculated by dividing 1.0×10^{-8} risk by the chemical-specific unit risk factor. This results in a chemical concentration below which no health effect is expected.

5.3.7.2 Radiological Air Quality

The SWEIS analysis reviewed the radiological emissions from all SNL/NM facilities. Section 4.9.2 identifies 17 SNL/NM facilities as producing radiological emissions. Based on historic SNL/NM radionuclide emissions data, NESHAP (40 CFR Part 61), compliance reports, and the *SNL/NM Facilities and Safety Information Documents* (FSID) (SNL/NM 1998ee), 10 of the 17 SNL/NM

Table 5.3.7–6. Annual Carcinogenic Chemical Concentrations from Facility Emissions Under the No Action Alternative

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	NO ACTION CONCENTRATION (ppb/μg/m³)
Chloroform (Trichloromethane)	6580	1.45×10^{-3}[5.89×10^{-3}]
Dichloromethane (Methylene chloride)	870	7.31×10^{-2}[2.11×10^{-1}]
Dichloromethane (Methylene chloride)	878	2.66×10^{-3}[7.67×10^{-3}]
Formaldehyde	878	4.77×10^{-4}[4.87×10^{-4}]
Trichloroethene	878	8.74×10^{-3}[3.90×10^{-2}]
1,2-Dichloroethane (Ethylene dichloride)	893	2.93×10^{-4}[9.85×10^{-4}]
1,4-Dichloro-2-butene	897	3.96×10^{-5}[1.68×10^{-4}]
Acrylonitrile	897	1.52×10^{-4}[2.74×10^{-4}]
Chloroform (Trichloromethane)	897	1.25×10^{-3}[5.07×10^{-3}]
Trichloroethene	897	1.58×10^{-3}[7.06×10^{-3}]

Source: SNL/NM 1998a
mg/m³: micrograms per cubic meter
ppb: parts per billion
Bldg. 6580 – Hot Cell Facility (HCF)
Bldg. 870 – Neutron Generator Facility
Bldg. 878 – Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 – Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 – Integrated Materials Research Laboratory (IMRL)

facilities were modeled for radiological impacts (Table 5.3.7–7). The ACRR would be operated under one of two configurations: medical isotopes production (primarily molybdenum-99 production) or DP. However, for the purpose of conservative analysis, the ACRR was evaluated under simultaneous operation of both configurations. Based on the review of historical dose evaluations, facilities other than these 10 would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI and were screened from further consideration in the SWEIS. The modeled releases to the environment would result in a calculated dose to the MEI and the population within 50 mi of TA-V. TA-V was selected as a center for the population within a 50-mi radius, because the majority of radiological emissions would be from TA-V, specifically the HCF, and TA-V is historically addressed for annual SNL/NM NESHAP compliance (SNL/NM 1996u). The *CAP88-PC* computer model (DOE 1997e) was used to calculate the doses. Details on the *CAP88-PC* model, radionuclide emissions, model and source parameters, exposures, meteorological data, and population data are presented in Appendix D. Figure 5.3.7–3 shows the locations of the 10 facilities modeled in the SWEIS. Table 5.3.7–7 presents the estimated radiological emissions from the 10 SNL/NM facilities under the No Action Alternative. The radiological emissions from each facility were estimated based on SNL/NM planned operations and tests projected into the future. Detailed information is available in the FSID (SNL/NM 1998ee). The emission of argon-41 from the ACRR, under the medical isotope production configuration, would be lower than during the base year, 1996, because of the refurbishing operations conducted during 1996. The SPR emissions were estimated to be higher than the base year. This was due to instituting NESHAP requirements for "confirmatory measurements" of radiological air emissions where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emission factors. These measurements are source-specific to the SPR and ACRR and would not affect the calculations or measurements for other facilities.

Because the general public and USAF personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impacts evaluations (see Appendix D.2). Based on NESHAP reports, 16 onsite and 6 offsite additional receptor locations were also evaluated. A total of 38 receptor locations were evaluated for dose impacts. The core receptor locations include schools, hospitals, a museum, and clubs, and were considered for analysis because of potential impacts to children, the sick, and the elderly. The 32 modeled onsite and core receptor locations and locations of public concern are shown in Figure 5.3.7–4.

The dose to an individual at each receptor location and to the population within 50 mi from the radionuclide emissions from each source was calculated using the *CAP88-PC* model. The public receptor receiving the maximum reported dose is identified as the MEI. The model-calculated dose contributions, including external, inhalation, and ingestion exposure pathways from each of the 10 sources, calculated individually at each receptor location, were combined to determine the overall SNL/NM site-wide normal operations dose to the MEI. Under the No Action Alternative, the maximum effective dose equivalent (EDE) to the MEI from all exposure pathways from all modeled sources was calculated to be 0.15 mrem/yr. The MEI is located at the Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC), north of TA-V. This location is consistent with the location of the MEI historically identified in the annual NESHAP compliance reports. The EDE contributions from these 10 sources to this highest combined MEI dose are presented in Table 5.3.7–8. Table 5.3.7–9 presents the doses to 38 onsite, core, and offsite receptor locations. The potential doses for these additional locations would be much lower than the MEI dose. Under the No Action Alternative, the total collective dose to the population of 732,523 within a 50-mi radius of TA-V was calculated to be 5.0 person-rem per year. Section 5.3.8 discusses the human health impacts of radiological emissions at SNL/NM. The contributions from the 10 modeled sources to the overall SNL/NM site-wide normal operations collective dose to the population within 50 mi are also presented in Table 5.3.7–8. The average dose to an individual (collective dose divided by the total population) in the population within 50 mi of TA-V would be 6.8×10^{-3} mrem/yr.

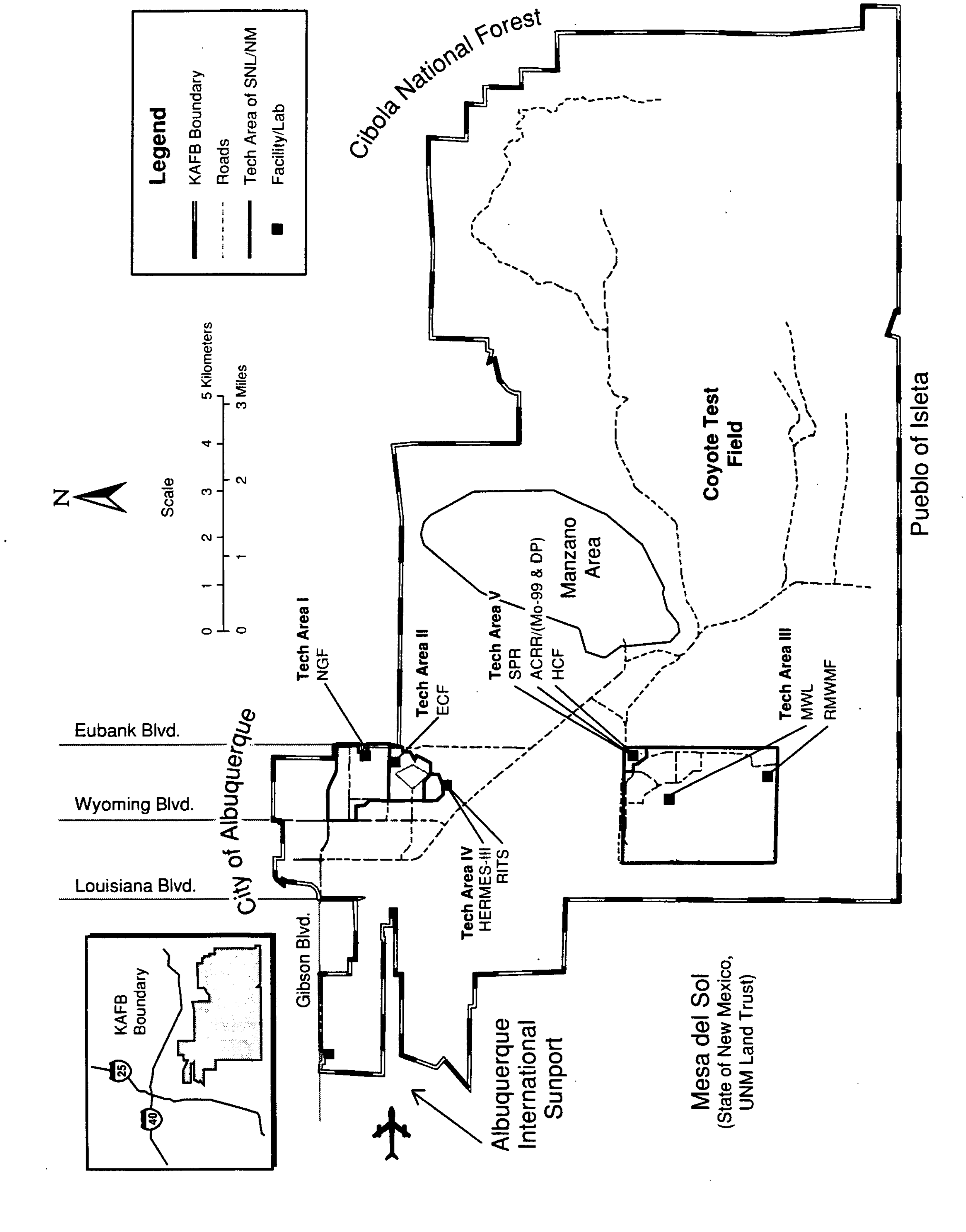
The calculated total MEI dose of 0.15 mrem/yr would be much lower than the regulatory limit of 10 mrem/yr to an MEI from SNL/NM site-wide total airborne releases of radiological materials (40 CFR Part 61). This dose is small compared to an individual background radiation dose of 360 mrem/yr (see Figure 4.10–2). The calculated collective dose from SNL/NM operations to the population within 50 mi of TA-V, 5.0 person-rem per

Table 5.3.7–7. Radiological Emissions from Sources at SNL/NM Under the No Action Alternative

FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	RELEASE (Ci/yr)
Annular Core Research Reactor (ACRR) (DP configuration), Building 6588	V	Argon-41	2.6
Annular Core Research Reactor (ACRR) (medical isotopes production configuration), Building 6588	V	Argon-41 Tritium	1.1 1.1
Explosive Components Facility (ECF), Building 905	II	Tritium	2.0×10^{-3}
High-Energy Radiation Megavolt Electron Source (HERMES III), Building 970	IV	Nitrogen-13 Oxygen-15	1.245×10^{-3} 1.245×10^{-4}
Hot Cell Facility (HCF), Building 6580	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	1.17 3.0 5.4 0.22 3.3 198.0 0.19 290.0 57.0 480.0 1.8 2,160.0 102.0 2,070.0 360.0
Mixed Waste Landfill (MWL)	III	Tritium	0.29
Neutron Generator Facility (NGF), Building 870	I	Tritium	156.0
Radioactive and Mixed Waste Management Facility (RMWMF), Building 6920	III	Tritium	2.203[b]
Radiographic Integrated Test Stand (RITS), Building 970	IV	Nitrogen-13	0.12
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	9.5

Source: SNL/NM 1998a
Ci/yr: curies per year
DP: Defense Programs
SNL/CA: Sandia National Laboratories/California

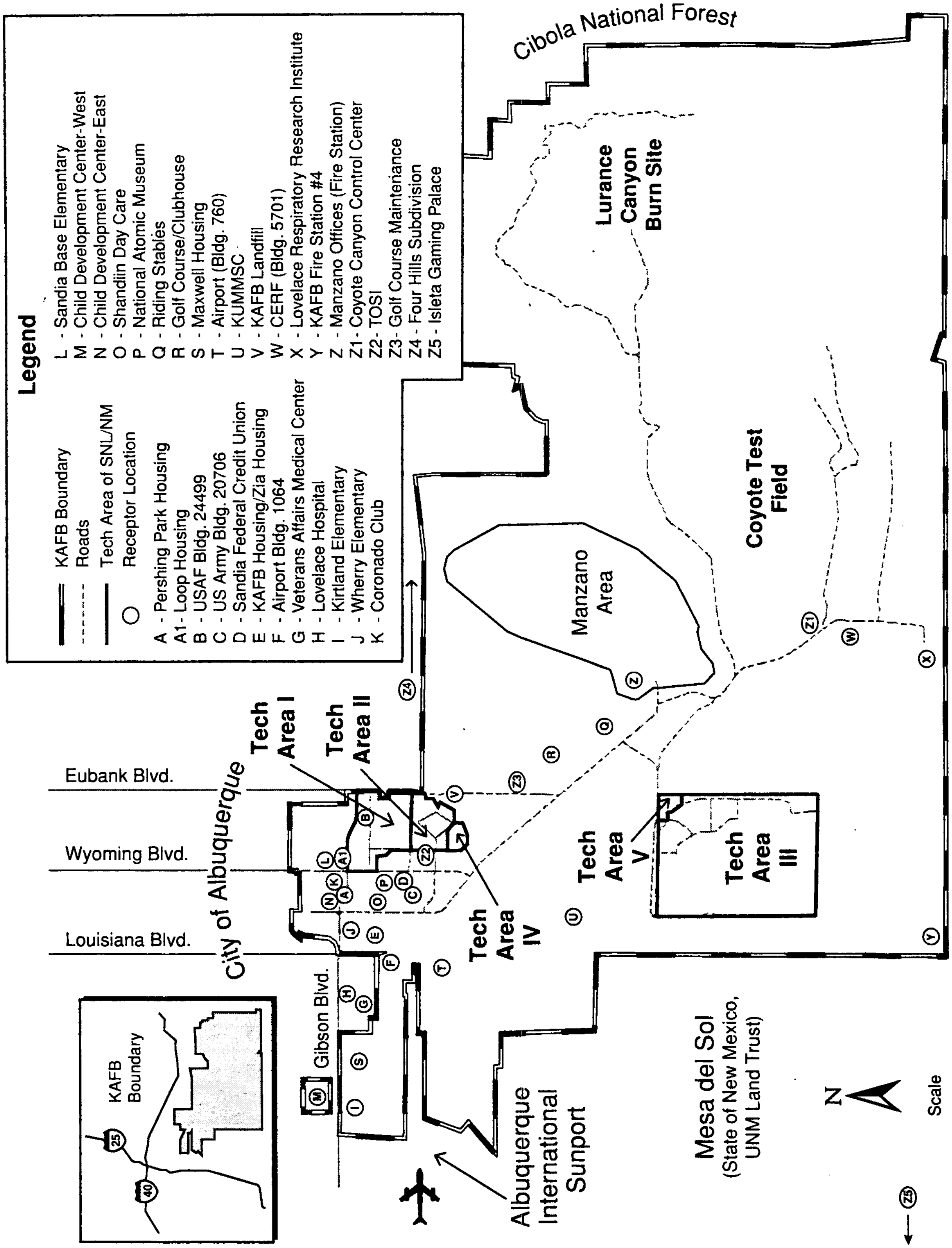
[a] Radiological emissions are projections based on planned activities, projects, and programs. Radionuclide releases are not the same as those presented in Chapter 4.
[b] Because SNL/CA tritium-contaminated oil levels handled at the RMWMF during the base year were abnormally high, this maximum level of emissions was assumed to be released in any year and, therefore, was constant for all alternatives.



Source: Original

Figure 5.3.7–3. Locations of Radionuclide-Releasing Facilities at SNL/NM

The 10 SNL/NM facilities that release radionuclides are in 5 technical areas.



Source: SNL/NM 1996u

Figure 5.3.7–4. Normal Operational Onsite and Core Receptor Locations

Thirty-two onsite and core receptor locations were evaluated for potential normal operation impacts.

Table 5.3.7–8. Summary of Dose Estimates from Radioactive Air Emissions to the SNL/NM Public Under the No Action Alternative

SOURCE	ANNUAL MEI DOSE, EDE (mrem)	ANNUAL POPULATION DOSE, PERSON-REM
Annular Core Research Reactor (ACRR) (DP configuration)	4.2×10^{-4}	7.2×10^{-3}
Annular Core Research Reactor (ACRR) (medical isotopes production configuration)	2.1×10^{-4}	5.36×10^{-3}
Explosive Components Facility (ECF)	9.9×10^{-9}	4.19×10^{-6}
High-Energy Radiation Megavolt Electron Source (HERMES III)	1.0×10^{-8}	2.1×10^{-7}
Hot Cell Facility (HCF)	1.5×10^{-1}	4.61
Mixed Waste Landfill (MWL)	4.0×10^{-6}	6.16×10^{-4}
Neutron Generator Facility (NGF)	7.4×10^{-4}	3.22×10^{-1}
Radioactive and Mixed Waste Management Facility (RMWMF)	7.5×10^{-6}	3.24×10^{-3}
Radiographic Integrated Test Stand (RITS)	9.8×10^{-7}	4.5×10^{-7}
Sandia Pulsed Reactor (SPR)	1.3×10^{-3}	2.54×10^{-2}
TOTAL MEI DOSE	**0.15**	-
50-MILE POPULATION COLLECTIVE DOSE	-	**5.0**

Sources: DOE 1997e, SNL/NM 1998a
DP: Defense Programs
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem

Note: Although the Annular Core Research Reactor is expected to be operated under DP configuration intermittently, for this analysis it was assumed to be operated simultaneously with the medical isotopes production configuration. Its contribution to the total dose is not appreciable.

Table 5.3.7–9. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the No Action Alternative

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
ONSITE AND NEAR-SITE RECEPTORS	
Albuquerque International Sunport (Bldg. 1064)	1.8×10^{-2}
Albuquerque International Sunport (Bldg. 760)	3.9×10^{-2}
Building 20706	2.8×10^{-2}
Building 24499	2.0×10^{-2}
Child Development Center-East	1.8×10^{-2}
Child Development Center-West	1.9×10^{-2}
Civil Engineering Research Facility (Bldg. 5701)	1.2×10^{-2}
Coronado Club	2.0×10^{-2}
Coyote Canyon Control Center	1.2×10^{-2}
Golf Course Clubhouse	7.2×10^{-2}

Table 5.3.7–9. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the No Action Alternative (concluded)

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
Golf Course Maintenance Area	4.5×10^{-2}
Kirtland Elementary School	1.9×10^{-2}
KAFB Firestation #4 (Bldg. 9002)	1.7×10^{-2}
KAFB Landfill	2.9×10^{-2}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	1.5×10^{-1}
Loop Housing	2.1×10^{-2}
Lovelace Hospital	1.4×10^{-2}
Lovelace Respiratory Research Institute	1.2×10^{-2}
Manzano Offices (Fire Station)	3.4×10^{-2}
Maxwell Housing	2.2×10^{-2}
National Atomic Museum	2.5×10^{-2}
Pershing Park Housing	1.7×10^{-2}
Riding Stables	6.3×10^{-2}
Sandia Base Elementary	1.7×10^{-2}
Sandia Federal Credit Union	3.1×10^{-2}
Shandiin Day Care Center	2.2×10^{-2}
Technical Onsite Inspection Facility	3.3×10^{-2}
Veterans Affairs Medical Center	2.7×10^{-2}
Wherry Elementary School	1.8×10^{-2}
Zia Park Housing	2.4×10^{-2}
OFFSITE RECEPTORS	
Albuquerque City Offices	5.1×10^{-2}
East Resident	2.4×10^{-2}
Eubank Gate Area (Bldg. 8895)	4.5×10^{-2}
Four Hills Subdivision	4.1×10^{-2}
Isleta Gaming Palace	2.7×10^{-2}
Northeast Resident	3.0×10^{-2}
Seismic Center (USGS)	2.7×10^{-2}
Tijeras Arroyo (West)	6.3×10^{-2}

Sources: DOE 1997e, SNL/NM 1998a
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem
USGS: U.S. Geological Survey

year, is much lower than the collective dose to the population from background radiation. Based on the individual background radiation dose, the population within 50 mi of TA-V would receive 263,700 person-rem per year.

5.3.8 Human Health and Worker Safety

The implementation of the No Action Alternative could result in impacts to public health and worker health and safety from both normal facility operations and postulated accident scenarios. The impacts would be the result of radiological and nonradiological releases from SNL/NM operations. The following sections describe these impacts.

A receptor is any individual who could be affected by SNL/NM operations. Health risk assessments for receptors at specific locations in the immediate SNL/NM vicinity were used to characterize the health risks for all possible receptors.

Fourteen core receptor locations were consistent among the evaluations for impacts due to routine operations, chemical and radiological emissions, and potential facility accidents at SNL/NM. These receptor locations were selected based on a review of historic NESHAP compliance reports, which discuss the location of the MEI member of public and take into consideration that the general public and Air Force personnel have access to SNL/NM. Other factors taken into account include information contained in the *SNL/NM Facility Source Documents* (SNL/NM 1998a), receptor locations in close proximity to the sources, the nearest site boundary in the prevailing wind directions, and the presence of potentially sensitive receptors such as children, the sick, and the elderly. These 14 receptor locations are listed below.

- Child Development Center-East
- Child Development Center-West
- Coronado Club
- Golf Course (Clubhouse)
- Kirtland Elementary School
- KAFB Housing (Zia Housing)
- KUMMSC
- Lovelace Hospital
- National Atomic Museum
- Riding Stables
- Sandia Base Elementary School
- Shandiin Day Care Center
- Veterans Affairs Medical Center (Hospital)
- Wherry Elementary School

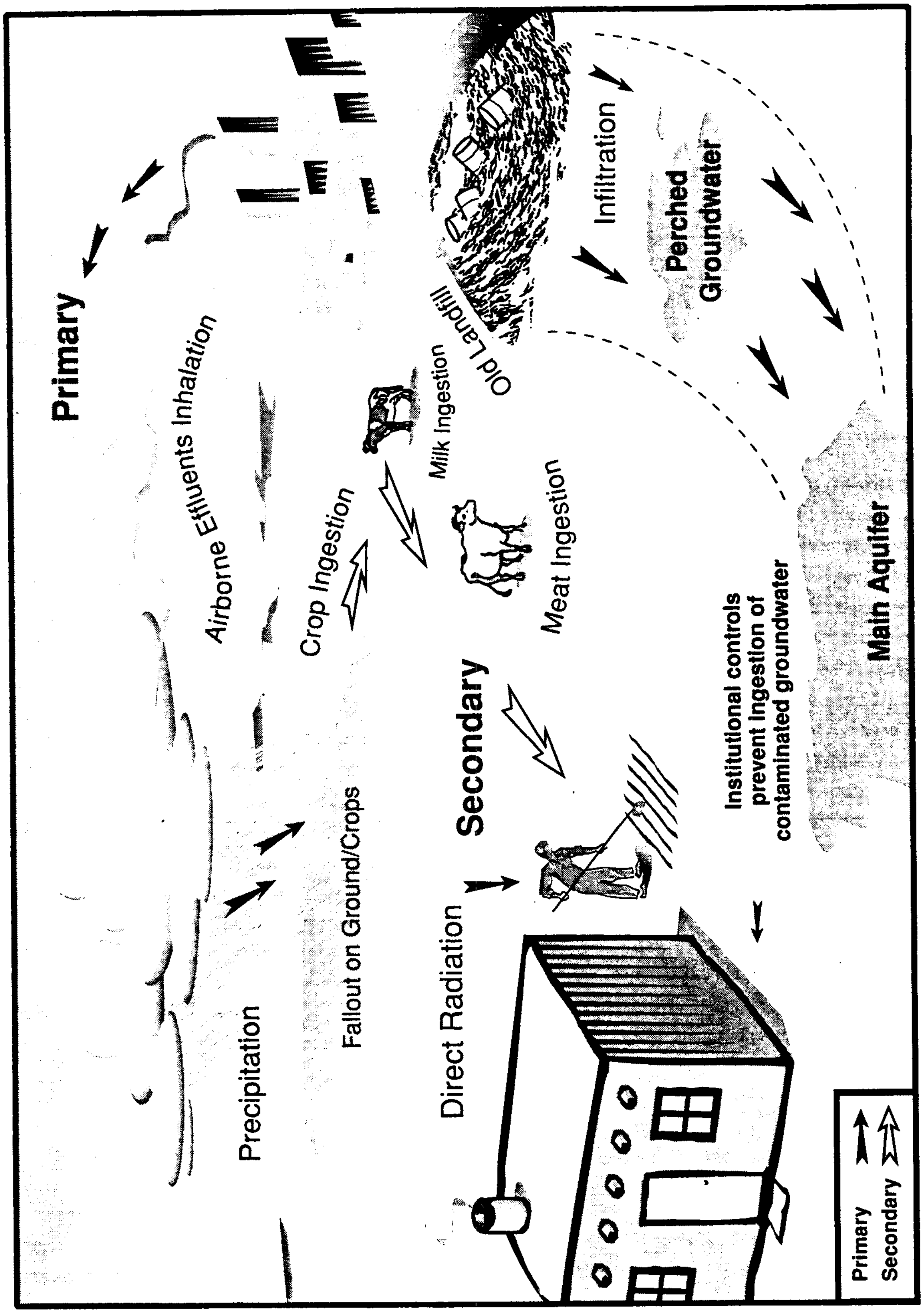
In addition to these 14 core receptor locations, 2 locations of public concern, the Four Hills Subdivision and the Isleta Gaming Palace, were also evaluated for human health. The specific evaluations of chemical air emissions, radiological air emissions, and facility accidents also included additional receptor locations unique to the needs of the resource area, in order to complete their analyses of impacts (see discussions in radiological air, chemical air, and accident analyses).

5.3.8.1 Normal Operations

This section provides information on public health and worker health and safety under the No Action Alternative. It assesses the potential human health impacts associated with releases of radioactive and nonradioactive hazardous material from SNL/NM normal operations. Human health risk analyses identify potential health effects to all possible receptors, such as SNL/NM employees, contractors, visitors, and members of the public within and outside the KAFB boundary. For detailed discussions of analytical methods and results, along with terminology, definitions, and descriptions, see Appendix E.

Radiological and nonradiological hazardous material released by SNL/NM during normal operations reach the environment and potentially reach people in different ways (Figure 5.3.8–1). See specific sections in Chapter 5 on geology and soils, water, and air quality for a description of SNL/NM's impacts to the different environmental media. These sections discuss historic results from environmental sampling programs and predictive modeling of future conditions. They also present quantitative and qualitative assessments of the potential exposure pathways associated with these media. The air pathway is the primary exposure pathway identified in the SWEIS that has the potential to carry materials directly from SNL/NM facilities to the environment and then to people who are exposed directly by way of inhalation. Secondary air exposure pathways exist from the indirect ingestion of pollutants by way of foods, including crops contaminated by airborne pollutants and livestock products from animals ingesting contaminated crops.

Other pathways investigated include groundwater, surface water, and soils. The potential primary exposure pathway of directly ingesting contaminated water was investigated,



Source: Original

Figure 5.3.8–1. Primary and Secondary Complete Exposure Pathways Associated with SNL/NM Normal Operations.

Radiological and nonradiological hazardous material released by SNL/NM operations have the potential to reach people through different exposure pathways.

but the determination was made that the area of polluted groundwater beneath SNL/NM would not migrate to areas planned or currently in use for the drinking water supply (see Appendix B). People would not be exposed through ingesting surface water because SNL/NM normal operations would not affect surface water resources (see Sections 5.3.4, 5.4.4, and 5.5.4). Affected soils at SNL/NM would be controlled under the ER Project. Potential routine (nonremedial) releases of contaminated soils or dust are controlled on a site-specific basis, thus preventing potential exposures by way of inhalation or ingestion (DOE 1996c).

The different health risks identified for specific receptor locations, individual exposure scenarios, and the potential maximum exposures adequately characterize health risks from SNL/NM normal operations.

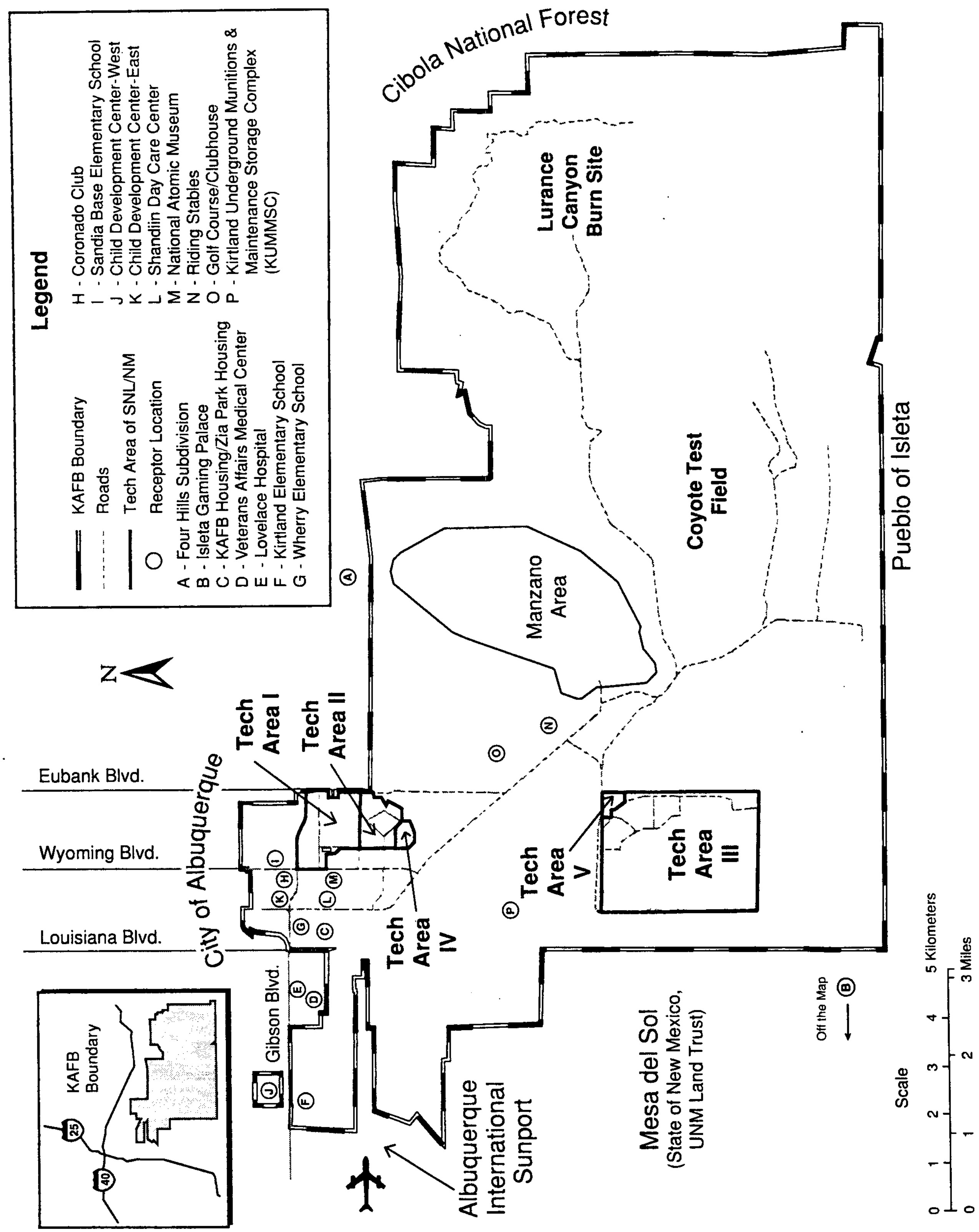
Health risk analyses are presented for potential exposures at each specific receptor location and for the maximum potential exposures to radiation and chemical air releases. Figure 5.3.8–2 shows the core- and public concern-receptor locations selected for health risk analyses. The maximum potential exposure to radiation is known to likely occur within KAFB at the KUMMSC, based on analysis of years of data collected to meet NESHAP requirements. Health risk at the KUMMSC receptor location, therefore, represents the maximum potential health risk from radiation and is referred to as the MEI for normal operations. A location where the maximum potential exposure to chemical air releases could occur was not identified because of limited historical chemical air emissions information. Instead, a bounding value for health risk from chemical air emissions was calculated based on a hypothetical worst-case exposure scenario. The hypothetical worst-case exposure scenario assumed simultaneous exposure to the estimated maximum offsite concentration of each chemical. Because these estimated concentrations are expected to occur at different locations, this exposure level would be implausible. The actual potential maximum exposure to chemical air emissions and the associated health risks are identified as "less than" this upper-bound health risk value.

A range of health risks was used to evaluate the possibility of adverse health impacts due to SNL/NM normal operations. Health risks depend on a person actually coming in contact with hazardous material released into the environment. Receptor location, estimated time of exposure to the material, and age of the receptor are among the parameters used to establish exposure scenarios. In the case of transport by way of the air pathway, exposure also varies with wind direction and distance from the source. This equates to variability in potential health risks.

Chemical Air Release Pathways

Air releases of hazardous chemicals from laboratories and other chemical operations at SNL/NM are reported in compliance with *Superfund Amendments Reauthorization Act* (SARA) Title III requirements. Actual monitoring of emissions from each potential building source is not required. Estimates of total pounds emitted of HAPs, TAPs, and VOCs were based on the conservative assumption that the entire purchased amounts of chemicals would be released. For purposes of assessing routine exposures to chemical releases from SNL/NM normal operations, potential emissions were first estimated and then evaluated against screening TEVs that are based on the OELs/100 for noncarcinogens, and a 10^{-8} cancer risk for carcinogens (see Appendix D). Only those chemical sources (buildings and amounts) exceeding the screening TEVs could be expected to result in potential exposures to receptors in the SNL/NM vicinity. Air exposure concentrations were estimated and used to evaluate potential health risk. Concentrations of chemicals having toxicity dose-response information become the basis for calculating the hazard index (HI) and excess lifetime cancer risk (ELCR) values under different exposure scenarios. This chemical assessment process identified seven individual chemicals of concern (COCs) (three chemicals are common) under the No Action Alternative (see Appendix E, Table E.3–2). These COCs are associated with SNL/NM's operations in Buildings 878 (Advanced Manufacturing Processes Laboratory [AMPL]), 893 (Compound Semiconductor Research Laboratory [CSRL]), 897 (Integrated Materials Research Laboratory [IMRL]), 6580 (HCF), and 870 (NGF).

The potential for human contact with airborne chemicals would vary with time and distance from the SNL/NM building source. The health risk and corresponding potential for adverse health effects is a range of values. Several receptor locations, individual exposure scenarios, and a hypothetical worst-case exposure scenario were used to present the range of health risks from airborne chemicals in the SNL/NM vicinity. Adult and child and residential and visitor risk assessments were calculated. The health risk values presented are the total risk to a receptor due to chronic exposure to all COCs.



Source: SNL/NM 1997j

Figure 5.3.8–2. Receptor Locations in the SNL/NM Vicinity Assessed for Human Health Impacts

Specific receptor locations in the SNL/NM vicinity are used to assess human health risk from SNL/NM normal operations.

Measures of Nonradiological Health Risks

Chemicals of concern are categorized by health effect. Exposure to some chemicals can cause cancer, while others have a noncarcinogenic health effect, such as damage to a specific organ of the body (target organ). Other chemicals have the potential to induce both carcinogenic and noncarcinogenic health effects.

The risk of a noncarcinogenic health effect occurring is expressed as a Hazard Index (HI). Hazard quotients are derived for different chemicals from the ratio of the estimated exposure level to the reference exposure level expected not to cause a health effect, and then summed to get a Total HI. The hazard quotient assumes that there is a level of exposure (reference exposure) below which it is unlikely for even sensitive populations to experience adverse health effects. If the Total HI is less than 1, health effects are not expected. If an HI exceeds 1, there may be concern for potential health effects; however, it should not be interpreted as a probability for actually occurring. The level of concern does not increase linearly with HIs above 1 (EPA 1989).

Excess Lifetime Cancer Risk (ELCR) is the increased chance of getting cancer in addition to all other causes or susceptibilities in a person's life. For example, if exposures to air emissions of a specific chemical equate to a ELCR of 10^{-7}, a person has an additional 1-in-10 million lifetime chance of getting cancer from that exposure. ELCR is the product of the estimated exposure level and the chemical-specific cancer slope factor that represents the health effect per unit intake over a lifetime. ELCR values for different chemicals are summed to obtain the Total ELCR.

Under the Superfund Program, the EPA has established a 10^{-6} ELCR (1 in 1 million persons) as the "point of departure for establishing remediation goals." It expresses EPA's preference for setting clean-up levels at the more protective end of the risk range (10^{-4} to 10^{-6}). Setting an "acceptable" risk level becomes a site-specific decision based on long-term use of the site (40 CFR Part 300). The background 1997 estimated fatal cancer rate in New Mexico is 146 per 100,000 persons (ACS 1997).

The calculation of HIs and ELCRs takes into account potentially sensitive subpopulations. To take into account differences among individuals, such as breathing rate or body weight within the potentially exposed population, the EPA recommends doing both a "reasonable maximum" exposed (RME) and an "average" exposed individual (AEI) risk assessment (EPA 1989). The assessment of the RME uses upper bound (90th percentile) intake parameters to describe the individual. The assessment of the AEI uses central tendency (50th percentile) intake parameters to describe the individual (see Appendix E, Table E.5–1). The risks to the AEI are applicable to the general population, while risks to the RME are applicable to individuals within the population with a greater potential intake under the same exposure scenario.

Potential exposures (exposure point concentrations) to chemical air releases at specific receptor locations in the SNL/NM vicinity were estimated for normal SNL/NM operations and are shown in Appendix E, Table E.3–2. The potential health risks at these specific receptor locations due to the estimated exposure levels are shown in Table 5.3.8–1. These potential health risks would be very low and no adverse health effects would be expected at these risk levels. In addition, the assessment of the hypothetical worst-case exposure scenario bounds (sets an upper value to) the analysis of health risk. The estimated upper bound values for health risk from noncarcinogenic chemical releases under the No Action Alternative are HIs of less than 1, and from carcinogenic chemicals, are ELCR values of less than 10^{-6} (see Appendix E, Table E.6–3).

Radiation Air Release Pathways

Air releases of radionuclides from SNL/NM operations would result in low radiation exposures to people in the SNL/NM vicinity. Table 5.3.7–8 identifies the radiation dose to the potential MEI and the collective radiation dose to the population within the ROI, associated with these releases. The risk estimator of 500 fatal cancers per 1 M person-rem to the public converts radiation dose to latent fatal cancer risk. The potential maximum annual exposure to radiation from SNL/NM radiological facilities of 0.15 mrem would occur within the site boundary at the KUMMSC and increase the MEI lifetime risk of fatal cancer by $7.5x10^{-8}$ (see Table 5.3.8–2). In other words, the likelihood of the MEI developing fatal cancer from a 1-year dose from SNL/NM operations is less than 1 chance in 10 M. The annual collective dose of 5.0 person-rem to the

Table 5.3.8–1. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
RESIDENTIAL SCENARIOS			
Four Hills Subdivision[a]	Adult	<0.01/<0.01	$3.7 \times 10^{-11}/2.3 \times 10^{-11}$
	Child	<0.01/<0.01	$1.5 \times 10^{-11}/1.5 \times 10^{-11}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.6 \times 10^{-9}/1.7 \times 10^{-11}$
	Child	<0.01/<0.01	$1.1 \times 10^{-9}/1.3 \times 10^{-11}$
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$6.7 \times 10^{-10}/7.0 \times 10^{-12}$
	Child	<0.01/<0.01	$4.7 \times 10^{-10}/5.3 \times 10^{-12}$
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$6.1 \times 10^{-10}/6.9 \times 10^{-12}$
Child Development Center-West	Child	<0.01/<0.01	$1.2 \times 10^{-10}/1.4 \times 10^{-12}$
Coronado Club	Adult	<0.01/<0.01	$1.1 \times 10^{-9}/1.1 \times 10^{-11}$
	Child	<0.01/<0.01	$7.4 \times 10^{-10}/8.4 \times 10^{-12}$
Golf Course (Clubhouse)	Adult	<0.01/<0.01	$3.8 \times 10^{-10}/3.9 \times 10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$1.0 \times 10^{-10}/1.1 \times 10^{-12}$
Kirtland Underground Munitions & Maintenance Storage Complex (KUMMSC)[b]	Adult	<0.01/<0.01	$3.8 \times 10^{-10}/4.0 \times 10^{-12}$
Lovelace Hospital	Adult	<0.01/<0.01	$3.0 \times 10^{-10}/3.1 \times 10^{-12}$
	Child	<0.01/<0.01	$2.1 \times 10^{-10}/2.3 \times 10^{-12}$
National Atomic Museum	Adult	<0.01/<0.01	$1.8 \times 10^{-9}/1.9 \times 10^{-11}$
	Child	<0.01/<0.01	$1.3 \times 10^{-9}/1.4 \times 10^{-11}$
Riding Stables	Adult	<0.01/<0.01	$3.0 \times 10^{-10}/3.0 \times 10^{-12}$
Sandia Base Elementary School	Child	<0.01/<0.01	$8.2 \times 10^{-10}/9.3 \times 10^{-12}$
Shandiin Day Care Center	Child	<0.01/<0.01	$6.9 \times 10^{-10}/7.8 \times 10^{-12}$
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$2.9 \times 10^{-10}/3.0 \times 10^{-12}$
Wherry Elementary School	Child	<0.01/<0.01	$4.6 \times 10^{-10}/5.2 \times 10^{-12}$

Source: SmartRISK 1996
RME: reasonable maximum exposed
AEI: average exposed individual
[a] Four Hills Subdivision receptor location impacts are based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions.
[b] This receptor location was analyzed using a worker scenario, as discussed in Appendix E.5.
Notes: Calculations were completed using SmartRISK. See the beginning of Section 5.3.8 for a discussion of selection of receptor locations.

Table 5.3.8–2. Human Health Impacts in the SNL/NM Vicinity from Radiological Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	$9.0x10^{-9}$
Child Development Center-West	$9.5x10^{-9}$
Coronado Club	$1.0x10^{-8}$
Four Hills Subdivision	$2.1x10^{-8}$
Golf Course (Clubhouse)	$3.6x10^{-8}$
Kirtland Elementary School	$9.5x10^{-9}$
KAFB Housing (Zia Park Housing)	$1.1x10^{-8}$
Kirtland Underground Munitions & Maintenance Storage Complex[a] (KUMMSC)	$7.5x10^{-8}$
Lovelace Hospital	$7.0x10^{-9}$
National Atomic Museum	$1.3x10^{-8}$
Riding Stables	$3.2x10^{-8}$
Sandia Base Elementary School	$8.5x10^{-9}$
Shandiin Day Care Center	$1.1x10^{-8}$
Isleta Gaming Palace	$1.4x10^{-8}$
Veterans Affairs Medical Center	$1.4x10^{-8}$
Wherry Elementary School	$9.0x10^{-9}$

Sources: DOE 1997e, SNL/NM 1998a
MEI: maximally exposed individual
[a] The radiological MEI receptor location for normal operations
Note: Calculations were completed using *CAP88-PC*.

population increases the number of fatal cancers in the entire population within the ROI by $2.5x10^{-3}$. Therefore, no LCFs would be likely to occur in the ROI population due to SNL/NM radiological air releases.

Other receptors in the SNL/NM vicinity would receive lower exposures to radiation than the MEI, based on wind direction and distance from the facility sources. Radiation doses at specific receptor locations, including schools, hospitals, and day care centers in the SNL/NM vicinity are identified in Table 5.3.7–9. The range in potential human health effects associated with the radiation doses at several of these locations are shown in Table 5.3.8–2. The increase in lifetime cancer risk at many of the specific receptor locations from a 1-year dose from SNL/NM operations is lower than the increase in lifetime cancer risk to the MEI receptor located at the KUMMSC.

Receptors in the SNL/NM vicinity could also be exposed to air releases of radionuclides by way of the indirect pathway of ingesting food that contains radionuclides. *CAP88-PC* integrates doses from this pathway in the collective dose estimation for the population within the ROI, but does not integrate it into the exposure dose estimated for the potential onsite MEI receptor. Ingesting potentially contaminated foods accounts for approximately 11 percent (0.55 person-rem of the 5.0 person-rem collective population dose) of the population dose, which means it also accounts for approximately 11 percent of the health risk value. When the same percent contribution is assumed, this pathway potentially increases the lifetime risk of fatal cancer to the MEI by 11 percent ($8.3x10^{-9}$), less than 1 chance in 10 M.

Measures of Radiological Health Risks

The National Council on Radiation Protection and Measurements has adopted numerical values, known as risk estimators, that associate radiation dose to increased risk of developing fatal cancer. These values were recommended by the International Council on Radiation Protection and Measurement (ICRP 1991).

The risk estimator of 500 excess fatal cancers per 10^6 (million) person-rem, used to assess health effects to the public, takes into account children, the elderly, and other potentially sensitive receptors. The risk estimator of 400 excess fatal cancers per 10^6 (million) person-rem, used for workers, is a lower number, assuming that the worker population is a healthy adult population.

A 1 M person-rem exposure dose is equivalent to 1 million people exposed to 1 rem each. That is, 0.0005 fatal cancers per person-rem and 0.0004 fatal cancers per person-rem are multiplied by the dose to obtain the number of fatal cancers from the exposure to radiation.

For an individual, excess cancer risk is the increase in the person's chance (probability) of getting fatal cancer in a lifetime. For the population, the risk of an excess latent cancer fatality (LCF) is the additional increase in the total number of cancer fatalities in the entire ROI population from the collective population radiation dose. For all practical purposes, an LCF of less than 1 means that no additional cancer fatalities are expected.

Nonfatal Cancers and Genetic Disorders

Radiation exposures can cause nonfatal cancers and genetic disorders. The National Council on Radiation Protection and Measurements (NCRP) has adopted risk estimators developed by the ICRP for the public for assessing these health effects from radiation (ICRP 1991). The public dose-to-risk conversion factors recommended for nonfatal cancer and genetic disorders are 100 and 130 health effects per 1 M person-rem, respectively. The SNL/NM maximum annual dose would increase the lifetime risk of nonfatal cancers and genetic disorders to the MEI by 1.5×10^{-8} and 2.0×10^{-8}, respectively, which would be less than 1 chance in 50 M.

The SNL/NM annual collective dose to the ROI population would increase the number of nonfatal cancers and genetic disorders by 5.0×10^{-4} and 6.5×10^{-4}, respectively, which is interpreted that no additional nonfatal cancers or genetic disorders would be likely to occur within the ROI due to radiological air releases from SNL/NM normal operations.

Transportation

The potential human health risks and accident fatalities associated with transporting various radiological materials for SNL/NM operations are discussed in Section 5.3.9. The ratio of the total travel distance to the distance traveled within the ROI determines the estimated dose to the population along the travel route within the ROI. The distance traveled within the 50-mile ROI is conservatively estimated as 10 percent of the total distance traveled. Therefore, 10 percent of the total radiological dose (off-link and on-link) calculated for all radiological materials transported is considered as an additional human health impact to the population along the transport route within the ROI (see Appendix G). Ten percent of the annual collective population dose from transportation activities would increase the number of LCFs by 8.3×10^{-4}, thus increasing the total number of fatal cancers in the ROI to 3.3×10^{-3}. Therefore, it is likely that no additional LCFs would occur in the ROI population due to SNL/NM radiological material transportation activities, even when impacts are summed with impacts due to SNL/NM radiological air releases.

Historic Cancer Rate

For the U.S., the 1997 cancer mortality rate was 173 deaths per 100,000 persons. For the state of New Mexico, the rate was 146 deaths per 100,000 persons.

Composite Cancer Risk

The potential increase in lifetime cancer risk due to SNL/NM operations is associated with both the small amounts of radionuclides and small amounts of carcinogenic chemicals emitted into the air. Composite cancer risk due to both radiation and chemical exposures at the same location was assessed. To assess a composite cancer risk capturing the greatest potential cancer risk from exposure to radiation, the sum of the radiological MEI cancer risk and the chemical cancer risk at the same location (KUMMSC) was calculated. Cancer risk from the annual dose to the MEI, accumulated over a 30-year exposure duration, would be $2.3x10^{-6}$, or less than 1 chance in 434,000. Thirty years is consistent with the exposure used in calculating the chemical cancer risk at the KUMMSC; the contribution to cancer risk from exposure to chemicals would be so small that when the chemical cancer risk is added to the MEI fatal cancer risk, the value would not increase (the increased lifetime cancer risk remains $2.3x10^{-6}$). Therefore, the radiation exposure would be the majority of the risk (see Table E.6–3).

To assess a composite cancer risk capturing the highest potential cancer risk from chemicals, the upper bound value for cancer risk from chemicals, which assumes a hypothetical worst-case exposure scenario, and the radiological MEI (KUMMSC) cancer risk were summed. This is an impossible scenario because these exposures would not occur at the same location. However, it is a conservative assessment capturing the upper bound/ chemical risk (See Table E.6–3). The upper bound composite increased lifetime cancer risk would be $2.4x10^{-6}$, or less than 1 in 416,000. This would be within the EPA's established cancer risk range for the protection of human health of 10^{-6} to 10^{-4} (40 CFR Part 300). SNL/NM's potential contribution (from low exposures to chemicals and radiation) to an individual's lifetime cancer risk is very low, considering that overall in the U.S., men have a 1-in-2 lifetime risk of developing cancer, and for women the risk is 1-in-3. Approximately 1 out of every 4 deaths in the U.S. is from cancer (ACS 1997).

Worker Health and Safety

Operations at SNL/NM have to comply with DOE Orders, Federal Occupational Safety and Health Administration (OSHA) requirements, and occupational radiation protection requirements (10 CFR Part 835) for worker health and safety. These requirements regulate the work environment and minimize the likelihood of work-related chemical and radiation exposures, illnesses, and injuries. Periodic accidents, injuries, and illnesses do occur in the workforce. Most of the risks to worker health and safety are from common industrial accidents such as falls, slips, trips, contact with objects that result in sprains, cuts, abrasions, fractures, and other injuries to the body. Exposures to hazardous substances (chemical and radiological) are minimized or prevented through monitoring and using personal protective equipment. Overall, the SNL/NM injury and illness rates are much lower than those for private industry (national or local) and similar to those for the DOE as a whole (see Section 4.10).

Based on a 5-percent increase in the worker population under the No Action Alternative (Section 5.3.12) and the assumption that the SNL/NM nonfatal injury and illness rate per 100 workers would remain consistent with the 5-year average derived for 1992 through 1996, the total number of impacts to workers would increase slightly. Impacts for the entire SNL/NM workforce are projected to be zero fatalities per year, an average of 47 mrem/yr radiation dose (total effective dose equivalent [TEDE]) to the radiation-badged worker (based on the base year of 1996), approximately 311 nonfatal injuries and illnesses per year, and 1 or 2 confirmed chemical exposures annually.

Routine air emissions evaluated for potential exposures to specific receptors in the SNL/NM vicinity have the potential to impact noninvolved workers at SNL/NM. A noninvolved worker is an SNL/NM worker not associated with the operations of the facility and, therefore, not exposed during chemical or radiological work-related activities. Potential noninvolved worker exposures to airborne radiation are identified using the KUMMSC receptor location (Table 5.3.8–2). Potential noninvolved worker exposures to airborne chemicals are identified using a receptor location at the center of TA-I near the SNL/NM chemical facility sources. Based on an exposure scenario for a worker, health risks from chemicals to the noninvolved worker would be below a HI of 1 and less than 10^{-6} for an ELCR (see Appendix E, Table E.6–3).

Noninvolved Worker

A noninvolved worker is a SNL/NM worker not associated with the operations of the facility. For accidents, this worker is conservatively assumed to be located at 100 m from the accident for the entire duration of the accident in an unshielded condition. For routine operations, this worker is located nearest the source of emission.

The risk of cancer fatality from the annual average individual worker dose, annual maximum worker dose, and annual workforce collective dose for radiation workers (those working in radiation-designated areas) is shown in Table 5.3.8–3. Health risks from the annual average individual and annual maximum worker doses would be expected to remain constant for all three

Table 5.3.8–3. Radiation Doses (TEDE)[a] and Health Impacts to Workers from SNL/NM Operations Under the No Action Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY FROM A 1-YEAR DOSE
Annual Average Individual Worker Dose	47[b] (mrem/year)	$1.9x10^{-5}$
Annual Maximum Worker Dose	845[b] (mrem/year)	$3.4x10^{-4}$
RADIATION WORKER DOSE RATES	**RADIATION DOSE**	**NUMBER OF LATENT CANCER FATALITIES**
Annual Workforce Collective Dose	17 (person-rem/year)	$6.8x10^{-3}$

Source: SNL/NM 1997k
mrem: millirem
TEDE: total effective dose equivalent
[a] Average measured TEDE means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] Annual average individual and annual maximum worker doses are expected to remain consistent with the baseline year 1996 (see Section 4.10).
Note: Because not all badged workers are radiation workers, "radiation workers" refers to those badges with greater than 10 mrem above background measurements used in the calculations.

alternatives (based on the Radioactive Exposure Monitoring System [REMS] database dose information for 1996) (see Appendix E, Section E.6.1.1). The annual workforce collective dose was estimated for the radiation worker population calculated under the No Action Alternative, based on the ICRP risk estimator of 400 fatal cancers per 1 M person-rem among workers, and was associated with $6.8x10^{-3}$ additional fatal cancers in the entire radiation worker population. For assessment purposes, this equates to no additional LCFs in the radiation worker population under the No Action Alternative.

Nonfatal Cancers and Genetic Disorders

The worker dose-to-risk conversion factor used to assess potential nonfatal cancers and genetic disorders is 80 health effects per 1 M person-rem. The SNL/NM annual workforce collective dose to the radiation worker population increases the number of nonfatal cancers and genetic disorders by $1.4x10^{-3}$ each. In other words, no additional nonfatal cancers or genetic disorders would be likely to occur in the radiation worker population under the No Action Alternative.

Nonionizing Radiation

Sources of nonionizing radiant energy at SNL/NM include both laser and accelerator facilities. The laser light source can damage the unprotected eye and may also damage equipment. The safety documents for the SNL/NM laser facilities report that these facilities operate in accordance with American National Standards Institute (ANSI) guidelines that require that light paths be isolated from workers and from other equipment (SNL/NM 1996b). Accelerators generate electromagnetic pulse (EMP) that could present a high-voltage hazard to personnel. ANSI guidelines require mitigation measures such as shielding to block high voltage hazards from personnel and, during tests shots, exclude personnel from high-bay areas. However, based on the measurements from pulsed-power facilities, the EMP exposures to personnel outside the high-bay would be less than the AC61 standard of 100 kV/m (SNL/NM 1996b). Therefore, routine high voltage impacts to SNL/NM workers and the public would not occur.

5.3.8.2 Accidents

This section describes the potential impacts to workers and the public from accidents involving the release of radioactive and/or chemical materials, explosions, and other hazards under the No Action Alternative. The methods used to estimate the accident impacts are described in Section 5.2.9. Additional details on the accident analyses and impacts are presented in Appendix F. Existing mitigation measures, engineered safety features, administrative controls, and the emergency planning and preparedness programs designed to prevent and/or minimize the impacts of accidents are described in Section 5.6.

Site-Wide Earthquake

An earthquake in the Albuquerque, New Mexico, area has the potential for human injury and building damage throughout the local region. Due to differences in structural design, SNL/NM buildings and structures vary in their capabilities to withstand earthquake forces. Any magnitude earthquake has the potential to cause injury to workers in and around buildings and damage to structures from the physical forces and effects of the earthquake. Additional injury to workers and the public would be possible from explosions and from exposure to chemical and radioactive materials that could be released from buildings and storage containers. Facilities in TA-I are the predominant source of chemical materials that could be released during an earthquake. Facilities in TA-V are the predominant source of radioactive materials that could be released. The ECF in TA-II is the predominant source of explosive materials. Lesser quantities of radioactive materials in TAs-I and -II could also be released and cause exposures to workers and the public.

The Uniform Building Code (UBC) specifies different levels of seismic design depending on the location and proposed use of a facility or structure. For office buildings and other nonhazardous use of buildings, the UBC specifies an acceleration of 0.17 *g* (approximately 6.0 on the Richter Scale) for the Albuquerque area. This level seismic design would apply to most buildings in TA-I. For those facilities that would contain radioactive materials, the UBC specifies an acceleration level of 0.22. In the event of a 0.17 *g* earthquake, various buildings in TA-I could be affected and various chemicals could be released (see Appendix F, Table F.7–7); larger magnitude earthquakes could cause more serious impacts. The only dominant chemical that changes among the alternatives is arsine, and it is not released in the earthquake at 0.17 *g* and lesser accelerations. Therefore, failure of facilities at lesser accelerations would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged. The shape and direction of released chemical plumes would depend upon local meteorological conditions and physical structures. The plumes shown on Figure 5.3.8–3 are positioned to reflect the predominant wind direction during daylight hours. The daylight period was chosen to maximize the number of people potentially affected onsite, because more people are working onsite during the daytime than during nighttime periods. The circled area represents the potential area that could be affected by other wind directions. For wind blowing toward the north-northeast, there would be up to 423 people exposed to chemical concentrations above ERPG-2. Existing and known mitigation features designed to limit chemical release from storage containers, rooms, and buildings would limit or reduce plume size, concentration levels, and exposures. Emergency procedures, sheltering, and evacuations would also minimize exposures to workers and the public.

Nuclear facilities in TAs-I, -II, and -V could also be damaged during an earthquake. The frequency of an earthquake (0.17 *g*) that could cause the release of radioactive materials from TAs -I and -II facilities is

The Richter Scale

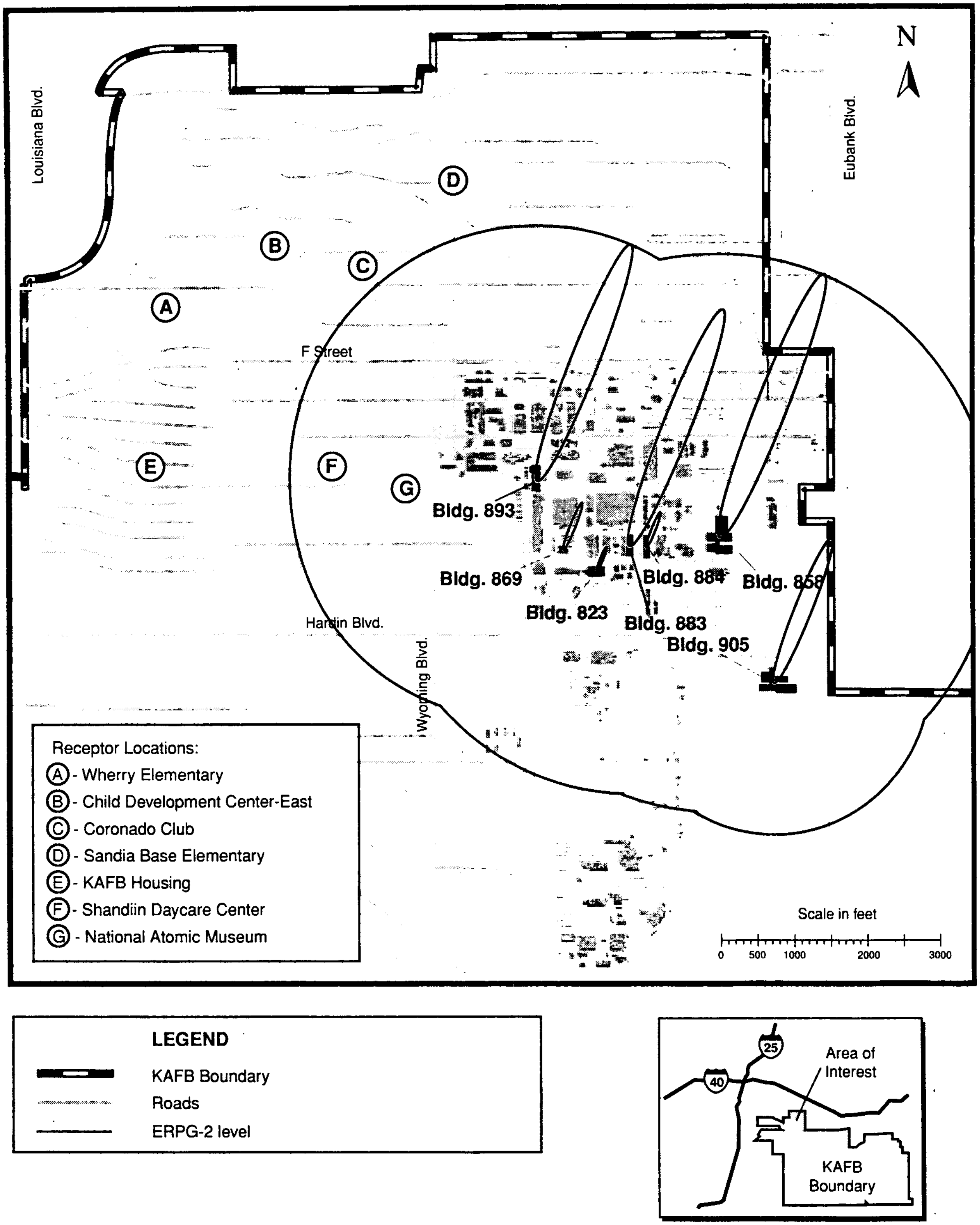
The Richter Scale measures the strength of an earthquake. Only people very sensitive to motion changes can detect an earthquake that measures 3.5 or less on this scale. The worst earthquake ever recorded was 8.9 on the Richter Scale. A 0.2-gravity earthquake would measure in the range of 6.2 to 6.9 on the Richter Scale. The largest earthquake in New Mexico occurred in the Socorro area on November 15, 1906 and had a magnitude equivalent to about 6.0 on the Richter scale; it was felt throughout most of New Mexico and in parts of Arizona and Texas.

1.0×10^{-3} per year, or 1 chance in 1,000 per year. The frequency of a more severe earthquake (0.22 *g*) that could also cause the release of radioactive materials from TAs -I (NG-1), -II (ECF-1), and -V facilities is 7.0×10^{-4} per year or 1 chance in 1,500 per year. The consequences of a 0.22-*g* earthquake are shown in Table 5.3.8–4. If a 0.22-*g* earthquake was to occur, there would be less than one tenth of an additional LCF in the total population within 50 mi of the site. The largest impact to the MEI and largest impact to the noninvolved worker would be an increased probability of LCF of 6.9×10^{-6} and 3.0×10^{-2}, respectively, associated with the HC-1 accident scenario. The risks for these receptors can be estimated by multiplying these consequence values by the probability (frequency) of earthquake. If a stronger earthquake was to occur, larger releases of radioactive materials would be possible and could cause greater impacts.

A severe earthquake could also cause damage to other SNL/NM facilities and result in environmental impacts. For example, the large quantities of oil stored in external tanks and in accelerator buildings in TA-IV could potentially be spilled and cause impacts to the ecosystem

Emergency Response Planning Guideline Level 2

The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.



Source: Original
Note: See Appendix F.7, Figure F.7–1

Figure 5.3.8–3. Areas Above Emergency Response Planning Guideline Level 2 from a Site-Wide Earthquake Under the No Action Alternative

The circled areas represent locations that could be above ERPG-2 levels, depending on wind direction.

Table 5.3.8–4 Site-Wide Earthquake Radiological Impacts Under the No Action Alternative

ACCIDENT ID[a]	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES WITHIN 50-MILES POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
			MAXIMALLY EXPOSED INDIVIDUAL[b]	NONINVOLVED WORKER[c]
TECHNICAL AREA -I				
NG-1	$7.0x10^{-4}$	$5.1x10^{-5}$	$1.4x10^{-9}$	$3.2x10^{-6}$
TECHNICAL AREA -II				
ECF-1	$7.0x10^{-4}$	$3.0x10^{-6}$	$1.5x10^{-10}$	$1.9x10^{-7}$
TECHNICAL AREA -V				
AM-2	$7.0x10^{-4}$	$2.0x10^{-3}$	$2.4x10^{-7}$	$7.4x10^{-5}$
HC-1	$7.0x10^{-4}$	$6.4x10^{-2}$	$6.9x10^{-6}$	$3.0x10^{-2}$
SP-1	$7.0x10^{-4}$	$9.2x10^{-3}$	$5.8x10^{-7}$	$2.7x10^{-4}$
AR-5	$7.0x10^{-4}$	$5.9x10^{-3}$	$8.4x10^{-7}$	$2.2x10^{-4}$

Source: Original (See also Appendix F, Tables F.7–4 and F.7–5)

[a] Facility Accident Descriptors:
- Neutron Generator Facility: NG-1
- Explosive Component Facility: ECF-1
- Annular Core Research Reactor-Medical Isotope Production: AM-2
- Annular Core Research Reactor-Defense Programs: AR-5
- Hot Cell Facility: HC-1
- Sandia Pulsed Reactor: SP-1

[b] The maximally exposed individual is located at the Golf Course and the consequences can be added.

[c] Because the noninvolved worker is located 100 meters from the release point, the location varies relative to each technical area. Therefore, the consequences to the noninvolved worker can only be added for a given technical area.

Note: 1) In the No Action Alternative, the Annular Core Research Reactor can be operated in either the medical isotopes production or Defense Programs configuration. The highest consequence (AR-5) was used.
2) The only earthquake radiological accident that changes among alternatives is AR-5, which contributes only 3.9 person-rem to the 150-person-rem dose. Therefore, failure of facilities at lesser accelerations that 0.22 *g* would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged.

and water resources. Underground natural gas lines could break and ignite, causing brush and forest fires that could further damage facilities and injure persons in the vicinity. Hydrogen storage tanks in TA-I could be damaged, causing hydrogen combustion or explosion and potential injury to persons in the vicinity. Explosives in the ECF in TA-II and smaller quantities in other facilities could also be accidentally detonated during an earthquake with injury to persons in the vicinity. Occupants of all facilities would be at risk of injury as a result of the earthquake forces and building damage.

Facility Hazards

Some of the facilities at SNL/NM contain occupational hazards with the potential to endanger the health and safety of involved workers in the vicinity of an accident. Some of these facilities also contain hazardous materials that, in the event of an accident, could endanger the health and safety of people outside the immediate vicinity of an accident and beyond. These people include noninvolved SNL/NM workers, members of the military assigned to KAFB, and members of the public located within the KAFB boundary and offsite. Offsite consequences are determined to a 50-mile radius around the affected facility.

Explosion, radiological, and chemical accidents with the largest impacts to workers and the public have been analyzed, as discussed in the following sections. Potential accidents associated with other facility hazards such as lasers, electricity, x-rays, transformer oil, noise, explosive test debris, pyrotechnics, and compressed gases could affect the health and safety of the involved workers. However, the impacts to noninvolved workers and the public for these other accidents would be lower than the impacts from explosion, radiological, and chemical accidents described in the SWEIS (see Appendix F, Table F.6–3).

The DOE recognizes the potential adverse effects for workers, the public, and the environment that could result from the deterioration of SNL/NM equipment, structures, and facilities. However, the analysis of potential accidents discussed in this section assumes that deterioration of equipment, structures, and facilities would not affect the occurrence, progression, and effects of accidents. The basis for this assumption is that the DOE safety analysis process, specified in DOE Orders and standards, would require periodic assessments of facility safety to ensure that operations are being performed within an approved safety envelope. The process would also require an assessment of all unresolved safety questions that would result from any change in a facility or operation that could affect the operation's authorization basis. Depending on the results of the assessment, modifications to the facility and/or operational procedures would be implemented to maintain operations within the authorization basis.

Explosion Accidents

Explosive materials are stored, handled, transported, and used at some SNL/NM facilities. Administrative controls and facility design would help prevent an explosion accident and limit the impacts to personnel, if an accident was to occur. The ECF, for example, contains large quantities of explosives for use in its testing programs. Hydrogen trailers are another large source of explosive material. There are five hydrogen trailers parked near facilities or routinely transported to facilities from remote locations.

In the Draft SWEIS, the largest quantity of hydrogen with the highest potential for consequences to both SNL/NM workers and facilities was a set of horizontally mounted cylinders, with a storage capacity of approximately 90,000 standard cubic feet (SCF) located approximately east of the CSRL, Building 893, in TA-I. An explosion at the hydrogen cylinder location near the CSRL was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion was to occur in this relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 61 ft of an explosion could be seriously injured and would have a 50 percent chance of survival. Involved workers out to a distance of 126 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance.

Based on additional information gathered since the Draft SWEIS was published, the Final SWEIS bounding facility explosion would be in a cryogenic tank with a storage capacity of approximately 493,000 SCF, located northwest of the MDL, Building 858, in TA-I. An explosion at the cryogenic tank was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion were to occur in this relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 101 ft of an explosion could be seriously injured and would have a 50 percent chance of survival. Involved workers out to a distance of 210 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance, as shown in Table 5.3.8–5.

Table 5.3.8–5. Impacts of an Explosion Accident Under the No Action Alternative

P_r (psi)	PHYSICAL EFFECTS	DISTANCE (ft)	
		472-lb TNT	2203-lb TNT
50	50% survival rate for pressures in excess of 50 psi	61	101
10	50% rate of eardrum rupture and total destruction of buildings for pressures in excess of 10 psi	126	210
2.0	Pressures in excess of 2-3 psi will cause concrete or cinder block walls to shatter.	370	617
1.0	Pressures in excess of 1 psi will cause a house to be demolished.	657	1,096

Source: Original
ft: feet
lb TNT: weight in pounds of equivalent mass of trinitrotoluene
psi: pounds per square inch
Note: See also Appendix F, Table F.4–1.

The actual number of persons in the vicinity of an accident depends upon many factors, making the actual number of potential fatalities uncertain. Factors include the time of day (morning, lunchtime, after hours), location of the people (or the amount of relative shielding), and spread of the pressure waves within a complex arrangement of buildings, alleys, and walkways.

This bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen, stored in a tank outside the MDL building, caused by human errors (such as mishandling activities) or equipment failures (such as a pipe joint failure), and the presence of an ignition source (such as a spark) near the location of release. For an uncontrolled release of hydrogen to explode, multiple failures would have to occur; therefore, this accident scenario would be extremely unlikely (that is, between $1x10^{-6}$ and $1x10^{-4}$ per year).

The human organs most vulnerable to shock explosions are the ears and lungs because they contain air or other gases. The damage would be done at the gas-tissue interface, where flaking and tearing could occur. Both the ear and the lung responses would be dependent not only on the overpressure, but also on impulse and body orientation; the shorter the pulse width, the higher the pressure the body could tolerate. An overpressure of approximately 50 psi would result in a 50 percent fatality rate; approximately 10 psi would result in eardrum rupture. These overpressure estimates are based on a square pressure wave with a pulse duration greater than 10 msec, and their effects could vary depending on body orientation to the pressure wave.

Structural damage produced by air blasts would depend on the type of structural material. An overpressure of 1 psi would cause partial demolition of houses (rendering them uninhabitable); an overpressure of 2 to 3 psi would shatter unreinforced concrete or cinder block walls; and an overpressure in excess of 10 psi would cause total destruction of buildings.

Radiological Accidents

The largest quantities of radioactive materials at risk for radiological accidents are located in TA-V. The Manzano Waste Storage Facilities, and TAs-I, -II, and -IV also contain radioactive material, but in smaller amounts. The nuclear facilities in TA-V include the ACRR, SPR, HCF, and Gamma Irradiation Facility (GIF). The New Gamma Irradiation Facility (NGIF) is under construction in TA-V. Accident scenarios for the ACRR facility were considered and analyzed for both the medical isotopes production and DP testing configurations. The HCF has been reconfigured for medical isotopes production, and the accidents analyzed reflect this mode of operation. Accidents have also been analyzed for storage of radioactive materials in the HCF not associated with medical isotopes production.

The most serious radiological accident impacts associated with facilities under the No Action Alternative are shown in Table 5.3.8–6. The table lists a set of accidents and their consequences in terms of an increased probability of an LCF for exposed individuals and increased number of LCFs for the offsite population. Other radiological accidents could also occur at these facilities, but their impacts would be within the envelope of the selected set of accidents.

The accident scenarios shown in Table 5.3.8–6 are briefly described below and in more detail in Appendix F.2.

The following descriptions correspond to accidents presented in Tables 5.3.8–4 and 5.3.8–6.

ACRR-Medical Isotopes Production

- *AM-1 Airplane Crash, Collapse of Bridge Crane*—For the ACRR facility, release from an airplane crash would be due to the bridge crane falling into the reactor pool, impacting the reactor superstructure, and resulting in the rupture of four fuel elements in the reactor core.
- *AM-2 Earthquake (0.22 g) and Collapse of Bridge Crane*—The postulated site-wide earthquake would cause the crane to fall onto the reactor superstructure with resultant rupture of four fuel elements. The releases for this scenario were assumed to be the same as those for the airplane crash scenario (scenario AM-1).
- *AM-3 Fuel Element Rupture*—This scenario would be initiated by a pinhole leak in the cladding of a fuel element through which water would be drawn by heat-up/cool-down cycles. Steam generation during a pulse might build up internal pressure and rupture the cladding. The fission products from one fuel element were assumed to be released into the reactor pool.
- *AM-4 Rupture of One Molybdenum-99 Target*—It was postulated that one target would rupture in the core after a 21-kW, 7-day irradiation. This accident was postulated to bound accidents involving targets that might take place during irradiation. The consequences were based on the rupture of one irradiated target in the target grid assembly in the reactor core.

Table 5.3.8–6. Potential Impacts of Radiological Facility Accidents Under the No Action Alternative

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO THE 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Annular Core Research Reactor medical isotopes production configuration	*AM-1*	Airplane crash - collapse of bridge crane	6.30×10^{-6}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
	AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	4.9×10^{-4}	5.4×10^{-8}	3.8×10^{-6}
	AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	3.9×10^{-4}	4.3×10^{-8}	3.0×10^{-6}
	AM-5	Fuel handling accident - irradiated element	1.0×10^{-4} to 1.0×10^{-6}	4.9×10^{-3}	6.1×10^{-7}	7.6×10^{-5}
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	1.6×10^{-6}	1.0×10^{-10}	4.9×10^{-8}
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0 \times 10^{-6}$	3.9×10^{-4}	4.9×10^{-8}	1.4×10^{-5}
Hot Cell Facility medical isotopes production	*HM-1*	Operator error - molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	3.8×10^{-5}	3.3×10^{-9}	1.6×10^{-7}
	HM-2	Operator error - iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	1.6×10^{-6}	1.0×10^{-10}	4.2×10^{-9}
	HM-4	Fire in glovebox	1.0×10^{-2} to 1.0×10^{-4}	2.6×10^{-3}	2.4×10^{-7}	2.3×10^{-6}
Hot Cell Facility Room 108 storage	*HS-1*	Fire in room 108, average inventories	3.3×10^{-5}	2.1×10^{-3}	1.8×10^{-7}	2.0×10^{-7}
	HS-2	Fire in room 108, maximum inventories	2.0×10^{-7}	7.9×10^{-2}	6.6×10^{-6}	7.4×10^{-6}

Table 5.3.8–6. Potential Impacts of Radiological Facility Accidents Under the No Action Alternative (concluded)

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO THE 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Sandia Pulsed Reactor	*S3M-2*	Control-element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	1.2×10^{-3}	1.5×10^{-7}	2.5×10^{-4}
	S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	7.9×10^{-3}	8.4×10^{-7}	3.8×10^{-3}
	SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	9.2×10^{-3}	5.8×10^{-7}	5.5×10^{-4}
Annular Core Research Reactor Defense Programs Configuration	*AR-1*	Uncontrolled addition of reactivity	$<1.0 \times 10^{-6}$	7.3×10^{-3}	9.3×10^{-7}	1.2×10^{-4}
	AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	1.3×10^{-3}	1.7×10^{-7}	1.2×10^{-5}
	AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	9.0×10^{-3}	1.0×10^{-6}	1.4×10^{-4}
	AR-6	Airplane crash - collapse of bridge crane	6.3×10^{-6}	5.9×10^{-3}	8.4×10^{-7}	2.2×10^{-4}

Source: Original
TA-V Facility Accident Descriptors:
ACRR - Medical Isotope Production: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell - Medical Isotope Production: HM-1, HM-2, HM-4
Hot Cell - Room 108 Storage: HS-1, HS-2
SPR: S3M-2, S3M3, SS-1
ACRR- Defense Programs: AR-1, AR-2, AR-4, AR-6

- *AM-5 Fuel Handling Accident, One Irradiated Fuel Element Rupture*—The accident was postulated to occur outside of the reactor pool, so there would be no pool mitigation. While being transferred from the ACRR pool to the GIF pool, an irradiated fuel element is dropped, impacts a hard surface, and ruptures.
- *AM-6 Airplane Crash and Fire in Reactor Room with Unirradiated Fuel and Targets Present*—The scenario postulates an airplane crash into the reactor building while the reactor is shut down in preparation for refueling. New fuel elements would be present in the reactor room awaiting insertion into the core. In addition, fresh targets would also be present, awaiting insertion after refueling. The airplane would penetrate the building and cause a large fire in the reactor room.
- *AM-7 Target Rupture During Transfer from ACRR to HCF*—A target rupture would occur in transit between the ACRR and the HCF as a result of an unspecified incident involving transport equipment or operation.

HCF

- *HM-1 Operator Error During Molybdenum-99 Target Processing*—An operator inadvertently opens the wrong valve or opens the correct valves at the wrong time. Mechanical failures of valves or transfer lines could occur, releasing the waste gases from the decay tank (cold trap).
- *HM-2 Operator Error During Iodine-125 Target Processing*—This scenario is similar to HM-1, but would occur while iodine-125 targets, rather than molybdenum-99 targets, are being processed. This scenario was postulated to occur 72 hours after irradiation. Cold trap valves would be left open when the gas is being transferred between decay storage tanks.
- *HM-4 Fire in Steel Containment Box Used for Processing Targets*—It was postulated that a large fire in the steel containment box would result in the release of the gases in the decay tank (cold trap), as in scenario HM-1, plus the fission products from one irradiated target being processed.
- *HS-1 Fire in Room 108*—A general combustible fire would be ignited by an event such as an electrical short, forklift incident, or other unspecified circumstance. Various radioactive materials ranging from fissile material to fission products in various forms would be stored in Room 108.
- *HS-2 Fire in Room 108*—This scenario, discussed above under the HS-1 scenario, involves a larger consequence and lower frequency.
- *HC-1 Earthquake (0.22 g) and Building Collapse*—This scenario is an earthquake-induced building collapse, with fire in a steel containment box and in Room 108 of the HCF. The impacts are represented by the impacts for accidents HM-4 and HS-1.

SPR

- *S3M-2 Control Element Misadjustment Before Pulse Element Insertion*—Control element positions are set for each operation to produce the desired pulse size. Control element misadjustment before pulse element insertion could result in a larger-than-anticipated superprompt critical pulse. The estimated upper limit total worth insertion of reactivity would result in the nearly complete destruction of the core and subsequent release of an abnormal amount of fission products into the reactor room and the environment.
- *S3M-3 Failure of a Fissionable Experiment*—The experiment involves the rapid heating of uranium or plutonium rods to excite the fundamental oscillation modes of the material. Plutonium experiments are required to incorporate two levels of containment; however, to encompass the worst-case, the scenario assumes no containment and the complete melt of 7,000 g of plutonium.
- *SS-1 Airplane Crash into North Vault (NOVA)*—The SWEIS analysis postulated an airplane crash into the vault, causing a large fire that releases stored radioactive material. An experiment containing plutonium-239, similar to the experiment used in scenario S3M-3 and representative of other plutonium components tested at TA-V, was assumed to be stored in the NOVA.
- *SP-1 Earthquake (0.22 g) and Building Collapse*—This scenario is an earthquake-induced SPR building collapse. This accident scenario is represented by the release from SS-1.
- *S4-1.* This scenario is the same as S3M-3, except that the accident would occur during operation of the SPR-IV reactor rather than the SPR IIIm reactor.

ACRR-DP

- *AR-1 Uncontrolled Addition of Reactivity*—An uncontrolled amount of reactivity is inserted into the core over a time frame of 80 msec. This accident is assumed to occur without regard to some initiating event or failure of a reactivity control system or violation of prescribed procedures. The absolute magnitude of the reactivity change could be caused by the addition of reactivity from either the removal of negative reactivity (control rods, transient rods, or negative worth experiment) or positive reactivity (positive worth experiment). In terms of operational capabilities, the reactivity would represent the total available in the transient bank coupled to an unplanned removal of a large negative worth experiment in the same time frame.

- *AR-2 Waterlogged Fuel Element Ruptures*—This event would be initiated by failure of a single waterlogged fuel element during a pulse from low initial power and subsequent damage to adjacent elements. The pulse would be assumed to occur when the maximum fission product inventories have built up in the core. Adjacent elements would be assumed to be damaged by the rupture of the waterlogged element. The analysis assumes failure of a total of four fuel elements, with ejection of the fuel from all four elements into the pool water.
- *AR-4 Fire in Reactor Room with Experiment Present*—A fire could affect fissionable material in an experiment, and small quantities of uranium oxide and other contaminants could be released into the local atmosphere. To bound the potential consequences of this type of scenario, the SWEIS conservatively assumed a large fire in the reactor room without specific analysis of combustible loading and ignition sources. Also, to bound the potential consequences, an experiment containing plutonium was assumed to be present in the reactor room.
- *AR-5 Earthquake (0.22 g) and Collapse of Bridge Crane*—This scenario is a seismic event that would cause the 15-ton bridge crane to fall directly on the reactor superstructure. This is assumed to damage 24 fuel elements (approximately 10 percent of the core) to the extent that their entire inventory would be released.
- *AR-6 Airplane Crash, Collapse of Bridge Crane*—In order to bound the consequences of an airplane crash, it was postulated that the crash would knock the bridge crane off its rails onto the reactor superstructure. The SWEIS analysis postulates that an airplane crash would cause collapse of the bridge crane, which would be assumed to fall directly on the reactor superstructure and damage 24 fuel elements (approximately 10 percent of the core).

NGF

- *NG-1 Catastrophic Release of NGF Tritium Inventory*—The SNL/NM SWEIS source documents provide the material at risk for this scenario in the form of facility tritium inventories of 836 Ci (SNL/NM 1998a).

ECF

- *ECF-1 Catastrophic Release of ECF Tritium Inventory*—The source documents indicate that the expected tritium inventory present at the ECF is 49 Ci. The tritium inventory is based on the amount involved in the shelf-life test (SNL/NM 1998a).

The accident for a single facility with the highest consequences to the public would be a fire in Room 108 at the HCF in TA-V (HS-2). If this accident was to occur, there would be an additional 7.9×10^{-2} LCFs in the offsite population within 50 mi of the site. There would be a increased probability of an LCF for an MEI and a noninvolved worker of 6.6×10^{-6} and 7.4×10^{-6}, respectively. The estimated frequency of occurrence for this accident is 2.0×10^{-7} per year, or less than 1 chance in 5,000,000 per year.

Involved workers run the highest risk of injury or fatality in the event of many radiological accidents discussed in this section as well as the many others that could occur. Although there are protective measures and administrative controls to protect involved workers, they are usually in the immediate vicinity of the accident where they could be exposed to radioactivity.

The impacts to the other receptors would be less than for the MEI. Details on the impacts to all receptors analyzed are provided in Appendix F.2.

Chemical Accidents

Many SNL/NM facilities store and use a variety of hazardous chemicals. The quantities of chemicals vary, ranging from small amounts in individual laboratories to bulk amounts in specially designed storage areas. In addition, the effects of chemical exposure on personnel would depend upon its characteristics, and could range from minor to fatal. Minor accidents within a laboratory room, such as a spill, could result in injury to involved workers in the immediate vicinity. A catastrophic accident such as a large uncontrolled fire, explosion, earthquake, or aircraft crash could have the potential for more serious impacts to involved workers and the public. A catastrophic accident could also release various chemicals from multiple release points and increase the potential for human exposure and serious injury.

In order to assess the impacts of chemical accidents in a bounding manner, chemical inventories at facilities were estimated and ranked using a systematic procedure described in Appendix F.3; that is, a risk hazard index (RHI). The RHI is an indicator of a specific chemical's potential to cause human injury and fatality that factors in the chemical toxicity, volatility, and inventory. For the chemical with the highest RHI in each building, a catastrophic accident involving total release of the building inventory was postulated as the bounding event, then estimates were made of chemical concentrations at various distances from the accident. The results are shown in Table 5.3.8–7. Building inventory values are shown for the source term release to reflect the variability and uncertainty in the actual amount of the chemical that could be present at the time of an accident. Similarly, estimates are shown for the range of distances within which the ERPG-2 would be exceeded. The ERPG-2 is an accepted guideline for public exposure (see Appendix F.3 for an explanation of the various ERPG levels).

In the event of a severe chemical accident in TA-I, involved workers, noninvolved workers, KAFB personnel, onsite residents, and onsite and offsite members of the public would be at risk of being exposed to chemical concentrations in excess of ERPG-2 levels. The number of individuals at risk during normal business hours is shown in Table 5.3.8–8. Although Table 5.3.8–8 shows the number of people at risk, the actual number exposed would depend on the time of day, location of people, wind conditions, and other factors.

As shown in Table 5.3.8–7, the dominant chemical accident would be a catastrophic release of arsine from Building 893 in TA-I. If the building arsine inventory (65 lb) were released, individuals within a distance of 6,891 ft from the point of release would receive exposures that exceed the ERPG-2. Figure 5.3.8–4 illustrates the KAFB locations that would be affected by these worst-case chemical accident scenarios involving the release of arsine or chlorine from Buildings 893 and 858, respectively. The plumes on the figure correspond to the areas within which the ERPG-2 would be exceeded. Some individuals within the ERPG-2 circle close to the release point could experience or develop irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. For any release, the seriousness of an exposure would generally decrease for distances further from the point of release.

In the event of an aircraft crash or earthquake involving buildings with various chemical inventories, multiple chemicals would be released. Although the impacts of mixed chemicals could be greater than individual chemicals, their behavior, dispersion, and health effects can be complex and have, therefore, not been considered quantitatively. An earthquake could also cause the release of like chemicals from multiple buildings and lead to increased concentrations where individual plumes overlap. The potential and impacts for overlapping plumes are discussed in Appendix F.7.

Aircraft Crash

Military, civilian, and commercial aircraft with various cargo land and take off on runways adjacent to KAFB. These aircraft could potentially crash into or in the vicinity of SNL/NM facilities. If such an accident were to occur, it could act as an initiator of other events at a facility that could lead to the release of hazardous radioactive and/or chemical materials. The frequency of an aircraft crash into a facility at SNL/NM and the extent of injury to personnel and damage to property and the environment depend upon many factors. Factors include aircraft size, type, speed, and impact angle; air traffic patterns and takeoff/landing frequencies; and the dimensions of the facility and the robustness of its construction. Estimates of an aircraft crash into SNL/NM facilities have been made and are discussed in Appendix F, Section F.5. Aircraft crash frequencies were used where applicable as facility accident initiating events.

Other Accidents

Other types of potential accidents would have impacts that were not measured in terms of LCFs or chemical concentrations. These could cause serious injury or fatality for humans or impacts to the nonhuman environment such as the ecology, historic properties, or sensitive cultural sites.

- *Brush Fires*—Small fires are expected and planned for during outdoor testing that involves propellants and explosives. The potential exists for brush and forest fires when hot test debris or projectiles come in contact with combustible elements in the environment. One such incident was reported in 1993 in TA-III when a rocket motor detonated during a sled track impact test and resulted in a 40-ac brush fire. An accident at the Aerial Cable Facility in the Coyote Test Field resulted in a fire that swept up the side of a mountain before being extinguished by SNL/NM workers. Many others have occurred that were contained in the immediate vicinity of the test area. Measures would be taken to prevent fires and, should a fire occur, the effects would be mitigated by

Table 5.3.8–7. Potential Impacts of Chemical Accidents under the No Action Alternative

BUILDING	CHEMICAL	BUILDING INVENTORY (lb)	ERPG-2 LEVEL (ppm)	ERPG-2 EXCEEDANCE DISTANCE (ft)	FREQUENCY (per year)
823	Nitrous Oxide	32.17	125	351	$1.0x10^{-3}$ to $1.0x10^{-4}$
858	Chlorine	106.41	3		$1.0x10^{-3}$ to $9.7x10^{-5}$
869	Nitric Acid	18.6	15		$1.0x10^{-3}$ to $1.0x10^{-4}$
878	Nitrous Oxide	50	125	426	$1.0x10^{-3}$ to $3.2x10^{-5}$
880	Hydrofluoric Acid	2	20	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
883	Phosphine	6.8	0.5	3,357	$1.0x10^{-3}$ to $1.0x10^{-4}$
884	Hydrofluoric Acid	10	20		$1.0x10^{-3}$ to $1.0x10^{-4}$
888	Fluorine	0.07	1	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
893	Arsine	65	0.5	6,891	$1.0x10^{-3}$ to $1.0x10^{-4}$
897	Chlorine	4.4	3	699	$1.0x10^{-3}$ to $6.6x10^{-5}$
905	Thionyl Chloride	101.1	5		$1.0x10^{-3}$ to $9.0x10^{-5}$

Sources: DOE 1996f, NSC 1995 [See also Appendix F, Tables F.3–4 and F.5–2]
ERPG: Emergency response planning Guideline
ft: feet
lb: pound
NR: Not Reported. The model did not provide a plume footprint due to near field unreliability.
No population estimations are available.
ppm: parts per million
TA: technical area
Note: Frequency ranges from $1.0x10^{-3}$ for an earthquake in TA-I to $1.0x10^{-4}$ for an airplane crash into a generic building.

823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility

Table 5.3.8–8. Maximum Impacts of Chemical Accidents on Individuals Within KAFB Under the No Action Alternative

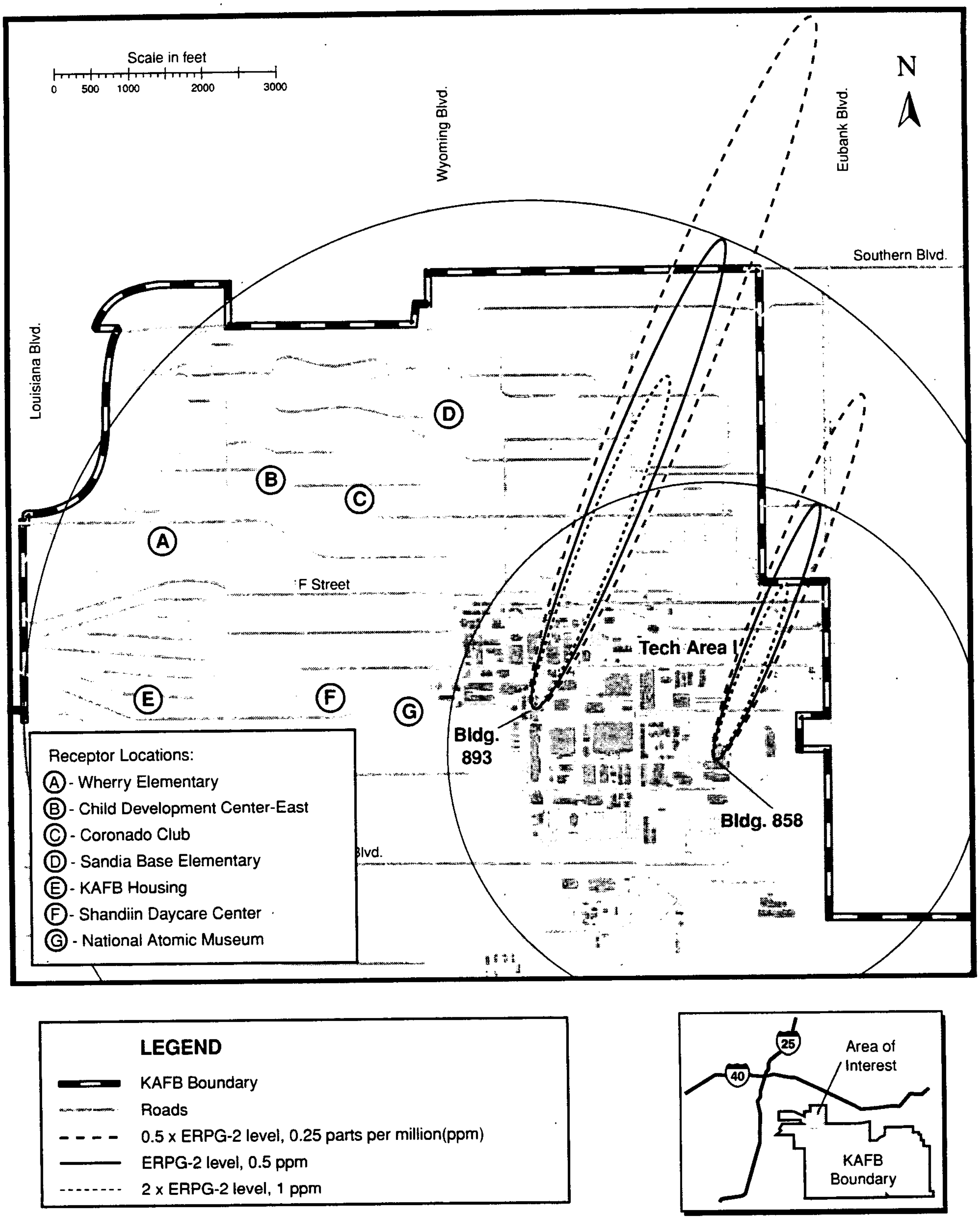
BUILDING	CHEMICAL NAME	RELEASE (lb)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)	NUMBER OF PEOPLE WITHIN ERPG-2 PLUME
823	Nitrous Oxide	32.17	351	2
858	Chlorine	106.41	3,726	141
869	Nitric Acid	18.6	666	6
878	Nitrous Oxide	50	426	3
880	Hydrofluoric Acid	2	NR	NR
883	Phosphine	6.8	1,440	100
884	Hydrofluoric Acid	10	504	2
888	Fluorine	0.07	NR	NR
893	Arsine	65	4,884	409
897	Chlorine	4.4	699	5
905	Thionyl Chloride	101.1	2,067	55

Source: Bleakly 1998c (See also Appendix F, Table F.3–6)
ALOHA: Areal Location of Hazardous Atmosphere (model)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound
NR: Not Reported. The model did not provide a plume footprint due to near-field unreliability. No population estimates are available.
823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility

activating fire fighting facilities in the test area (DOE 1995a, SNL/NM 1993d, SNL/NM 1998i).

- *Natural Phenomena*—Naturally occurring events such as tornadoes, lightning, floods, and heavy snow, as documented in existing SNL/NM safety documentation, were considered for their potential to initiate the accidental release of radioactive, chemical, and other hazardous materials that affect workers and the public. Any of these events, should they occur, could also lead to serious injury or fatality as a result of the physical and destructive forces associated with the events. The risks of such events to workers and the public would be equivalent to everyday risks from naturally occurring events to the general public wherever they work and reside.

- *Spills and Leaks*—The potential would exist throughout SNL/NM for the accidental spill of radioactive, chemical, or other hazardous materials. The effects of such spills on workers and the public through airborne pathways were considered earlier in this section. The impacts from pathways other than airborne would normally be bounded by exposure from airborne pathways. Any spill of a hazardous substance would have the potential for impacts to the nonhuman elements of the environment. A spill could make its way into surface and groundwater systems, affecting water quality and aquatic life. Spills of flammable substance could cause fires that damage plant and animal life and other land resources. There have been spills of hazardous substances at the SNL/NM site that had the potential to affect the nonhuman elements of the environment. In 1994,



Note: See Table 5.3.8–8

Figure 5.3.8–4. Projected Extent of Emergency Response Planning Guideline Level 2 from Accidental Release of Arsine (Bldg. 893) and Chlorine (Bldg. 858)

The encircled areas represent locations that could be above ERPG-2 levels, depending on the wind direction, for an accidental release of arsine (Building 893) or chlorine (Building 858) under the No Action Alternative.

over 100 gal of oil were spilled at the Centrifuge Complex in TA-III when a hydraulic pump failed during a centrifuge test, causing a potential impact to the nonhuman elements of the environment. Also in 1994, a small spill of transformer oil occurred from an oil storage tank in TA-IV when a gasket failed and, at the Coyote Test Field, a leaking underground storage tank containing ethylene glycol was discovered.

- *Radiological and Chemical Contamination*—Some accidents analyzed in this section, and others that were considered but not analyzed, could potentially impact the nonhuman elements of the environment. Any accidentally released chemicals would result in concentrations that would typically decrease with increasing distance from the point of release. While chemical concentrations would diminish over distance to a point where a human hazard would no longer be present, the concentrations could still affect other elements of the environment such as the ecology, water quality, and cultural resources. Radiological releases could also affect nonhuman elements of the environment. After an accident, SNL/NM, through their spill and pollution control and radiological emergency response plans, are required to assess the potential for ground contamination; if contamination exceeds guidance levels, plans will be developed for remediation.
- *Industrial*—In addition to radioactive and chemical materials and explosives, many SNL/NM facilities conduct operations and use materials and equipment that could also be potentially hazardous to workers. These hazards are typically referred to as normal industrial hazards, not unlike similar hazards that workers are exposed to throughout the nation, and include working with electricity, climbing ladders, welding, and driving forklifts. The SWEIS acknowledges the existence of, but does not analyze, normal industrial hazards. All operations and activities at SNL/NM facilities, as well as all DOE facilities, would be subject to administrative procedures and safety features designed to prevent accidents and mitigate their consequences should they occur.

5.3.9 Transportation

Under the No Action Alternative, transportation impacts were assessed for each of three ROIs: KAFB; major Albuquerque roadways; and major roadways between Albuquerque and specific waste disposal facilities, vendors, and other DOE facilities. This analysis involved estimating the number of trips made by SNL/NM-associated vehicles under normal operations in each of these transportation corridors. Transportation projections were based on data provided by SNL/NM or material inventory multipliers developed and presented in Appendix A.

5.3.9.1 Transportation of Material and Wastes

The number of material shipments received by SNL/NM is generally proportional to total SNL/NM material consumption. According to facility projections, material consumption under the No Action Alternative would increase by 84 percent overall through the year 2003, and by 96 percent through the year 2008. Therefore, total material shipments would also increase during the same time frame, although not necessarily for all types of material.

Radioactive and explosive material shipments are often delivered through government carriers, unless the quantities and activities being transported are low enough to meet the Federal guidelines and restrictions in place for authorized commercial transporters. Government carriers operate on an as-needed basis; thus, the increase in material inventory under the No Action Alternative would result in a similar increase in these kinds of shipments.

Due to their primary shipment method, there would be very little change to the number of chemical shipments made to SNL/NM. Chemicals that are ordered infrequently and in small quantities under the just-in-time (JIT) program are usually shipped to SNL/NM by way of commercial carriers such as Federal Express and United Parcel Service (UPS). These carriers make daily shipments to SNL/NM to deliver packages other than chemicals, and an increase in the volume of chemicals they handle per shipment would not generally increase shipment frequency. Similarly, major chemical vendors who deliver their own material, rather than use a commercial carrier, also usually make daily shipments to SNL/NM. Therefore, any increase in the volume of material that major vendors ship per load would not have an impact on the frequency of those shipments. Thus, chemical shipments would remain at approximately the same level regardless of the fluctuations in material consumption.

Considering the above factors, overall material transportation due to normal operations would increase by 50 percent over baseline levels through the year 2003 and by 52 percent through the year 2008. The anticipated annual and daily material receipts and shipments for each material category are presented in Table 5.3.9–1. The analysis assumed that SNL/NM has 250 work days per calendar year.

Table 5.3.9–1. SNL/NM Annual Material Receipts/Shipments Under the No Action Alternative

MATERIAL TYPE		BASE YEAR (1997) ANNUAL SHIPMENTS	NO ACTION ALTERNATIVE ANNUAL SHIPMENTS	
			2003	2008
Radioactive		305	562	597
Radioactive (medical isotopes production)	*Receiving*	0	16	16
	Shipping	0	1,140	1,140
Chemical		2,750	2,750	2,750
Explosive		303	557	593
TOTAL		**3,358**	**5,025**	**5,096**

Sources: FWENC 1998a, b; SNL/NM 1998s, 1998z, 1998a

Waste Transportation

With the exception of solid waste, the amount of waste shipped from SNL/NM to disposal facilities correlates directly to SNL/NM waste generation levels. Overall, waste shipments offsite would also increase under the No Action Alternative. Waste shipments for 2003 and 2008 include waste currently disposed of at the KAFB landfill, approximately 741 shipments for all alternatives. The total anticipated waste shipments during all operations for each type of waste are presented in Table 5.3.9–2 and Appendix G, Table G.3–3.

This analysis indicates there would be an actual 302 percent increase in all offsite waste shipments through the year 2003 and a 305 percent increase through the year 2008 under the No Action Alternative (see Appendix G for details). Of this increase, 285 percent is considered to be waste currently disposed of at the KAFB landfill. This leaves real increases of 17 percent through 2003 and 20 percent through the year 2008.

Table 5.3.9–2. Annual (Summary) Waste Shipments from Normal Operations Under the No Action Alternative

WASTE TYPE	BASE YEAR SHIPMENTS	2003 SHIPMENTS	2008 SHIPMENTS
LLW (1996)[a]	4	13	13
LLMW (1996)	1	3	3
Hazardous (RCRA+TSCA) (1997)	102	118	122
Recyclable[a,b] *(Hazardous and Nonhazardous) (1997)*	86	231	231
Solid[b] *(Municipal, Construction, and Demolition) (1997)*	51	650	650

Sources: Rinchem 1998a; SNL/NM 1998a, 1998y, n.d.(d)
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Excludes decontamination and decommissioning
[b] Recyclable and solid wastes currently handled by the KAFB landfill could be shipped offsite in the future, contributing an additional 741 shipments.

Specials Projects

Two special project wastes, ER Project and legacy, were addressed separately due to their one-time operation/project status and in order to avoid skewing the SNL/NM normal operations impact. Legacy wastes would be anticipated to account for an additional 18 shipments of LLW, 3 shipments of LLMW, and 2 shipments of TRU/MTRU wastes over the 10-year time frame (see Figures 4.12–1, 4.12–2, and 4.12–3). In 1998 through 2000, the ER Project could account for up to a total of 312 offsite shipments of LLW, 101 offsite shipments of LLMW, 2 offsite shipments of RCRA waste, 5 offsite shipments of *Toxic Substances Control Act* (TSCA) waste, and 75 shipments of nonhazardous waste. Both of these special projects have been included within the total facility risks.

Offsite Receipts and Shipments of Material and Waste

The bounding case for this analysis assumed that each material and waste shipment is composed of two trips: one to and one from SNL/NM. Thus, in 2008, the total number of trips made by material and waste transporters under this alternative would be 12,296 (total shipments x 2). Assuming that the year is comprised of 250 work days, the average work day traffic within KAFB contributed by these carriers would be approximately 49 trips. This comprises 0.17 percent of all SNL/NM commuter trips (28,522 trips per day) entering and exiting KAFB in 2008. The total SNL/NM vehicular traffic under this alternative would comprise 36 percent of total 2008 KAFB traffic. SNL/NM waste and material truck traffic would account for 0.06 percent of KAFB traffic. Therefore, the overall KAFB traffic would remain constant under the No Action Alternative.

Shipments of Material and Waste in the Albuquerque Area

Total SNL/NM placarded material and waste shipments comprise 0.96 percent of the total placarded truck traffic shipments entering the greater Albuquerque area during the base year (1996 or 1997). Although a 70-percent increase in SNL/NM placarded material and waste truck traffic would be expected by 2008, the SNL/NM truck component would represent only 1.4 percent of all placarded trucks entering Albuquerque. This increase includes waste currently managed at the KAFB landfill and new shipments from medical isotopes production. ER Project wastes and legacy wastes are addressed separately under special projects. Thus, the impacts under the No Action Alternative would be negligible (see Table 5.3.9–3).

Placarded Trucks

Trucks that carry any quantity of a hazardous material are required to have U.S. Department of Transportation (DOT) markings on each side and end. These trucks are called placarded trucks. These markings, requirements, and exclusions are defined in 49 CFR Part 172.500. There are nine categories of material (hazard class or division number) placards, such as explosive, radioactive, oxygen, flammable gas, and combustible. Examples are shown below.

Table 5.3.9–3. 24-Hour Placarded Material and Waste Truck Traffic Counts Under the No Action Alternative

ROUTE (ALL TRAFFIC)[b]	BASE YEAR (1995) (480,577)[b]	2003 (526,712)[b]	2008 (555,547)[b]
I-25 North (52,400)	230	253	268
I-25 South (18,000)	94	103	110
I-40 West (16,400)	621	683	725
I-40 East (54,200)	569	626	664
TOTAL (141,000)	**1,514**	**1,665**	**1,767**
SNL/NM[c]	**14.5**	**24.3**	**24.6**

Sources: Scientific Services 1995, SNL/NM 1998a
I:Interstate
[a] Total vehicle count for all types of vehicles entering and departing Albuquerque
[b] Bernalillo county population projections
[c] SNL/NM placarded trucks (daily average)

Shipments of Material and Waste Outside of Albuquerque

All material and waste transported by truck between SNL/NM and locations outside of Albuquerque typically enter and depart the city by way of Interstate-25 or Interstate-40. Table 5.3.9–3 presents the impacts to those corridors from material and waste shipments under the No Action Alternative. The specific remote facility locations are listed in Section 4.11. Daily SNL/NM material and waste truck figures were derived for comparison purposes by dividing the annual waste and material shipment totals in Tables 5.3.9–1 and 5.3.9–2 by the approximately 250 work days in a calendar year.

Albuquerque population projections were also taken into consideration. The 2020 Socioeconomic Forecast projects a 30-percent population increase in Bernalillo county from the base year (1995) (MRGCOG 1997b), and it was assumed for the bounding case that this would increase proportionally at a rate of 1.2 percent per year for all traffic. For this analysis, it was assumed the total placarded truck traffic would also increase by 1.2 percent annually.

The SNL/NM overall material and waste truck traffic component would be expected to increase from 14.5 shipments per day to 24.6 shipments per day by 2008. While this would represent a 70-percent increase in SNL/NM shipments per day, SNL/NM shipments of 24.6 per day would represent only 1.4 percent of the total number of shipments (1,767) on the Albuquerque interstates. Furthermore, the SNL/NM truck traffic would comprise less than 0.015 percent of all traffic, including all types of vehicles, projected to be entering and departing Albuquerque in 2008. For the base year (1996 or 1997), waste leaving Albuquerque represented 35 percent of the total shipments, with an additional 20 percent going to Rio Rancho. Because most materials are supplied through the JIT vendors, origination points are generally not known. However, most vendors use local suppliers; therefore, in the base year, 82 percent of material was assumed to be provided locally, with the remaining 18 percent coming from outside Albuquerque. Thus, the impact to this ROI from the No Action Alternative would be negligible.

5.3.9.2 Other Transportation (Traffic)

Overall vehicular traffic impacts under the No Action Alternative were assessed by projecting the total increased number of SNL/NM commuter vehicles traveling to and from SNL/NM in 2003 and 2008. The term "commuter" includes all vehicles operated by SNL/NM employees, contractors, and visitors; DOE employees; and additional traffic, such as delivery vehicles.

Traffic on KAFB

Table 5.3.9–4 presents general anticipated traffic impacts at KAFB under the No Action Alternative. The number of SNL/NM commuter vehicles traveling to the site each work day was conservatively assumed to increase at the same rate as the SNL/NM work force level (Section 5.3.12, Socioeconomics). KAFB operations and commuter levels were assumed to remain constant through 2008. Based on this analysis, overall KAFB traffic would increase by 1.8 percent under this alternative. Air quality impacts resulting from traffic are discussed in Section 5.3.7.

Table 5.3.9–5 shows projected 24-hour KAFB vehicular flow for each of the three main gates under the No Action Alternative. It was assumed that the Carlisle and Truman gates would be used primarily by KAFB personnel and not by SNL/NM employees. For the bounding case for this analysis, it was assumed that the SNL/NM contribution to total KAFB flow at each gate would fluctuate by the same factor as the total

Table 5.3.9–4. KAFB Daily Traffic Projections Under the No Action Alternative

COMPONENT	BASE YEAR (1996-1997)			2003			2008			CHANGE IN BASE YEAR BY 2008 (%)
	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	
SNL/NM Commuters	36	13,582	27,164	37	14,125	28,250	37	14,261	28,522	5
KAFB Commuters	64	24,145	48,290	63	24,145	48,290	63	24,145	48,290	0
Total KAFB Commuter Traffic	**100**	**37,727**	**75,453**	**100**	**38,170**	**76,640**	**100**	**38,406**	**76,812**	**1.8**
SNL/NM Material & Waste Transporters	0.04	14.5	29	0.06	24.3	49	0.06	24.6	49	70[a]

Sources: SNL/NM 1997a, 1998a

[a]This increase represents inclusion of waste currently managed at the KAFB landfill and new shipments from medical isotopes production.

fluctuation in SNL/NM traffic under this alternative.

Based on this analysis, the daily KAFB gate traffic would increase by 1.8 percent under the No Action Alternative. This minimal change would not have an appreciable impact on service at the gates.

Short-term adverse traffic impacts would potentially occur onsite during routine construction activities at KAFB due to traffic lane restrictions, reduced speeds in construction areas, and traffic increases in slowly moving heavy equipment. These common occurrences would take place during the modification of Gibson Boulevard to Eubank Boulevard, as part of a bypass of KAFB, or any other construction project. The degree of traffic impact would be a function of the location, extent of the project scope, and duration. Building construction and onsite roadway rehabilitation are currently planned under the No Action Alternative. Short-term circulation impacts would potentially occur if vehicles are rerouted to avoid construction areas. However, it is anticipated that adequate detour routes and signage would be provided and that the impacts would be minimal and limited in duration.

Traffic in the Albuquerque Area

To determine the traffic impacts in the Albuquerque traffic corridor, roadways most likely to be affected by SNL/NM traffic were selected for analysis. The bounding case used the projected SNL/NM traffic contributions from Table 5.3.9–5 to approximate the SNL/NM component of the total traffic count for each roadway. For worst-case impacts, the SNL/NM traffic component was assumed to be equivalent to the total SNL/NM traffic at the nearest gate. In actuality, a significant percentage of traffic would likely diffuse onto other nearby roads, which would greatly reduce the magnitude of the SNL/NM component. The SNL/NM component was also assumed to increase at the same rate on each roadway in proportion to the SNL/NM projected work force level.

Albuquerque population projections were also taken into consideration. The 2020 Socioeconomic Forecast (MRGCOG 1997b) projects a 30-percent population increase in Bernalillo county from the base year (1995), and it was assumed for the bounding case that this would increase proportionally at a rate of 1.2 percent per year. For this analysis, it was also assumed the total roadway traffic flow would increase by the same 1.2 percent annually. The projected impacts to these roadways under the No Action Alternative, according to the bounding case factors, are presented in Table 5.3.9–6.

This analysis indicates that although SNL/NM traffic would increase slightly, the SNL/NM component of total Albuquerque traffic would actually decrease from 19 percent to 17 percent by 2008. This is due to the general population growth in Bernalillo county, which would exceed SNL/NM's growth rate.

Table 5.3.9–5. Total KAFB Gate Traffic Under the No Action Alternative

GATE	BASE YEAR (1996)			NO ACTION ALTERNATIVE						% CHANGE IN BASE YEAR BY 2008
				2003			2008			
	24-HOUR SNL/NM[a]	24-HOUR TOTAL[b]	PEAK HOUR[c]	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	GATE TOTAL
Wyoming	7,141	19,835	1,941	7,427	20,121	1,972	7,498	20,192	1,976	1.8
Eubank	5,324	14,788	2,683	5,537	15,001	2,726	5,590	15,053	2,731	1.8
Gibson	8,108	22,523	1,571	8,432	22,847	1,596	8,513	22,928	1,599	1.8
Average	6,858	19,048	2,065	7,132	19,323	2,098	7,200	19,391	2,102	1.8

Sources: USAF 1995e, SNL/NM 1997a

[a] SNL/NM commuter and transporter trips per day equals 36 percent of total KAFB trips per day

[b] Total KAFB trips per day

[c] Total KAFB trips per hour, 1996 traffic counts

Table 5.3.9–6. Albuquerque Daily Traffic Counts Under the No Action Alternative

ROADWAY		BASE YEAR[a] (480,577)[b]		2003 (526,712)[b]		2008 (555,547)[b]		% CHANGE IN BASE YEAR BY 2008
		DAILY[c]	PEAK[d]	DAILY	PEAK	DAILY	PEAK	DAILY
Gibson west at Louisiana	*TOTAL*	15,671	2,066	17,175	2,264	18,116	2,388	+15.6
	SNL/NM	8,108	1,069	8,432	1,111	8,513	1,122	+5
	% SNL/NM	52		49		47		-9.6
Wyoming south of Lomas	*TOTAL*	37,639	2,293	41,252	2,513	43,511	2,651	+15.6
	SNL/NM	7,141	435	7,427	452	7,498	457	+5
	% SNL/NM	19		18		17		-10.5
Eubank south of Copper	*TOTAL*	14,572	1,852	15,971	2,030	16,845	2,141	+15.6
	SNL/NM	5,324	677	5,537	704	5,590	710	+5
	% SNL/NM	37		35		33		-10.8
Interstate 25 at Gibson[e]	*TOTAL*	91,000		99,736		105,196		+15.6
	SNL/NM	8,108		8,432		8,513		+5
	% SNL/NM	8.9		8.5		8.1		-9.0
Interstate 40 at Eubank[e]	*TOTAL*	90,300		98,969		104,387		+15.6
	SNL/NM	5,324		5,697		5,590		+5
	% SNL/NM	5.9		5.8		5.4		-8.5
Wyoming north of KAFB gate	*TOTAL*	20,272	1,749	22,218	1,917	23,434	2,022	+15.6
	SNL/NM	7,141	612	7,427	636	7,498	642	+5
	% SNL/NM	35		33		32		-8.6

Sources: MRGCOG 1997b, 1997c; SNL/NM 1997b, 1998a; UNM 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Bernalillo county population projections

[c] Vehicles per day, *1996 Traffic Flows for the Greater Albuquerque Area*

[d] Vehicles per hour, *1996 – 1998 Traffic Counts*

[e] Peak hour counts are not available for this intersection.

Traffic Outside of Albuquerque

The additional local SNL/NM traffic under the No Action Alternative would have minimal impacts on transportation routes between Albuquerque and other DOE facilities, vendors, and disposal facilities (see Section 4.11 for a list of these facilities). In a worst-case assessment, the baseline year SNL/NM component would represent an average 18.8 percent of the total traffic count (144,000 vehicles per day) on major roadways entering and departing Albuquerque. This assumes that all SNL/NM traffic would actually enter and depart Albuquerque by way of the interstates every day, although a significant portion of SNL/NM traffic would more likely diffuse onto other roadways and remain in Albuquerque. Regardless, the overall SNL/NM traffic component would actually decrease under the No Action Alternative by the year 2008. This is due to the projected general population growth in Bernalillo county, which would exceed SNL/NM's growth rate.

Offsite and onsite transportation activities were compared to determine if offsite shipments were conservatively bounding for estimating risk to the public (see Appendix G). The primary factor considered was distance traveled and the potential for public exposure. The longest anticipated route for a routine shipment was selected for a conservative analysis. Mountaintop, Pennsylvania, was chosen for radioactive material and Silverdale, Washington, was chosen for explosive material. Both locations exceed 1,500 mi from SNL/NM. The longest distance chosen for onsite transfers was 12 mi. One 1,500-mi shipment would approximate 125 onsite transfers of 12 mi. Onsite transfers would be in areas of very limited public access compared to offsite transportation activities, providing another level of public protection. Based on these assumptions, offsite transportation hazards would bound onsite transfers.

5.3.9.3 Transportation Risks Associated with Normal Operations

Incident-Free Exposure

The representative conservative cases for this analysis used the distances traveled by SNL/NM waste and material carriers, as listed in Table 5.3.9–7. These distances were based on the average distance traveled by trucks in route to other facilities under the No Action Alternative.

Truck emissions are a function of the number of truck shipments to and from SNL/NM. The bounding case for a truck emissions impact analysis assumed that the greatest risk occurs when shipments are transported through urban areas, such as the Albuquerque transportation corridor, because these areas are most susceptible to emissions-related problems. To evaluate the actual risk associated with SNL/NM truck shipments, the most common origin and destination of all shipments of concern were compiled to determine the urban distance each material or waste would be transported (Section 4.11). Table 5.3.9–8 presents truck emissions impacts resulting from the No Action Alternative, projected for 2008, the year determined to pose the greatest increased risk.

Based on this analysis, the truck emissions due to increased SNL/NM truck traffic under the No Action Alternative would increase by 71 percent through the year 2008.

The radiological impact of exposure to incident-free routine transportation of radioactive materials was analyzed using *RADTRAN 4* (SNL 1992a), as described in Appendix G. Routes and population densities were modeled using *HIGHWAY* (Johnson et al. 1993). Results of these calculations are presented in Table 5.3.9–9.

In the absence of an accident that compromises package integrity, no incident-free chemical or explosive exposure would be foreseen to affect the public, workers, or vehicle transport crews under this alternative.

5.3.9.4 Transportation Risks Associated with Accidents

General Accidents

Accident impacts resulting from the No Action Alternative were developed using the projections for 2003 and 2008. The bounding case assumed that the percent increase in accidents would be equal to the percent increase in SNL/NM traffic under this alternative. Therefore, SNL/NM traffic accidents would increase from the base year (1996 or 1997) by 4 percent through 2003 and by 5 percent over the base year occurrences through the year 2008.

Hazardous Material/ Waste-Related Accidents

In conjunction with traffic fatality statistics (SNL 1986), the SNL/NM material and waste shipments projected in Table 5.3.9–1 and Table 5.3.9–2 were used to project the truck accident fatality incidence rate that would be expected under the No Action Alternative. Details of the analysis are presented in Appendix G. These impacts are presented in Table 5.3.9–10. Based on this analysis, accident fatalities due to SNL/NM truck transportation would nearly double through the year 2008. This would mean that fatalities would go from 0.22 in the base year (1996 or 1997) to 0.49 by 2008.

5.3.9.5 Radiological Transportation Accidents

The annual risks to the population due to transportation accidents that potentially involve radiological releases resulting from the No Action Alternative are presented in Table 5.3.9–11.

This analysis indicates that the incidences of LCFs due to the worst-case radiological transportation accident would increase from $1.2x10^{-3}$ to $2.6x10^{-5}$ LCFs by 2008 under the No Action Alternative. In addition, $2.2x10^{-3}$ LCFs could result from legacy and ER Project waste shipments. For more information, see Appendix G.

Risks due to radiological, chemical, and explosives accidents were evaluated and are discussed in detail in Appendix F. The bounding transportation accident analysis involves explosion of a tractor-trailer containing 40,000 ft^3 of hydrogen at standard temperature and pressure. Based on the results presented in Appendix F, Table F.4–1, the hydrogen explosion would result in structural damage to buildings up to a distance of 91 m from the truck. Fatalities would result up to a distance

Table 5.3.9–7. Truck Traffic Bounding Case Distances

MATERIAL TYPES[a]	ORIGIN-DESTINATION	DISTANCE (km)
Radioactive[b]	SNL/NM Bounding distance to Mountain Top, PA	3,022
Chemical	Albuquerque to SNL/NM	40
Explosive	SNL/NM to Silverdale, WA	2,406
LLW	SNL/NM to Clive, UT	1,722
LLMW[c] *(Receipt)*	SNL/CA to SNL/NM	1,780
LLMW (Shipment)	SNL/NM to Savannah River Site, SC	2,548
Hazardous Waste (Shipment)	SNL/NM to Clive, UT	1,722
Hazardous Waste (Receipt)	Local	13
Hazardous Waste (California) (Recyclable)	SNL/NM to Anaheim, CA	1,306
Hazardous Waste (Local) (Recyclable)	SNL/NM to Albuquerque, NM	32
Hazardous Solid Waste (D&D)	Local	32
Nonhazardous Solid Waste (Recyclable)	Local	32
Nonhazardous Landscaping (Recyclable)	SNL/NM to Rio Rancho, NM	50
Solid Waste (Municipal and C&D)	SNL/NM to Rio Rancho Sanitary Landfill, NM	50
TRU/MTRU[d] *Waste*	SNL/NM to Los Alamos National Laboratory, NM	167
Hazardous Waste TSCA-PCBs (D&D)	SNL/NM to Clive, UT	1,722
Hazardous Waste TSCA-Asbestos (D&D)	SNL/NM to Mountainair, NM	190
LLW (D&D)	SNL/NM to Clive, UT	1,722
Biohazardous Waste (Medical)	SNL/NM to Aragonite, UT	1,114
Legacy LLW (Storage)	SNL/NM to Clive, UT	1,722
Legacy LLMW (Storage)	SNL/NM to Savannah River Site, SC	2,548
Legacy TRU/MTRU (Storage)	SNL/NM to Los Alamos National Laboratory, NM	167
LLW (ER Project)	SNL/NM to Clive, UT	1,722
LLMW (ER Project)	SNL/NM to Savannah River Site, SC	2,548
RCRA Hazardous Waste (ER Project)	SNL/NM to Clive, UT	1,722
Nonhazardous Solid Waste (ER Project)	SNL/NM to Rio Rancho, NM	50

Sources: SNL 1992a, SNL/NM 1998a, DOE 1996h
C&D: construction and demolition
Ci: curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
km: kilometers
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic waste
TSCA: *Toxic Substances Control Act*
[a] Material types are used in or generated from normal operations unless otherwise noted.
[b] Shipment consisted of 100 kg of depleted uranium; the composition is given in Table 6.4–2.
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium-24; Transport Index= 0.1
[d] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index= 1.0

Table 5.3.9–8. No Action Alternative Incident-Free Exposure: Truck Emissions

CARGO	UNIT RISK[a] FACTOR PER URBAN KILO-METER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL SHIPMENTS			ANNUAL LCFs		
				BASE YEAR[b]	2003	2008	BASE YEAR[b]	2003	2008
NORMAL ROUTINE OPERATIONS									
RAD Materials	$1.0x10^{-7}$	73.0	$1.5x10^{-5}$	305	562	597	$4.6x10^{-3}$	$8.4x10^{-3}$	$9.0x10^{-3}$
Explosives	$1.0x10^{-7}$	48.0	$9.6x10^{-6}$	303	557	593	$2.9x10^{-3}$	$8.3x10^{-3}$	$5.7x10^{-3}$
Chemicals	$1.0x10^{-7}$	8.0	$1.6x10^{-6}$	2,750	2,750	2,750	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$
LLW	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	4	13	13	$2.6x10^{-5}$	$8.6x10^{-5}$	$8.6x10^{-5}$
LLMW (shipments)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	1	3	3	$8.1x10^{-6}$	$2.4x10^{-5}$	$2.4x10^{-5}$
LLMW (receipts)	$1.0x10^{-7}$	35.6	$7.1x10^{-6}$	0	1	1	0	$7.1x10^{-6}$	$7.1x10^{-6}$
Medical Isotopes Production (receipts)	$1.0x10^{-7}$	NA	NA	NA	16	16	NA	$2.0x10^{-3}$	$2.0x10^{-3}$
Medical Isotopes Production (shipments)					1,140	1,140			
Hazardous Waste	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	64	80	84	$4.2x10^{-4}$	$5.3x10^{-4}$	$5.5x10^{-4}$
Recyclable Hazardous to California	$1.0x10^{-7}$	23.0	$4.6x10^{-6}$	2	3	3	$9.2x10^{-6}$	$1.4x10^{-5}$	$1.4x10^{-5}$
Recyclable Hazardous to New Mexico	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	6	8	8	$7.8x10^{-6}$	$1.0x10^{-5}$	$1.0x10^{-5}$
Solid Waste	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	51	51	51	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	1	1	1	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$
D&D Hazardous Waste TSCA-Asbestos	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	14	14	14	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$
Biohazardous Waste	$1.0x10^{-7}$	24.0	$4.8x10^{-6}$	1	1	1	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$
Recyclable D&D Hazardous Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	22	22	22	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	78	78	78	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
Nonhazardous Landscaping Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	142	142	NA	$2.8x10^{-4}$	$2.8x10^{-4}$

Table 5.3.9–8. No Action Alternative Incident-Free Exposure: Truck Emissions (concluded)

CARGO	UNIT RISK[a] FACTOR PER URBAN KILO-METER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL SHIPMENTS			ANNUAL LCFs		
				BASE YEAR[b]	2003	2008	BASE YEAR[b]	2003	2008
Construction and Demolition Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	599	599	NA	$1.2x10^{-3}$	$1.2x10^{-3}$
RCRA Hazardous Waste (receipt)	$1.0x10^{-7}$	3	$6.0x10^{-7}$	12	25	25	$7.2x10^{-6}$	$1.5x10^{-5}$	$1.5x10^{-5}$
LLW (D&D)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	4	4	4	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$
TOTAL[b,c]							**$1.33x10^{-2}$**	**$2.3x10^{-2}$**	**$2.4x10^{-2}$**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS									
TRU/MTRU	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	1	3	0	$1.7x10^{-6}$	$5.1x10^{-6}$
TRU/MTRU (legacy)	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	0	2	0	0	$3.4x10^{-6}$
LLW (legacy)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	56	0	0	$3.7x10^{-4}$
LLMW (legacy)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	0	8	0	0	$6.5x10^{-5}$
LLW (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	136	0	0	$9.0x10^{-4}$
LLMW (ER)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	0	5	0	0	$4.1x10^{-5}$
Hazardous Waste (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	113	0	0	$7.5x10^{-4}$
Nonhazardous Solid Waste(ER)	$1.0x10^{-7}$	10	$2.0x10^{-6}$	0	0	9	0	0	$1.8x10^{-5}$
TOTAL[b,c]							**0**	**$1.7x10^{-6}$**	**$2.1x10^{-3}$**

Sources: DOE 1996h; SNL/NM 1982, 1997b, 1998a; SNL 1992a
D&D: decontamination and decommissioning
ER: environmental restoration
km: kilometers
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: Not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] LCFs per km of urban travel
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated LCFs from annual shipments and total special project shipments

Table 5.3.9–9. Doses to Crew and Public Under the No Action Alternative

CARGO	ANNUAL DOSE/ TRUCK CREW (PERSON-REM)			ANNUAL DOSE/ GENERAL PUBLIC (PERSON-REM)			ANNUAL LCFs		
	BASE YEAR[a]	2003	2008	BASE YEAR[a]	2003	2008	BASE YEAR[a]	2003	2008
NORMAL ROUTINE OPERATIONS									
RAD Materials [b]	9.8	18.0	19.1	82.4	151.7	161.2	$4.5x10^{-2}$	$8.3x10^{-2}$	$8.8x10^{-2}$
LLW	0.21	0.68	0.68	0.6	2.0	2.0	$3.8x10^{-4}$	$1.3x10^{-3}$	$1.3x10^{-3}$
LLMW [c]	$1.6x10^{-4}$	$5.9x10^{-4}$	$5.9x10^{-4}$	$1.6x10^{-3}$	$6.4x10^{-3}$	$6.4x10^{-3}$	$8.6x10^{-7}$	$3.4x10^{-6}$	$3.4x10^{-6}$
Medical Isotopes Production	NA	7.4	7.4	NA	21.2	21.2	NA	$1.4x10^{-2}$	$1.4x10^{-2}$
LLW (D&D)	0.21	0.21	0.21	0.60	0.60	0.60	$3.8x10^{-4}$	$3.8x10^{-4}$	$3.8x10^{-4}$
TOTAL							**$4.6x10^{-2}$**	**$9.9x10^{-2}$**	**0.1**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS									
TRU/MTRU [e]	0	$1.6x10^{-3}$	$4.8x10^{-3}$	0	$8.8x10^{-2}$	$2.6x10^{-2}$	0	$5.0x10^{-6}$	$1.5x10^{-5}$
TRU/MTRU [e] *(legacy)*	0	0	$3.2x10^{-3}$	0	0	$1.8x10^{-2}$	0	0	$1.0x10^{-5}$
LLW (legacy+ER)	0	0	10.0	0	0	28.8	0	0	$1.8x10^{-2}$
LLMW [c] *(legacy+ER)*	0	0	$2.1x10^{-3}$	0	0	$2.1x10^{-2}$	0	0	$1.1x10^{-5}$
TOTAL [b]							**0**	$5.0x10^{6}$	**$1.8x10^{-2}$**

Sources: SNL 1986, 1992a; SNL/NM 1997b, 1998a; DOE 1996h
D&D: decontamination and decommissioning
ER: environmental restoration
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
RAD: radiological
rem: roentgen equivalent, man
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium
[c] 1996 shipment of $7.2x10^{-6}$ Ci of sodium-24; Transport Index= 0.1
[d] Lifetime estimated total LCFs from annual shipments and total special project shipments
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index= 1.0

Table 5.3.9–10. Truck Transportation Traffic Fatalities Under the No Action Alternative

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT[a]	ANNUAL FATALITIES		
		BASE YEAR[b]	2003	2008
NORMAL ROUTINE OPERATIONS				
RAD Material	3.5×10^{-4}	1.1×10^{-1}	2.0×10^{-1}	2.1×10^{-1}
Explosives	2.9×10^{-4}	8.8×10^{-2}	1.6×10^{-1}	1.7×10^{-1}
Chemicals	2.1×10^{-6}	5.8×10^{-3}	5.8×10^{-3}	5.8×10^{-3}
LLW	2.2×10^{-4}	8.8×10^{-4}	2.9×10^{-3}	2.9×10^{-3}
Medical Isotopes Production	NA	NA	6.0×10^{-3}	6.0×10^{-3}
LLMW (shipments)	3.0×10^{-4}	3.0×10^{-4}	9.0×10^{-4}	9.0×10^{-4}
LLMW (receipts)	2.1×10^{-4}	0	2.1×10^{-4}	2.1×10^{-4}
Hazardous Waste	2.2×10^{-4}	1.4×10^{-2}	1.8×10^{-2}	1.9×10^{-2}
Recyclable Hazardous to California	1.5×10^{-4}	3.0×10^{-4}	4.5×10^{-4}	4.5×10^{-4}
Recyclable Hazardous to New Mexico	1.6×10^{-6}	9.6×10^{-6}	1.3×10^{-5}	1.3×10^{-5}
Solid Waste	2.6×10^{-6}	1.3×10^{-4}	1.3×10^{-4}	1.3×10^{-4}
D&D Hazardous Waste TSCA-PCBs	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
D&D Hazardous Waste TSCA-Asbestos	2.2×10^{-5}	3.1×10^{-4}	3.1×10^{-4}	3.1×10^{-4}
Biohazardous Waste	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}
Recyclable D&D Hazardous Waste	1.6×10^{-6}	3.5×10^{-5}	3.5×10^{-5}	3.5×10^{-5}
Recyclable Nonhazardous Solid Waste	1.6×10^{-6}	1.2×10^{-4}	1.2×10^{-4}	1.2×10^{-4}
Nonhazardous Landscaping Waste	2.6×10^{-6}	NA	3.7×10^{-4}	3.7×10^{-4}
Construction and Demolition Solid Waste	2.6×10^{-6}	NA	1.6×10^{-3}	1.6×10^{-3}
RCRA Hazardous Waste (receipt)	6.7×10^{-7}	8.0×10^{-6}	1.7×10^{-5}	1.7×10^{-5}
LLW (D&D)	2.2×10^{-4}	8.8×10^{-4}	8.8×10^{-4}	8.8×10^{-4}
TOTAL[c]		**0.22**	**0.40**	**0.42**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS				
TRU/MTRU	1.9×10^{-5}	0	1.9×10^{-5}	5.7×10^{-5}
TRU/MTRU (Legacy)	1.9×10^{-5}	0	0	3.8×10^{-5}
LLW (Legacy)	2.2×10^{-4}	0	0	1.2×10^{-2}

Table 5.3.9–10. Truck Transportation Traffic Fatalities Under the No Action Alternative (concluded)

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT[a]	ANNUAL FATALITIES		
		BASE YEAR[b]	2003	2008
LLMW (Legacy)	$3.0x10^{-4}$	0	0	$2.4x10^{-3}$
LLW (ER)	$2.2x10^{-4}$	0	0	$3.0x10^{-2}$
LLMW (ER)	$3.0x10^{-4}$	0	0	$1.5x10^{-3}$
Hazardous Waste (ER)	$2.2x10^{-4}$	0	0	$2.5x10^{-2}$
Nonhazardous Solid Waste(ER)	$2.6x10^{-6}$	0	0	$2.3x10^{-5}$
TOTAL[c]		**0**	$\mathbf{1.9x10^{-5}}$	$\mathbf{7.1x10^{-2}}$

Sources: SNL 1986, 1992a; SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
NA: Not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Round trip
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated total fatalities from annual shipments and total special project shipments

of 15 to 18 m from the truck, while eardrum ruptures would occur up to a distance of 36 m from the truck.

5.3.10 Waste Generation

Implementation of the No Action Alternative would not cause any major changes in the types of waste streams generated onsite. Except for new operations, waste generation levels at SNL/NM would remain constant or increase slightly, consistent with slight increases in laboratory operations. These increased waste volumes would be partially offset by increased waste minimization and pollution prevention programs, which project a 33-percent overall decrease in total waste disposal needs by FY 2000. Waste projections used for analysis do not take credit for potential waste minimization techniques that have not yet been implemented. Regardless, the increased generation activities would not exceed existing waste management disposal capacities.

For projection purposes, the baseline waste generation data were considered to be constant for existing facilities, with no major increases or decreases in the amount of wastes generated. Operations waste are considered to be derived from mission-related work. Nonoperations waste are generated from special programs. New operations are discussed separately in order to show the maximum likely existing operational increases. Waste generation levels for special program waste, such as for the ER Project, are derived separately from the representative facilities' projections under special projects. However, the amount of waste generated is anticipated to reflect proportional increases or decreases in SNL/NM activity levels over the next 10 years, with the exception of waste that would be generated by new operations. The waste quantities projected, listed in Table 5.3.10–1, represent a site-wide aggregate of quantities for each type of waste stream from existing selected facilities. As appropriate, the balance of operations (not selected facilities or special projects) waste generated is discussed within the individual waste sections. Units shown for each waste type are based on how industrial facilities charge commercial clients for disposal of these wastes.

5.3.10.1 Radioactive Wastes

Under the No Action Alternative, SNL/NM would potentially generate LLW, LLMW, and TRU and MTRU wastes. However, SNL/NM would not generate any high-level waste. Projections for waste generation at selected facilities from new and existing operations are shown in Appendix H.

Existing Operations

Under the No Action Alternative, SNL/NM anticipates a maximum 23 percent increase in the generation of LLW from existing operations over the next 10 years. LLW is

Table 5.3.9–11. Dose Risk to Population Due to Transportation Radiological Accident, Maximum Annual Radiological Accident Risk for Highway Shipments

CARGO	ANNUAL DOSE RISK TO POPULATION PERSON-REM			LCFs		
	BASE YEAR[a]	2003	2008	BASE YEAR[a]	2003	2008
NORMAL ROUTINE OPERATIONS						
RAD Materials [b]	2.3×10^{-2}	4.3×10^{-2}	4.5×10^{-2}	1.2×10^{-3}	2.2×10^{-3}	2.3×10^{-3}
LLW	2.3×10^{-3}	7.5×10^{-3}	7.5×10^{-3}	1.2×10^{-6}	3.8×10^{-6}	3.8×10^{-6}
LLMW [c]	4.6×10^{-11}	1.7×10^{-10}	1.7×10^{-10}	2.3×10^{-14}	8.5×10^{-14}	8.5×10^{-14}
Medical Isotopes Production	NA	1.5×10^{-2}	1.5×10^{-2}	NA	7.5×10^{-6}	7.5×10^{-6}
LLW (D&D)	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}
TOTAL [d]				1.2×10^{-3}	2.2×10^{-3}	2.3×10^{-3}
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS						
TRU/MTRU [e]	0	2.4×10^{-8}	7.2×10^{-8}	0	1.1×10^{-11}	3.6×10^{-11}
TRU/MTRU [e] ***(Legacy)***	0	0	4.8×10^{-8} 6.8×10^{-6}	0	0	2.4×10^{-11}
LLW (Legacy + ER)	0	0	0.11	0	0	5.5×10^{-5}
LLMW [c] ***(Legacy + ER)***	0	0	6.0×10^{-10}	0	0	3.0×10^{-137}
TOTAL [d]				**0**	1.2×10^{-11}	$\mathbf{5.5\times10^{-5}}$

Sources: DOE 1996h; SNL 1992a; SNL/NM 1997b, 1998a
Ci: curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RAD: radiological
rem: roentgen equivalent, man
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium-24; Transport Index= 0.1
[d] Lifetime estimated total LCFs
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index= 1.0

shipped offsite for final disposal. LLMW generation would increase by 19 percent for existing operations through 2008. Under the *Resource Conservation and Recovery Act, Part B Permit Application for Hazardous Waste Management Units* (SNL/NM 1996a), some treatment of the hazardous component of LLMW could be performed at SNL/NM (Table 4.12–2). LLMW for which no onsite treatment is available is shipped offsite for treatment and disposal. SNL/NM also projects that approximately 0.28 m^3 of TRU waste would be generated annually. The existing TRU/MTRU wastes stored onsite, as well as all future TRU/MTRU wastes, would be transferred to LANL for certification, prior to disposal at the Waste Isolation Pilot Plant (WIPP), as indicated in the Waste Management Programmatic Environmental Impact Statement (DOE 1997i) Record of Decision (ROD)(DOE 1998n). Projected MTRU waste generation would increase by 0.2 m^3 annually, approximately equal to one 55-gal drum. MTRU waste would also be transferred to LANL for certification. Existing SNL/NM operations would use less than 1 percent (0.21 percent) annually of the available radioactive waste storage capacity. This is considered to be less than significant.

New Operations

SNL/NM anticipates a maximum of 76.4 m^3 of LLW would be generated from new operations annually over the next 10 years. The majority of the increase would be

Table 5.3.10–1. Total Waste Generation Under the No Action Alternative

ALL WASTE		UNIT	BASE YEAR[a]	NO ACTION ALTERNATIVE	
				5-YEAR	10-YEAR
RADIOACTIVE WASTE					
Low-Level Waste (500 kg/m³)	Existing Operations	m³(kg)	16(8,000)	20(10,000)	20(10,000)
	New Operations	m³(kg)	4(2,000)	75(37,500)	76(38,000)
	SNL/NM Balance of Operations	m³(kg)	74(37,000)	74(37,000)	74(37,000)
	SNL/NM Total LLW	m³(kg)	94(47,000)	169(84,500)	170(85,000)
	Percent change		0.0%	79.2%	80.4%
Low-Level Mixed Waste (550 kg/m³)	Existing Operations	m³(kg)	3.85(2,120)	4.58(2,520)	4.58(2,520)
	New Operations	m³(kg)	0.20(110)	0.48(260)	0.48(260)
	SNL/NM Balance of Operations	m³(kg)	0.28(150)	0.28(150)	0.28(150)
	SNL/NM Total LLMW	m³(kg)	4.33(2,380)	5.34(2,940)	5.34(2,940)
	Percent change		0.0%	23.3%	23.3%
TRU Waste (310 kg/m³)	Existing Operations	m³(kg)	-	0.28(87)	0.28(87)
	New Operations	m³(kg)	-	-	-
	SNL/NM Balance of Operations	m³(kg)	-	-	-
	SNL/NM Total TRU	m³(kg)	-	0.28(987)	0.28(87)
MTRU Waste (76 kg/m³)	Existing Operations	m³(kg)	0.45(34)	0.65(49)	0.65(49)
	New Operations	m³(kg)	-	-	-
	SNL/NM Balance of Operations	m³(kg)	-	-	-
	SNL/NM Total MTRU	m³(kg)	0.45(34)	0.65(49)	0.65(49)
	Percent change		0.0%	43.8%	43.8%
RADIOACTIVE WASTE TOTAL[c]	**Existing Operations**	**m³(kg)**	**20.34 (10,154)**	**25.10 (2,656)**	**25.21 (12,656)**
	New Operations	**m³(kg)**	**4.62(2,110)**	**75.87 (37,760)**	**76.86 (38,260)**
	SNL/NM Balance of Operations	**m³(kg)**	**73.92 (37,150)**	**73.92 (37,150)**	**73.92 (37,150)**
	SNL/NM Total Radioactive Waste	**m³(kg)**	**98.88 (49,414)**	**174.88 (87,566)**	**175.99 (89,066)**
	Percent change		**0.0%**	**76.9%**	**78.0%**

Table 5.3.10–1. Total Waste Generation Under the No Action Alternative (concluded)

ALL WASTE	UNIT	BASE YEAR[a]	NO ACTION ALTERNATIVE	
			5-YEAR	10-YEAR
RCRA HAZARDOUS WASTE				
Existing Operations	kg	16,187	19,682	20,780
New Operations	kg	398	1,243	1,300
SNL/NM Balance of Operations	kg	39,267	49,544	52,278
SNL/NM Total RCRA Hazardous	kg	55,852	70,469	74,358
	m^3	44.3	55.9	59.0
Percent change		0.0%	26.2%	33.1%
SOLID WASTE				
SNL/NM Total Solid Waste[b]	m^3(kg)	0.6M (2,022)	0.6M (2,006)	0.6M (1,955)
Percent change		0.0%	-0.8%	-3.3%
WASTEWATER				
Existing Operations (net increase)	M gal	49	62	84
New Operations	M gal	0	4	4
SNL/NM Balance of Operations	M gal	231	224	216
SNL/NM Total Wastewater	M gal	280	290	304
Percent change		0.0%	+3.6%	+8.6%

Sources: SNL/NM 1997b, 1998a, 1998c, 1998t
m^3: cubic meter
kg: kilogram
LLMW: low-level mixed waste
LLW: low-level waste
M: million
M gal: million gallons
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Individual breakdowns of solid waste for existing, new, and balance of operations are unavailable because of tracking methods.
[c] Numbers are rounded and may differ from calculated values.
Note: Densities provided are from Table H.3–1.

primarily due to the full implementation of medical isotopes production in 2003. These operations, described in the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement (DOE 1996b), would account for over 80 percent of the total projected LLW in 2003 and 2008. However, due to the nature of the waste, it would be managed at the generation facility to minimize worker exposure until offsite disposal. LLMW generation from all new onsite sources would be a maximum of 0.48 m^3 annually through 2008.

SNL/NM does not expect to generate TRU or MTRU wastes from new operations. Approximately 190 kg of spent fuel would be generated over the 10-year period. Spent fuel is further discussed in Appendix A as a material resource.

Balance of Operations

The waste generation level for the balance of operations was determined for each type of radioactive waste (Table 5.3.10–1). Only LLW and LLMW would be affected. Balance of operations at SNL/NM would account for an additional 73.6 m^3 per year of LLW. These same operations would account for an additional 0.28 m^3 of LLW per year. The overall operations impact for this alternative would increase by 80 percent for LLW and 23 percent for LLMW.

Current Capacity

Previously generated radioactive wastes (legacy wastes) occupy approximately 494 m^3 of the available 11,866 m^3 of total radioactive waste storage capacity at the RMWMF and its associated storage areas. This represents

4.2 percent of the total available capacity. Therefore, there would be sufficient capacity to accommodate anticipated increases in radioactive wastes.

Special Projects

Projections indicate the ER Project, a special project beyond the scope of normal operations, will be the single largest waste generator at SNL/NM in 1998. The ER Project will produce a total of approximately 2,862 m^3 of LLW and 221 m^3 of LLMW, primarily contaminated soil and debris, prior to the end of the project in 2004. Projected ER Project waste volumes are presented in Table 5.3.10–2. ER Project wastes are stored and handled at the point of generation prior to disposal offsite. Management of ER waste is not expected to impact overall SNL/NM waste management operations. Actual field cleanup is now expected to be completed by 2002, with ER Project waste disposed of by 2004. Prior to disposal, ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

5.3.10.2 Hazardous Waste

Existing Operations

As shown on Table 5.3.10–1, under the No Action Alternative, SNL/NM anticipates a maximum 33 percent increase (over the base year [1996 or 1997]) in the overall generation of RCRA hazardous waste through 2008. Projections for selected facilities for new and existing operations are presented in Appendix H. Projected RCRA hazardous waste generation is shown in Figure 4.12–4.

No appreciable change in the generation of explosive waste would occur. Therefore, the TTF, with a treatment capacity of 9.1 kg of waste per burn, would continue to accommodate those wastes generated from the Light-Initiated High Explosive Facility. The majority of explosive waste would be disposed of at SNL/NM or through KAFB.

New Operations

SNL/NM anticipates annual generation of a maximum of 1,300 kg of hazardous waste by new operations over the next 10 years. The majority of the increase would be primarily due to the full implementation of medical isotopes production operations associated with the Medical Isotopes Production Project (MIPP) in 2003. These operations, described in the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement (DOE 1996b), would account for less than 2 percent of the total projected hazardous waste in 2003 and 2008.

New SNL/NM operations would use less than 1 percent annually of the available hazardous waste storage capacity, which is considered to be a minimal impact.

Balance of Operations

It was assumed that the RCRA hazardous waste levels for the balance of operations at SNL/NM would increase by the same proportion as RCRA wastes for selected facilities, because selected facilities represent the overall plant. Consequently, multipliers were used to project RCRA hazardous waste levels under all three alternatives. In the base year, the existing selected facilities generated 16,187 kg out of a total of 55,852 kg of all operational RCRA waste. The remainder, 39,267 kg, is the balance of operations RCRA hazardous waste. For 2003, this would increase to a maximum of 49,544 kg, and to 52,278 kg by 2008.

Current Capacity

The total volume of hazardous waste generated requiring offsite disposal at licensed/approved facilities would not exceed the existing 286.5 m^3 of storage and handling capacities at the HWMF and its associated storage buildings. The outside nonpermitted bermed storage area for nonhazardous waste is not included in the onsite storage capacity calculations. Projections indicate that a maximum of 26 percent of the existing hazardous waste capacity would be used. SNL/NM routinely ships hazardous waste to various offsite commercial disposal facilities. Most, if not all, waste is shipped in less than one year to meet regulatory requirements. Based on these projections and continued operations at selected facilities under the No Action Alternative, the hazardous waste generation impacts would continue to be minimal.

Special Projects

During field remediation, the ER Project would produce an additional 26 M kg of hazardous waste by 2002. Final disposal would be accomplished by 2004. Projected ER Project hazardous waste volumes are shown in Table 5.3.10–2. ER Project waste handling is discussed in Section 4.12.3.3.

Additionally, other facility maintenance and infrastructure support (as outlined in Section 2.3.5) would continue. This program would directly impact the quantity of TSCA hazardous waste requiring disposal. As a result, SNL/NM would continue to generate TSCA

Table 5.3.10–2. Estimated Volumes of Environmental Restoration Project Waste Generated From 1996 through 2000[a]

YEAR	MATRIX DEBRIS	SOIL	SOIL/ DEBRIS	SOIL/ DEBRIS/ PPE	PURGE W ATER	SEPTAGE	LIQUID	TOTAL (ft^3)	TOTAL (m^3)	TOTAL (kg)
HAZARDOUS WASTE (RCRA)										
1996	-	8,944.0	27.0	-	-	378.0	351.0	9,700.0	274.7	314,981
1997	1,080.0	140.4	-	-	-	-	7.0	1,227.4	34.8	39,957
1998	118,152.0	584,388	5,159.7	-	-	764.1	70.2	708,534	20,066.1	23 M
1999	-	16,019.1	8,499.6	-	-	-	7.0	24,525.7	694.6	796,402
2000	54,000	-	-	-	-	-	-	54,000	1,529.3	1.7 M
TOTAL	173,232	609,491.5	13,686.3	-	-	1,142.1	435.2	797,987.1	22,599.5	27.8 M
RADIOACTIVE WASTE (LLW)										
1996	540.0	8,217.7	-	1,809.0	-	2,646.0	-	13,212.7	374.2	429,046
1997	540.0	8,439.6	35.1	-	-	-	-	9,014.7	255.3	292,727
1998	540.0	77,728.7	7.0	-	-	-	-	78,275.7	2,216.8	2.5 M
1999	-	547	-	-	-	-	-	547	15.5	17,762
2000	-	-	-	-	-	-	-	-	-	-
TOTAL	1,620.0	94,933	42.1	1,809.0	-	2,646.0	-	101,050	2,861.8	3.2 M
MIXED WASTE (LLMW)										
1996	2,286.9	61	-	-	-	-	-	347.9	66.5	76,232
1997	3,518.1		-	-	-	-	-	3,572.1	99.6	114,240
1998	1,080.0	-	35.1	-	-	764.1	-	1,879.2	53.2	61,022
1999	27.0	-	35.1	-	-	-	-	62.1	1.8	2,017
2000	-	-	-	-	-	-	-	-	-	-
TOTAL	6,912.0	61	70.2	-	-	764.1	-	7,807.3	221.1	250,000

Table 5.3.10–2. Estimated Volumes of Environmental Restoration Project Waste Generated From 1996 through 2000[a] (concluded)

YEAR	MATRIX DEBRIS	SOIL	SOIL/ DEBRIS	SOIL/ DEBRIS/ PPE	PURGE W ATER	SEPTAGE	LIQUID	TOTAL (ft³)	TOTAL (m³)	TOTAL (kg)
TSCA WASTE										
1996	-	135.0	-	-	-	-	-	135.0	3.8	4,384
1997	-	189.0	-	-	-	-	-	189.0	5.4	6,137
1998	-	31,833	-	-	-	-	-	31,833.0	901.5	1.0 M
1999		31,023.0	-	-	-	-	-	31,023.0	878.6	1.0 M
2000	-	-	-	-	-	-	-	-	-	0
TOTAL	-	63,180	-	-	-	-	-	63,180	1,789.3	2.0 M
NONHAZARDOUS WASTE										
1996	-	1,350.0	27.0	-	-	-162.0	-	1,539.0	43.6	49,975
1997	-	-	2,646.0	-	-	-	-	2,646.0	74.9	85,921
1998	-	1,422.9	2,430.0	-	-	-	-	3,852.9	109.1	125,112
1999	-	-	1,350.0	-	-	-	-	1,350.0	38.2	43,837
2000	-	-	-	-	-	-	-	-		0
TOTAL	-	2,772.9	6,453.0	-	-	162.0	-	9,387.9	265.9	310,000
GRAND TOTAL	**181,764.0**	**770,438.4**	**20,251.6**	**1,809.0**	**0.0**	**4,714.2**	**435.2**	**979,412.4**	**27,737.5**	**33.6 M**

Source: SNL/NM 1998m
ER: Environmental Restoration
ft³: cubic feet
FY: fiscal year
LLW: low-level waste
LLMW: low-level mixed waste
m³: cubic meters
M: million
PPE: personal protective equipment
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] Baseline totals and projections generated by SNL/NM on 2/9/98; actual cleanup is now expected to be completed between FY 2003 and FY 2005, with ER Project waste disposed of prior to the end of the project.
Note: All wastes are assumed to have the average density for the 1997 LLW shipments.

hazardous waste, primarily polychlorinated biphenyls (PCBs) and asbestos that are removed from transformers and buildings. Since the main PCB relamping and transformer removal has been completed, quantities of TSCA waste have dropped to approximately 122,000 kg per year, and should remain at that level (Figures 4.12–5 and 4.12–6).

The total volume of TSCA waste would eventually decrease as the targeted facilities are removed. Currently, SNL/NM has 674 buildings providing a total of 5,020,014 gross ft^2 of office and operational space. The number of buildings would be reduced to 465 buildings totaling approximately 4,885,600 gross ft^2. This program would remove 138 small office buildings, temporary structures, and trailers accounting for 179,204 gross ft^2 within FY 1998 and FY 1999 at SNL/NM. During FY 2000 through FY 2002, 49 additional buildings, accounting for 108,937 gross ft^2, are potentially scheduled for removal. During FY 2003 to FY 2008, an additional 29 buildings would be removed with a total of 84,132 gross ft^2. To make up for the loss of office and operational space, seven additional buildings would be built, adding approximately 240,000 gross ft^2. No predictions are made for years beyond FY 2008. Separate NEPA review may be required in the future depending on the scale and extent of the work involved.

5.3.10.3 All Other Wastes

SNL/NM operations also involve the four additional waste management activity areas discussed below.

Biohazardous (Medical) Waste

The total volume of medical waste would generally remain a function of the total number of full-time employees and subcontractors at SNL/NM. In 1997, 2,463 kg of medical waste were disposed of at an approved offsite facility. Under the No Action Alternative, biohazardous waste generation would increase to 3,279 kg by 2008. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Nonhazardous Chemical Waste

In 1998, the ER Project will generate approximately 125,112 kg of nonhazardous waste (Table 5.3.10–2). The maximum quantity of operations nonhazardous waste generated annually at SNL/NM and managed by the HWMF would be 92,290 kg, based on the waste multiplier (see Appendix H) developed for RCRA hazardous waste (Rinchem 1998a). Existing commercial disposal facilities would still have adequate capacities to handle the continued generation of nonhazardous waste, thus no additional impacts would be anticipated.

Municipal Solid Waste

Site-wide solid waste generation trends at SNL/NM would generally remain a function of total building area and the number of full-time and subcontractor employees. This function is based on general building operations activities, such as maintenance and cleaning, and, to a lesser extent, the general office waste created by SNL/NM employees. Over the 10-year time frame, a decrease of an estimated 3 percent is anticipated. Despite the projected 5 percent personnel increase, no appreciable onsite impacts to disposal facilities would occur because existing waste handling capabilities are already in place. As existing buildings are replaced, personnel are moved to make more efficient use of the space. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient. However, a substantial amount of construction and demolition (C&D), a special class of solid waste, would potentially be generated under the facility modernization program described above. Quantities of C&D waste associated with the facility modernization program were projected to be similar to prior years. This waste is disposed of at KAFB and does not currently create an offsite impact. Table 5.3.10–3 summarizes construction debris disposal at the KAFB landfill. If this waste required shipment offsite, similar quantities would go to a regional commercial landfill.

Wastewater

Waste water would increase throughout SNL/NM due to varying levels of operation within each facility. SNL/NM would generate a maximum of approximately 304 M gal of wastewater annually. However, SNL/NM entered into a memorandum of understanding (MOU) with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997p). The MDL is the single largest generator of wastewater at 77 Mgal per year (Table 3.6–1). Reduction efforts would focus on the MDL in order to reduce the amount of wastewater being generated. See Section 5.3.2 for additional discussion of wastewater quantities and capacities.

Table 5.3.10–3. SNL/NM Construction and Debris Waste Volumes Managed at KAFB

SOURCE	1996			1997			1998[a]		
	WASTE (yd^3)	TONNAGE CONVERSION	% OF TOTAL	WASTE (yd^3)	TONNAGE CONVERSION	% OF TOTAL	WASTE (yd^3)	TONNAGE CONVERSION	% OF TOTAL
CONSTRUCTION & DEMOLITION									
DOE	324.50	129.80	0.14	167.25	66.90	0.16	104.00	41.60	0.18
DOE Contractors	837.00	334.80	0.37	1,520.00	608.00	1.49	392.00	156.80	0.67
SNL/NM	4,177.05	1,670.82	1.84	4,563.00	1,825.20	4.47	2,140.25	856.10	3.68
SNL/NM Contractors	13,471.00	5,388.40	5.94	10,070.00	4,028.00	9.86%	4,293.00	1,717.20	7.38
TOTAL (yd^3 [m^3])	226,822.30 [172,000]	90,728.92	100	102,119.00 [77,600]	40,847.60	100	58,146.75 [44,200]	23,258.70	100
YARD AND LANDSCAPE									
DOE	10.00	1.50	0.75	-	-	0	-	-	0
DOE Contractors	-	-	0	-	-	0	-	-	0
SNL/NM	386.00	57.90	29.11	19.00	2.85	16.81	-	-	0
SNL/NM Contractors	427.00	64.05	32.20	17.00	2.55	15.04	-	-	0
TOTAL (yd^3 [m^3])	1,326.00 [1,000]	198.90	100	113.00 [86]	16.95	100	-	-	0
COMPOST AND WOODPILE									
DOE	206.25	30.94	1.89	80.00	12.00	1.21	16.00	2.40	0.88
DOE Contractors	-	-	0	2.00	0.30	0.03	-	-	0
SNL/NM	2,607.75	391.16	23.96	1,642.25	246.34	24.79	724.25	108.64	39.78
SNL/NM Contractors	527.00	79.05	4.84	217.00	32.55	3.28	40.00	6.00	2.20
TOTAL	10,885.25 [8,300]	1,632.79	100	6,625.00 [5,000]	993.75	100	1,820.75 [1,400]	273.11	100

Source: Houston 1998b
yd^3: cubic yards
[a] 1998 number represents January through June 1998

5.3.11 Noise and Vibration

The implementation of the No Action Alternative would result in a continuation of the noise and vibration impacts currently experienced during operations at SNL/NM facilities. Section 5.3.11.1 describes potential noise impacts, and Section 5.3.11.2 describes potential impacts from vibrations.

5.3.11.1 Noise

The environmental concern about noise is twofold: first, repetitive exposure to loud noise leads to hearing impairment and eventual hearing loss; and second, noise may be a community nuisance at levels below those that cause hearing impairment. Two noise provisions that apply to SNL/NM address these concerns. The first provision is DOE 5480.10, Contractor Industrial Hygiene Program, which sets standards to protect workers in noisy occupations. Under this provision, workers without hearing protection may only be exposed to continuous sources at 85 dBA for up to 8 hours per day and to impulse noise at 140 dBA per event. The Hearing Conservation Program was initiated by SNL/NM to comply with DOE 5480.10 by limiting the time workers are exposed to noise. The louder the noise, the shorter the allowable exposure time for a worker.

The second provision is the city of Albuquerque Noise Control Ordinance (Ord. 21-1975, §9–9–1). This ordinance sets a limit on the amount of noise that may be produced above ambient levels in the city limits. This ordinance applies to any SNL/NM operation that is loud enough to be heard in neighborhoods bordering KAFB and that exceeds the limits cited in the ordinance. The ordinance allows a maximum allowable limit of 50 dBA, or 10 dBA above the ambient noise level, whichever is greater.

The No Action Alternative provides for SNL/NM to operate at current planned levels, which include baseline background noise levels and short-term noise impacts from SNL/NM test activities. The number of impulse noise-producing test activities is projected to increase 20 percent over 1996 levels for 2003 and 35 percent over the 1996 baseline number of test activities by 2008. Background noise levels would continue at similar levels from generators, air conditioners, and ventilation systems, but would increase due to additional vehicular traffic and aircraft noise. The range of background noise associated with these sources ranges from 50 to 70 dB (SNL/NM 1997a).

Construction noise, resulting from building new facilities, such as Building 701 in TA-I currently under construction, also contributes to the No Action Alternative background noise levels at SNL/NM. Table 5.3.11–1 presents typical noise levels associated with construction equipment that

Table 5.3.11–1. Typical Noise Levels from Construction and Industrial Equipment

CONSTRUCTION ACTIVITY	EQUIPMENT	NOISE LEVEL AT 50 FEET dBA
Constructing Foundation	Truck	91
	Concrete mixer	85
	Jack hammer	88
	Pneumatic Tools	85
Erecting Work	Paver	89
	Derrick	88
Finishing Work	Truck	91
	Paver	89
Miscellaneous	Generator	76
	Compressor	81
	Winch	88

Source: SNL/NM 1997a
dBA: decibels, A-weighted scale

would contribute to the background noise levels at SNL/NM during construction activities. These construction noise levels would contribute to the ambient background noise levels for the duration of construction, after which ambient background noise levels would return to pre-construction levels.

Large-scale impulse noise producing activities, such as explosives detonations, generate a pressure wave that is an atmospheric phenomenon visualized as ripples produced when a stone is thrown into a still body of water. The sudden increase in atmospheric pressure produced by these traveling pressure waves, called overpressure, is initially greater than the ambient atmospheric pressure and is responsible for disturbances such as noise and for building damage such as glass breakage. Building damage is sometimes blamed on ground vibration caused by explosive detonations, whereas the damage is often the result of the traveling pressure waves. These impulse noise levels resemble a dull thud and generally are considered an annoyance because of "startle" effects and window vibrations.

Air blast noise is associated with SNL/NM test activities performed primarily at TA-III, the Coyote Test Field, and other outdoor test facilities. Table 5.3.11–2 presents a summary of the short-term noise impacts from SNL/NM test activities, including expected noise levels at various locations throughout KAFB. The table column labeled "Source" provides the maximum dB level of the originating test activity at the various test facilities at SNL/NM. The remaining columns present dB levels at various locations throughout SNL/NM and KAFB. The maximum noise level at a given receptor occurs at the ground hazard area boundary for a 1,000-lb explosive test at the 10,000-ft sled track, a 40-pound explosive test at the Terminal Ballistics Complex, and a 155-mm gun firing at the outdoor firing range.

Figure 5.3.11–1 presents noise contours at each of the SNL/NM test facilities producing air blast noise. The outside contour represents the 140-dB contour resulting from the maximum sound-producing event at the site. The receptor locations presented in Table 5.3.11–2 are also shown on the figure.

Figure 5.3.11–1 indicates that the 140 dB contour from tests performed at Thunder Range crosses into the Pueblo of Isleta buffer zone. The Thunder Range Complex was used from 1969 through 1993 to support development, safety, reliability, and certification tests of Atomic Energy Commission (AEC)/DOE weapon systems. The testing activity at the complex declined substantially during the early 1990s, and the last test at the complex was conducted during the third quarter of 1993. The current use is for the disassembly and evaluation of special items and siting for radar studies. Although the special items may contain explosive materials, the site is not used for explosives testing by SNL/NM.

Ground Hazard Area

The ground hazard area boundary is a delineated zone around a test site intended to restrict personnel from potentially harmful operations. These areas protect personnel from potential exposure to noise as well as toxic air emissions, metal fragments, and other potentially hazardous conditions. The ground hazard area is enforced by a combination of warning lights and signs, spotters, fences, barricades, and gates to demarcate the ground hazard area boundary. Personnel are required to leave a test site before testing and must evacuate beyond the ground hazard area boundary. Heavily constructed buildings at the test facilities shield personnel who remain inside the ground hazard area boundary to monitor tests. Procedures require personnel to remain indoors until a test is completed. Personnel wear hearing protection equipment approved by the DOE Line Support, Pollution Prevention, and Environmental Programs Department. The program satisfies the requirements of DOE 5480.10. Monitoring activities conducted by SNL/NM, indicate that exposure of the work force does not exceed allowable exposure limits (SNL/NM 1997a).

Located to the southwest of the Thunder Range is the Air Force Research Laboratory (formerly Philips Laboratory and Air Force Weapons Laboratory) Conventional High Explosives and Simulation Test (CHEST) Site, also shown on maps as Chestnut Site or Range. The Chestnut Range is used for explosive tests. Although SNL/NM explosive testing activities at Thunder Range have ceased, Chestnut Range continues to be used as an active explosives testing site by the USAF and its contractors. Table 5.3.11–2 presents short-term noise impacts at receptor locations located throughout KAFB from test activities performed at Thunder Range.

For each air blast test activity, the distance at which the 50-dB, 24-hour average noise level extends beyond the source is within the 140-dB contour. The city of Albuquerque

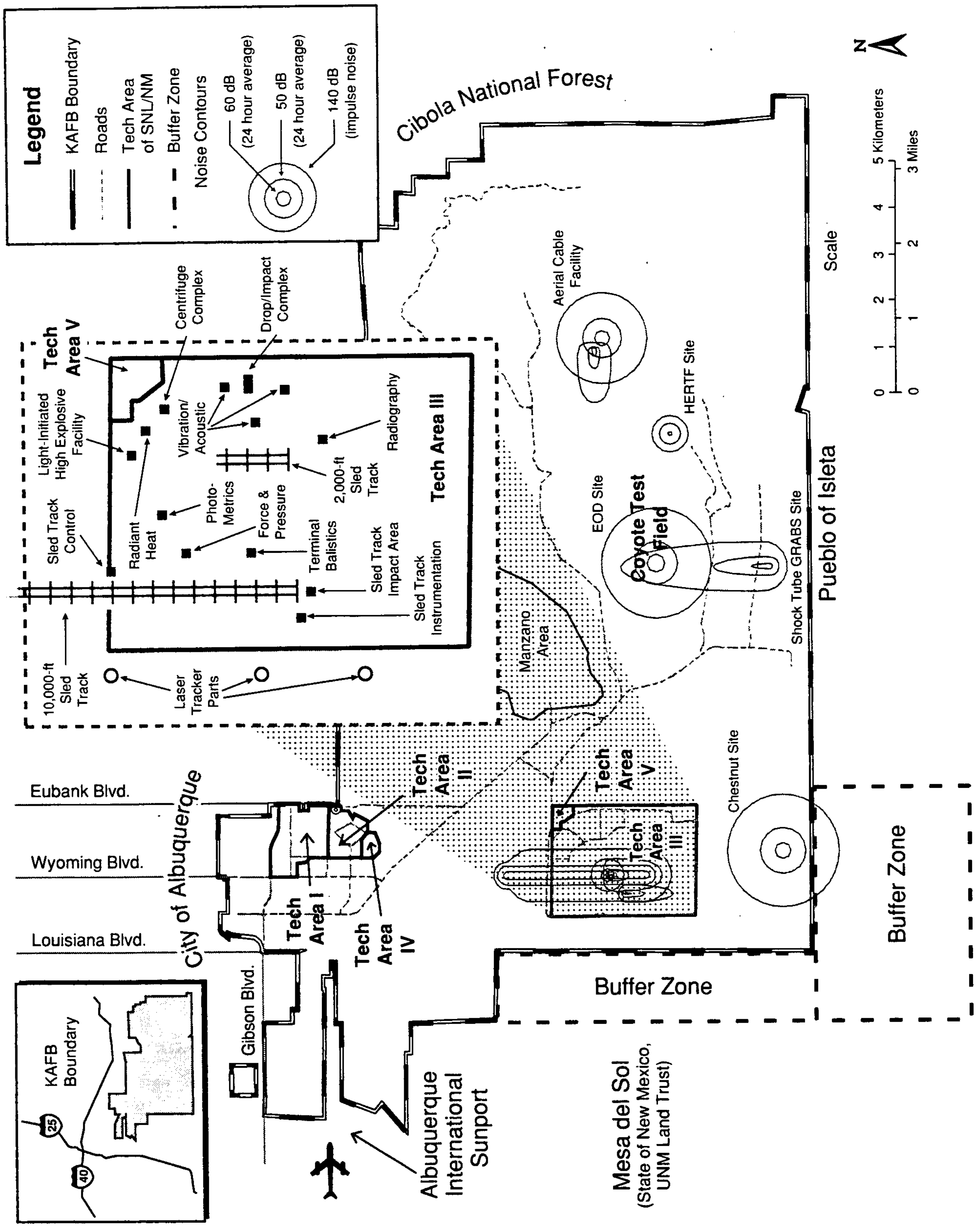
Table 5.3.11–2. Short-Term Noise Impacts of SNL/NM Test Activities (dB)

FACILITY	TIMES PER YEAR	SOURCE[a]	1[b]	2[c]	3[a]	4[a]	5[a]	6[a]	7[a]	8[a]	9[a]	10[a]	11[a]	12[a]	13[a]
10,000-FT SLED TRACK															
Explosive Weight (lbs TNT)															
50	32	151	131	96	96	109	102	103	103	113	123	115	110	111	114
250	4	156	136	101	102	114	108	108	108	118	128	120	115	116	119
1,000	10	161	140	106	106	119	112	113	113	123	132	125	120	120	123
Rocket Motors (numbers type)															
25 HVARs		137	119	100	100	101	96	103	103	107	121	107	106	106	125
1 Sprint	<1	155	137	118	119	120	115	122	122	126	140	126	125	124	143
Sonic Booms	100	149	131	112	112	114	109	116	116	120	134	120	118	118	137
Collision Impacts		145	127	102	102	109	104	106	106	113	123	115	111	111	115
CENTRIFUGE COMPLEX															
Explosives	3	140	126	88	88	93	87	100	100	140	113	116	122	122	107
Collision Impacts	50	117	105	76	76	78	75	83	83	117	93	95	101	101	88
Motors	3	86	64	35	35	37	34	42	42	76	52	54	60	60	47
TERMINAL BALLISTICS COMPLEX															
Explosive Weight (40 lbs TNT)	10	150	140	97	98	108	100	106	105	118	150	119	114	114	119
OUTDOOR FIRING RANGE															
155-mm gun	-	151	140	107	107	121	123	114	114	128	151	128	120	120	121
.30-caliber gun	-	100	80	47	48	54	48	52	52	61	90	62	58	58	62
DROP/IMPACT COMPLEX															
Rockets		135	117	92	92	100	93	98	99	113	107	135	108	111	104
Collision Impacts	100	119	109	76	76	84	77	83	83	97	91	119	92	95	88

Table 5.3.11–2. Short-Term Noise Impacts of SNL/NM Test Activities (dB) (concluded)

FACILITY	TIMES PER YEAR	SOURCE[a]	1[b]	2[c]	3[a]	4[a]	5[a]	6[a]	7[a]	8[a]	9[a]	10[a]	11[a]	12[a]	13[a]
RADIANT HEAT FACILITY															
Explosive Weight (< 1 lb TNT)	15	139	128	88	88	92	85	100	99	125	105	111	121	121	106
NORTH THUNDER RANGE															
Explosive weight (lbs TNT)															
50	150	NA	NA	116	117	121	119	122	124	127	127	130	126	127	124
250		NA	NA	121	123	126	124	127	129	132	132	135	131	132	129
450		NA	NA	123	124	128	126	129	131	134	134	137	133	134	131
SOUTH THUNDER RANGE															
Explosive weight (lbs TNT)															
50	120	NA	NA	115	116	122	121	120	121	124	126	127	124	124	123
1,000		NA	NA	125	126	132	131	130	131	133	135	136	133	133	132
4,000		NA	NA	129	130	136	135	134	135	138	140	141	138	138	137

Source: DOE n.d. (a)
dB: decibel
dBA: decibels, A-weighted scale
ft: foot
HVAR: High Velocity Aircraft Rocket
lb: pound
mm: millimeter
TNT: trinitrotoluene
[a] Area remote from most noise sources except distant aircraft and vehicular traffic Noise range is 40-65 dBA
[b] Affected by aircraft operating from the Albuquerque International Sunport Expected noise range 76-93 dBA
[c] Affected by aircraft operating from the Albuquerque International Sunport Expected noise range 90-102 dBA
1: Ground Hazard Area
2: Military housing along Pennsylvania Street at KAFB
3: Mobile home trailer park in Four Hills
4: Western boundary of KAFB
5: Pueblo of Isleta boundary located south of SNL/NM. There are no residences along this boundary
6: Golf course at KAFB
7: Riding stables at KAFB
8: Centrifuge Complex
9: Terminal Ballistics Complex
10: Drop/Impact Complex
11: Main gate TA-III
12: TA-V
13: Sled Track Complex (Control Building)



Sources: DOE n.d. (a), SNL/NM 1997a

Figure 5.3.11–1. Noise Contours Produced by SNL/NM Test Facilities

Air blast noise produced by SNL/NM test facilities reach receptor locations in TA-III.

noise control ordinance is not violated as long as the extent of the 50-dB, 24-hour average noise level remains within the KAFB boundary (SNL/NM 1997a).

Noise from test activities at SNL/NM, including rocket motors, explosives, and large caliber guns, would have minimal effect on the nearby communities. Impulse noise from these activities would be of short duration and would be concentrated in the lower frequency range. Low frequency noises are not perceived well by humans because the human ear hears higher frequencies better. A loud steady or continuous noise above 85 dB would produce adverse effects on exposed people. For example, it would render conversation nearly impossible. A single impulsive noise, on the other hand, even as high as 130 to 140 dB, produced by a sonic boom, explosion, or collision impact test, would be concentrated in the low frequencies that are relatively unimportant in oral communication. In addition, brief noises would tend to be masked by continuous noise or background noise such as vehicular traffic.

5.3.11.2 Vibration

Vibration concerns include annoyance to residents of nearby neighborhoods and potential structural damage to buildings adjacent to KAFB from test activities generating ground vibration at SNL/NM. The threshold range where vibration is viewed as "unpleasant" varies from 0.1 inch to 4 inches per second. For the typical frequencies generated by explosives, the threshold for annoyance ranges from 0.2 inch per second to 0.5 inch per second. The threshold level at which minor structural damage can begin to occur in 0.01 percent of structures is set at 2.0 inches per second (DOE 1992b).

The frequency of impulse noise under the No Action Alternative, based upon projected frequencies of impulse noise testing activities for 2008, would increase approximately 35 percent above the 1996 baseline frequency. Although impulsive noise may produce a "startle reaction," window vibrations, or public annoyance in some people, the effects on the public would be minor. Ground vibrations would remain confined to the immediate test area within the ground hazard area.

Blast Overpressure Versus Ground Vibration

An explosion creates both blast overpressure and ground vibration, either of which is capable of causing disturbance and/or damage. When an explosive charge is detonated in air, the gaseous products expand rapidly and compress the surrounding air. The compressed air moves outward like a ripple on a pond with great speed, thus initiating a shock wave or region of blast overpressure. Depending on the difference between the region of high pressure and the surrounding air, the potential exists for disturbance or damage to be done to objects that are within the path of the pressure wave. For example, if an overpressure wave hits a glass window, the glass is subject to momentary high pressure on one side, which can result in its breaking. The potential for damage depends on how close a structure is to the blast and the magnitude of the explosion.

An explosion will also cause the ground to shake upon detonation. Like blast overpressure, this ground vibration moves out from the point of detonation like waves on a pond due to the elasticity of the earth. The potential for damage from ground vibration depends on how much the earth moves or shakes. The greater the movement, which is measured as inches per second, the more likely it is that structural damage will occur. As with blast overpressure, damage will be greater if a structure is closer to a large explosion.

5.3.12 Socioeconomics

The implementation of the No Action Alternative would result in no changes to the demographic characteristics, economy, and community services in the ROI. The following discussion of impacts is based on a bounding economic analysis.

5.3.12.1 Demographic Characteristics

The No Action Alternative would not likely result in any noticeable change in existing demographic characteristics within the ROI (Section 4.14.3). Overall expenditures and employment at SNL/NM should remain relatively constant through 2008, which would, in turn, tend to maintain demographic characteristics within the ROI.

5.3.12.2 Economic Base

The No Action Alternative would not likely result in any noticeable change in the existing economic base within the ROI (Section 4.14.3). The total estimated economic activity associated with SNL/NM in 1996 was $3.93 B (Table 5.3.12–1). This represented 9.3 percent of the activity in the ROI (DOE 1997j). Overall expenditures and employment should remain relatively constant

Table 5.3.12–1. SNL/NM's Impact on Central New Mexico's Economy if Operations Were to Increase 5 Percent

ECONOMIC MEASURE	FY 1996[a]			ASSUMING A 5% INCREASE IN OPERATIONS			
	SNL/NM	TOTAL ROI	PERCENT OF ROI	SNL/NM	TOTAL ROI	PERCENT OF ROI	PERCENT CHANGE
ECONOMIC ACTIVITY ($ BILLIONS)							
Direct expenditures	1.43			1.50			
Indirect and induced	2.50			2.63			
Total economic activity	**3.93**	**42.40**	**9.3**	**4.13**	**42.60**	**9.7**	**0.4**
Economic activity multiplier: 2.75[b]							
INCOME ($ BILLIONS)							
Net wages and salaries	0.48			0.50			
Indirect and induced	0.58			0.61			
Total income	**1.07**	**13.40**	**8.0**	**1.11**	**13.45**	**8.3**	**0.3**
Income multiplier: 2.21[b]							
EMPLOYMENT (NUMBER OF EMPLOYEES)							
SNL/NM employment	7,652			8,035			
Indirect and induced	18,826			19,765			
Total employment	**26,478**	**331,800**	**8.0**	**27,800**	**333,122**	**8.3**	**0.3**
Employment multiplier: 3.46[b]							

Source: DOE 1997j
FY: fiscal year
ROI: region of influence
[a] Modeled results from DOE 1997j
[b] The use of multipliers in calculating economic impacts in the ROI is explained in Section 4.14.3.

through 2008. Historically, increases or decreases in operational levels of activities at SNL/NM have been gradual and/or have fluctuated by 1 or 2 percent per year (SNL/NM 1997a).

For analysis and consideration, Table 5.3.12–1 presents an estimate of the impacts under the No Action Alternative on the ROI economy from a 5-percent increase in operational levels of activity and associated increases in expenditures, income, and employment, both direct and indirect, at SNL/NM. The 5-percent increase was selected to bound increases for the selected facilities under the alternative and potential indirect increases across all other SNL/NM facilities. Additionally, the historical increases have been gradual; the 5-percent increase was projected over the 10-year period of the SWEIS (SNL/NM 1998a, SNL/NM 1997a). If operations at SNL/NM were to increase by 5 percent over current levels, overall economic activity within the ROI would be expected to increase by about 0.4 percent, with slightly smaller increases in income and employment at about 0.3 percent. As presented in Table 5.3.12–1, a 5-percent increase in SNL/NM activity operational levels by 2008 would generate an increase in total economic activity in the ROI from $42.4 B to $42.6 B. This would amount to a total increase of $200 M in additional economic activity (an average increase of $20 M per year) within the ROI. Total income at SNL/NM would increase from $1.07 B to $1.11 B, for a total of $40 M in additional income (an average increase of $4 M per year). Total employment in the ROI would increase from 331,800 to 333,122 or a total of 1,322 additional jobs (an average increase of 132 jobs per year) within the ROI. The increased economic activity over the baseline would be small.

During the next 10-year period, contributory effects from other industrial and economic sectors within the ROI would reduce or mask some of SNL/NM's effects on the ROI economy. This reduction or masking would occur if the estimated total employment in the ROI increases from 331,800 to 403,605 by 2008

(UNM 1997b). The ROI is experiencing and is expected to continue to experience strong growth. For a discussion on socioeconomic cumulative impacts, see Section 6.4.12.

5.3.12.3 Housing and Community Services

The No Action Alternative would not likely result in any noticeable change in existing housing and community services within the ROI (Section 4.14.3). Overall expenditures and employment at SNL/NM should remain relatively constant through 2008, which would, in turn, tend to maintain housing availability, value, and levels of service. Contributory effects from other industrial and economic sectors within the ROI should reduce or mask SNL/NM's proportional impact.

5.3.13 Environmental Justice

As indicated in Sections 5.3.1, 5.3.2, 5.3.3, 5.3.5, 5.3.10, 5.3.11, and 5.3.12, no discernible adverse impacts to land and visual resources, infrastructure, geology and soils, biological and ecological resources, waste generation, noise, or socioeconomics are anticipated under the No Action Alternative. Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated for these resource areas. The small potential impacts to geology and soils would be further reduced through the ER Project (see Section 5.3.3).

The city of Albuquerque's water supply system operates by interconnecting all areas of the city. The overlapping capability means the entire population shares impacts to the aquifer equally regardless of the location of a specific community. Impacts to the basin-wide aquifer are dominated by the city of Albuquerque (including citizens, businesses, and nonbusiness entities) by a 70 to 1 ratio with respect to SNL/NM. A localized impact of aquifer drawdown occurs as a result of SNL/NM operations; however, the local communities dominate this impact (see Section 5.3.4). Because the potential adverse impact from SNL/NM operations affects all communities equally, no disproportionately high and adverse impacts to minority or low-income communities are anticipated for this resource area.

As discussed in Section 5.3.6, the potential for impacts to cultural resources from explosive test debris, off-road vehicle traffic, and unintended fires would be minimal. Continued SNL/NM security would likely result in a positive impact on the resources, as archaeological sites remain protected. As a result of the ongoing consultation with 15 Native American tribes, no TCPs have been identified at SNL/NM; however, several tribes have requested that they be consulted under the *Native American Graves Protection and Repatriation Act* (NAGPRA) if human remains are discovered within the ROI. These consultations will continue. If specific TCPs are identified, any impacts of SNL/NM activities on the TCP and any impacts of restricting access to the TCP would be determined in consultation with Native American tribes and further NEPA review would be conducted, if appropriate.

The concentrations of chemical contaminants from air emissions and the dose to the ROI from radiological air emissions would be below regulatory standards and human health guidelines. The potential impacts to nonradiological air quality and radiological air quality would be minimal (see Sections 5.3.7.1 and 5.3.7.2). Thus, no disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

As presented in Section 5.3.8, SNL/NM operations would have minimal potential to adversely affect human health for offsite residents or onsite workers. Thus, no disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

As shown in Section 5.3.9, impacts to public health from transporting materials and waste to offsite facilities would be estimated to be 0.1 excess LCFs per year from incident-free transportation and 0.65 deaths or injuries per year from transportation accidents. Transportation along Gibson, Louisiana, Wyoming, and Eubank Boulevards includes low-income and minority neighborhoods. According to the April 1997 Sandia Report *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* (SNL 1997f), five block groups located near KAFB gates have high potential for environmental justice-related impacts. Four of these block groups lie between Louisiana and Wyoming Boulevards south of Central (see Figure 4.15–3). No disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

Based on the analyses of all the resource areas and topic areas, impacts that would result during the course of normal operations would not pose disproportionately high and adverse health or environmental impacts on minority and low-income populations. Table 5.3.13–1 provides a brief summary of potential impacts to each resource or topic area.

Table 5.3.13–1. Summary of Potential Environmental Justice Impacts Under the No Action Alternative

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBORHOODS
Land Use and Visual Resources	No changes in land use; minor changes in developed areas of SNL/NM	Not adverse	Not adverse	Not adverse
Infrastructure	All projected activities within capacities of existing road and utility systems	Not adverse	Not adverse	Not adverse
Geology and Soils	SNL/NM activities are not anticipated to destabilize slopes. Minimal deposition of contaminants to soils and continued removal of existing contaminants under the ER Program	Not adverse	Not adverse	Not adverse
Water Resources and Hydrology	SNL/NM groundwater use is projected to account for 11% of local aquifer drawdown.	Adverse	Not adverse	Not adverse
Biological and Ecological Resources	No significant adverse impacts are projected for biological and ecological resources.	Not adverse	Not adverse	Not adverse
Cultural Resources	Explosive testing debris, off-road vehicle traffic, and unintended fires would present a low potential for impacts.	Not adverse	Not adverse	Not adverse
Air Quality–Nonradiological Air	Emissions would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Concentrations would be below regulatory standards and human health guidelines. SNL/NM carbon monoxide emissions would account for 5.7% of Bernalillo county carbon monoxide emissions.	Not adverse	Not adverse	Not adverse
Air Quality–Radiological Air	MEI: 0.15 mrem/yr Collective ROI dose: 5.0 person-rem/yr Average collective ROI dose: 6.8×10^{-3} mrem/yr	Not adverse	Not adverse	Not adverse

Table 5.3.13–1. Summary of Potential Environmental Justice Impacts Under the No Action Alternative (concluded)

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW -INCOME	MINORITY NEIGHBORHOODS
Human Health and Worker Safety	MEI lifetime risk of fatal cancer increases by 7.5×10^{-8} 2.5×10^{-3} fatal cancers (additional ROI)/yr Risk of cancer fatality to workforce is 6.8×10^{-3}	Not adverse	Not adverse	Not adverse
Transportation	Total annual material shipments: 5,096 Total KAFB traffic (daily vehicles): 38,406 Incident-free exposure, truck emissions - annual LCFs: 2.4×10^{-2} Incident-free exposure, dose - annual LCFs: 0.1	Not adverse	Not adverse	Not adverse
Waste Generation	All waste projections within capacities of existing waste management operations	Not adverse	Not adverse	Not adverse
Noise and Vibration	Effects would be limited to windows rattling or "startle reaction." Background noise levels would continue at current levels from generators, air conditioners, and ventilation systems, but increase due to additional vehicular traffic, aircraft noise, and temporary construction projects (range from 50 to 70 dB).	Not adverse	Not adverse	Not adverse
Socioeconomics	SNL/NM employees: 8,035 SNL/NM total economic activity: $4.13 B/yr Percent of ROI total economic activity: 9.7%	Not adverse[a]	Not adverse	Not adverse

Source: Original
B: billion
dB: decibel
ER: environmental restoration
LCF: latent cancer fatality
MEI: maximally exposed individual
mrem: millirem
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
yr: year
[a] SNL/NM represents approximately 10 percent of the total economic activity in the ROI.

5.4 EXPANDED OPERATIONS ALTERNATIVE AND PREFERRED ALTERNATIVE

Under the Expanded Operations Alternative (the DOE's Preferred Alternative), DOE and interagency programs and activities at SNL/NM would increase to the highest reasonable activity levels that current facilities could support.

The DOE did not present a Preferred Alternative in the Draft SNL/NM SWEIS. The DOE has now selected the Expanded Operations Alternative exclusive of the MESA Complex as its Preferred Alternative. Under the Expanded Operations Alternative, the DOE would expand operations at SNL/NM as the need arose, subject to the availability of congressional appropriations, to increase the level of existing operations to the highest reasonable foreseeable activity levels that are analyzed in the SWEIS. The Preferred Alternative would only implement expansion at the existing MDL facility, without addition of the MESA Complex.

5.4.1 Land Use and Visual Resources

The implementation of the Expanded Operations Alternative would not affect existing land use patterns or visual resources at SNL/NM facilities on KAFB. If implemented, the MESA Complex configuration would have a negligible effect on land or visual resources because the Complex would be built on land owned by the DOE in TA-I, and the land is already well developed with structures of common scenic quality. Sections 5.4.1.1 and 5.4.1.2 discuss these resource areas in relation to the Expanded Operations Alternative.

5.4.1.1 Land Use

Under the Expanded Operations Alternative, there would be no additional impacts to existing land resources on KAFB. The extent of DOE land and USAF-permitted acreage currently available for use by SNL/NM facilities on KAFB would remain the same. Similarly, operations would remain consistent with industrial/research park uses and would have no foreseeable effects on established land-use patterns or requirements. Any new SNL/NM facilities, upgrades, and other actions associated with this alternative would not require changes to current land ownership or classification status because these activities would take place in or near existing facilities, within previously disturbed or developed areas, or on land already under DOE control. SNL/NM does not anticipate a need for additional land at testing sites on permitted or withdrawn areas in association with this alternative. At locations on permitted land where operations would be declining or shut down by the "owning" organization, SNL/NM would continue to hold the sites to conduct periodic safety checks and complete any environmental restoration actions (Section 5.3.3.1). Before the land could be returned to the USAF, SNL/NM would be responsible for conducting any demolition work and restoring the land to its condition when originally acquired (SNL 1997a).

5.4.1.2 Visual Resources

No additional impacts to visual resources are anticipated that would adversely change the overall appearance of the existing landscape, obscure views, or alter the visibility of SNL/NM structures. Any new facilities, expansions, and upgrades would be planned at or near existing facilities and in areas with common scenic quality. The efforts initiated by SNL/NM to incorporate campus-style design would continue. This style contains established principles and design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. The guidance covers building massing, facades, colors, building orientation and entries, traffic circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. These efforts would be consistent with the high concern for scenery due to the number of observers and users in the area.

Based on increased operational levels associated under the Expanded Operations Alternative, activities at outdoor testing facilities in the Coyote Test Field and the Withdrawn Area would increase; however, there would be no development at these areas that would alter existing visual resources. Some testing activities that produce smoke and dust of variable quantity and duration would take place, but these conditions would be periodic and short-term and would not change the visual characteristics of the area. Where decommissioning, demolition, or ER work are planned, actions would be taken such as backfilling, reducing sideslopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its condition when originally acquired by SNL/NM.

5.4.2 Infrastructure

As discussed in Section 5.3.2, the infrastructure analysis looked for potential incremental changes to SNL/NM services, utilities, and facilities by alternative. The two areas where incremental changes were identified are site-wide utility demands and four selected infrastructure facilities, including the steam plant, RMWMF, HWMF, and TTF. See Section 2.3 for a discussion of how the four infrastructure facilities were selected.

With regard to site-wide utility demands, most SNL/NM facilities do not meter utility use. For the Expanded Operations Alternative, the highest number reported under the No Action Alternative was used as the basis for projecting utility use. Any incremental changes from the base year and Expanded Operations Alternative projections in utility demands for the selected facilities (see Chapter 2) were taken into account by adjusting site-wide demand accordingly, as presented in Table 5.4.2–1. Facility-specific utility data are presented in Chapter 3, Table 3.6–1.

If the MESA Complex configuration is implemented, the DOE expects water use and wastewater discharge to increase by 3.8 M gal per year (see Table 5.4.2–1 footnote). In addition, electricity use would increase by 6,400 MWh, and natural gas use would increase by 6.4 M ft^3 annually.

As discussed in Section 5.3.2, analysis of the selected infrastructure facilities relied on the projected throughput and operational capacities as presented in Table 5.4.2–2.

Implementation of the Expanded Operations Alternative would result in demands on infrastructure generally increasing over the next 10 years (Table 5.4.2–1). Annual consumption of water, electricity, natural gas, fuel oil, and propane would be consistent with recent historic levels (SNL/NM 1998c). Small fluctuations in projected utility consumption rates would occur due to annual changes in weather. Table 5.4.2–1 includes a 10-percent increase for water, wastewater, electricity, and natural gas to show that system capacity would not be adversely affected if actual consumption exceeded projected consumption. More than 35 percent of the KAFB capacity would remain available.

While the Expanded Operations Alternative projects an increase in water use, both the DOE and SNL/NM are committed to reducing water use by 30 percent based on 1996 water use (see Section 5.3.2). Under the Expanded Operations Alternative, the current infrastructure resources would be capable of accommodating SNL/NM facility requirements and no major additional infrastructure facilities are proposed to be built. Generally, infrastructure facilities' operational levels and levels of support activities are projected to remain consistent with recent historical support levels. Although accounted for, SNL/NM D&D programs would reduce overall impacts to SNL/NM infrastructure. Specific details on infrastructure systems are presented in the *1998 Sites Comprehensive Plan* (SNL 1997a). Additional details on water resources are provided in Section 5.4.4. Traffic-related impacts are presented in Section 5.4.9. KAFB utility usage is specifically discussed in Section 6.2.

Steam production would continue at 544 M lb per year, which represents 16 percent of capacity. A discussion on the steam distribution system production capacity is provided in Section 5.3.2.

The HWMF would manage approximately 214,000 kg of waste per year (Table 5.4.2–2). Annual waste management would increase to 2.7 M lb per year at the RMWMF. Additional capacity exists with the HWMF and RMWMF by adding more hours to the work schedule. The TTF would process wastes at recent historical levels. Small fluctuations would occur due to normal operations. Actual generation rates would likely decrease over the next 10 years due to ongoing waste minimization and waste avoidance efforts and improved efficiencies (SNL/NM 1997a). Projected waste generation rates and waste facilities are further discussed in Section 5.4.10. If implemented, the MESA Complex configuration would change the annual throughput at the HWMF by an additional 1,200 kg (see Table 5.4.2–2). The MESA Complex configuration would not change annual throughput for the Steam Plant, RMWMF, and TTF.

5.4.3 Geology and Soils

The implementation of the Expanded Operations Alternative would increase activities at SNL/NM, thereby increasing the potential for soil contamination, as described in Section 5.4.3.1. As with the No Action Alternative, there would be no increase in the likelihood of impacts to slope stability (Section 5.4.3.2).

5.4.3.1 Soil Contamination

Section 5.3.3 describes the methods used to evaluate soil contamination at SNL/NM. It focuses on near-surface (zero to 1 ft deep) soil contamination at SNL/NM sites, particularly those investigated for the ER Project. The DOE has committed to managing 162 of 182 ER sites as inactive; the remaining 20 sites are still listed active. Of concern to the DOE among these active sites are outdoor testing areas where normal operations or accidents could result in the deposition of contaminants on the ground surface.

The more frequently tests are undertaken, the greater the probability of an occurrence that results in soil contamination. The Expanded Operations Alternative

Table 5.4.2–1. Annual[a] SNL/NM Utility Usage (Plus 10%) and Capacities Under the Expanded Operations Alternative

RESOURCE/DATA SOURCE	BASE YEAR USAGE	EXPANDED OPERATIONS ALTERNATIVE ANNUAL USAGE	SYSTEM CAPACITY[b]	SNL/NM USAGE[c] AS PERCENT OF CAPACITY	OTHER KAFB USAGE AS PERCENT OF CAPACITY
WATER USE (PLUS 10%, see note)					
Site-Wide Demand[d]	440 M gal	440 M gal	2 B gal	22	32
Selected Facilities/ Facility Groups[e]	0 M gal	55 M gal	NA		
TOTAL	**440 M gal**	**495 M gal (545 M gal)**	**2 B gal**	**25 (27)**	**32**
WASTEWATER DISCHARGE (PLUS 10%)					
Site-Wide Demand[d]	280 M gal	280 M gal	850 M gal	33	25
Selected Facilities/ Facility Groups[e]	0 M gal	41.6 M gal	NA		
TOTAL	**280 M gal**	**322 M gal (354 M gal)**	**850 M gal**	**38 (42)**	**25**
ELECTRICAL USE (PLUS 10%)					
Site-Wide Demand[d]	197,000 MWh	197,000 MWh	1,095,000[f] MWh	18	28
Selected Facilities/ Facility Groups[e]	0 MWh	525 MWh	NA		
TOTAL	**197,000 MWh**	**198,000 MWh (218,000 MWh)**	**1,095,000[f] MWh**	**18 (20)**	**28**
NATURAL GAS USE (PLUS 10%)					
Site-Wide Demand[d,g]	475 M ft^3	475 M ft^3	2.3 B ft^3	21	31
Selected Facilities/ Facility Groups[e,h]	0 M ft^3	0 M ft^3	NA		
TOTAL	**475 M ft^3**	**475 M ft^3 (522.5*M ft^3)**	**2.3 B ft^3**	**22 (24)**	**31**
MISCELLANEOUS					
Fuel Oil[h,i,j]	7,000 gal	7,000 gal	Not limited by infrastructure	NA	NA
Propane[h,j]	383,000 gal	383,000 gal	Not limited by infrastructure	NA	NA

Sources: SNL 1997a: SNL/NM 1998a, c: USAF 1998a, 1997b
B: billion
ft^3: cubic feet
FY: fiscal year
gal: gallon
M: million
MW: megawatt
MWh: megawatt hour

Table 5.4.2–1. Annual[a] SNL/NM Utility Usage (Plus 10%) and Capacities Under the Expanded Operations Alternative (concluded)

MESA: Microsystems and Engineering Sciences Applications
NA: Not applicable
psi: pounds per square inch
[a] Base Year is 1996 or 1997, the most representative of usage. Not necessarily the same as in Chapter 4. Although not accounted for in the table, SNL/NM expects to reduce water usage by approximately 30 percent by 2004 (see Table 5.3.2–1 for conservation-based scenario).
[b] Capacity means the actual or calculated maximum amount of water, wastewater, or other resource that can be used, discharged, or consumed
[c] Usage means the annual actual or calculated amount of water, wastewater, or other resource used, discharged, or consumed
[d] Prorated based on the following square footage: Base Year = 5.266 M FY 2003 = 5.143 M; FY 2008 = 4.986 M
[e] Adjustment for contribution from selected facilities/facility groups as reported in SNL/NM 1998a. With the addition of MESA, water use would increase by 3.8 M gal per year, wastewater discharge would increase by 3.8 M gal per year, electricity use would increase by 6,400 MWh per year, and natural gas use would increase by 6.4 M ft3.
[f] Based on 125-MW rating
[g] Estimated based on 60 psi
[h] No adjustments were reported in SNL/NM 1998a
[i] Fuel oil is used in emergency situations at the steam plant and is not dependent upon square footage.
[j] Not expected to increase due to MESA.
Note: Ten percent was added to show that system capabilities are more than adequate.

Table 5.4.2–2. Selected (Infrastructure) Facility Annual Throughput[a] and Capacities Under the Expanded Operations Alternative

FACILITY[d]	BASE YEAR ANNUAL 1997	EXPANDED OPERATIONS ANNUAL THROUGHPUT	FACILITY CAPACITY ANNUAL	THROUGHPUT AS PERCENT OF CAPACITY
Steam Plant (Steam Produced)[e]	544 M lb	544 M lb	3.33 B lb[b]	16
HWMF (Waste Handled)[e]	203,000 kg	214,000 kg (with MESA 215,200 kg)	579,000 kg[c]	38
RMWMF (Waste Handled)[e]	1.6 M lb	2.7 M lb	2.7 M lb	100
TTF (Waste Handled)[e]	Minimal	1,200 lb	7,300 lb[b]	16

Sources: SNL/NM 1998a
B: billion
ft³: cubic feet
HWMF: Hazardous Waste Management Facility
kg: kilogram
lb: pound
M: million
RMWMF: Radioactive and Mixed Waste Management Facility
TTF: Thermal Treatment Facility
[a] Throughput means the amount of steam produced or waste handled.
[b] Permit capacity
[c] This is the capacity for single-shift work with current employment level, not permit capacity.
[d] See Section 2.3 for a discussion on how these facilities were selected.
[e] See Table 3.6–1, "Infrastructure" category
Note: If implemented, the MESA Complex configuration would not change Steam Plant, RMWMF, and TTF annual throughput.

would increase the likelihood of soil contamination over the No Action Alternative. The number of Lurance Canyon certification burn tests, for example, would increase from 12 to 55 per year. Accordingly, the once in 10 years event, which would require decontamination and cleanup of up to 7,000 µg of DU per g of soil over a 1,000-ft² area, might be expected to occur once every 2 years. SNL/NM conducts immediate cleanup actions (SNL/NM 1998a) and periodic site surveys (SNL 1997e) to clean up these sites to levels that meet future land use standards.

5.4.3.2 Slope Stability

Section 5.3.3 describes the relevance of and methods used to evaluate slope stability. Four areas were selected for a detailed, qualitative evaluation: the southern boundary of TA-IV, the Aerial Cable Facility, the Lurance Canyon Burn Site, and the Electro-Explosive Research Facility. The likelihood of slope failure at these locations would be remote.

Under the Expanded Operations Alternative, no changes in activity types or frequencies would be projected for TA-IV and the Electro-Explosive Research Facility (SNL/NM 1998a). An increase in testing would be expected at the Aerial Cable Facility and the Lurance Canyon Burn Site, with some tests increasing by a factor of five over 1996 levels (SNL/NM 1998a). No slope destabilizing activities have been identified at the Lurance Canyon Burn Site. Accidental burns of vegetation from hot missile debris could become more frequent at the Aerial Cable Facility. This could cause a decrease in vegetation cover. However, this area is mostly bedrock with a thin soil veneer, and no evidence of slope instability was observed in a previously burned area. Therefore, no effect on slope stability would be projected under the Expanded Operations Alternative, with the likelihood of slope failure continuing to remain remote.

If implemented, the MESA Complex configuration would have a negligible effect on geology and soil resources. The facility would be constructed in a heavily developed area on disturbed land that currently contains buildings and structures. The complex would be built to UBC standards.

5.4.4 Water Resources and Hydrology

Impacts from the implementation of the Expanded Operations Alternative would not differ substantively from impacts described in Section 5.3.4 for the No Action Alternative. Impacts to groundwater quality and quantity and surface water quality and quantity are described in Sections 5.4.4.1, 5.4.4.2, 5.4.4.3, and 5.4.4.4, respectively.

5.4.4.1 Groundwater Quality

Section 5.3.4 identifies sources of groundwater contamination and presents modeling of the CWL. All groundwater quality impacts described in Section 5.3.4.1 are alternative-independent—the Expanded Operations Alternative would not cause any change in the nature or extent of groundwater contamination. Contamination of groundwater would remain an adverse impact as discussed in Section 5.3.4.1. No changes in rate and scope of ER Project remediation activities are projected for the Expanded Operations Alternative.

5.4.4.2 Groundwater Quantity

Under the Expanded Operations Alternative, using the groundwater quantity analysis described in Section 5.3.4.2 and projected SNL/NM water use for 1998 to 2008, 628 M ft^3 of water would be withdrawn over the 10-year operational period in comparison with 605 M ft^3 under the No Action Alternative. Under the Expanded Operations Alternative, this amount would account for approximately 12 percent of the 5,384 M ft^3 of groundwater withdrawal in the vicinity of KAFB from 1998 to 2008, compared to 11 percent under the No Action Alternative. If the MESA Complex configuration is implemented, an additional 7 M ft^3 (or 635 M ft^3) of water would be withdrawn over the 10-year operational period. This would increase groundwater withdrawal in the vicinity of KAFB by 0.1 percent. The total usage would contribute approximately 3 ft to local aquifer drawdown over the 10-year period.

The impacts described in Section 5.3.4.2 would not vary in any significant manner under the Expanded Operations Alternative. Aquifer drawdown would remain an adverse impact.

5.4.4.3 Surface Water Quality

SNL/NM impacts to surface water quality are discussed in Section 5.3.4. This discussion compares results of water quality analyses in Tijeras Arroyo (from samples collected during storm events), near the downstream boundary of KAFB, with NMWQCC stream standards. No constituents in the analyses exceeded these standards. Further, the three major potential contributors to surface water contamination (ER Project sites; permitted storm water discharges from TAs-I, -II, and -IV; and outdoor testing facilities) were evaluated based on potential contaminants and likelihood of migration.

Under the Expanded Operations Alternative, two changes could occur in the potential contributors to surface water contamination.

- A projected increase in staff of 10 percent over current levels (Section 5.4.12) could potentially add to the quantity of oil and grease runoff from permitted storm water discharges in TAs-I, -II, and -IV. The most recent storm water monitoring shows oil and grease concentrations ranging from 0.60 to 1.4 mg/L (SNL 1997d). Although there are no quantitative NPDES or state limits for oil and grease, these concentrations are near detection limits. A 10-percent increase in these values would have no discernible environmental consequence, especially considering dilution that would occur in Tijeras Arroyo during periods of runoff.

- An increase in the frequency of outdoor tests could result in an increase of radioactive materials deposited on the ground surface. Surface water sampling in Tijeras Arroyo has shown concentrations of radionuclides consistent with background levels. Only two outdoor testing sites, the Aerial Cable Facility and the Lurance Canyon Burn Site, have a defined path to Tijeras Arroyo. Some types of tests at both of these facilities would increase by a factor of five from the baseline year (1996) under the Expanded Operations Alternative. However, to date, surface water sampling has not shown evidence of contamination resulting from tests, and both sites are located at least 10 mi upstream of the point where Tijeras Arroyo exits KAFB. Therefore, concentrations of radionuclides at the exit point of Tijeras Arroyo from KAFB would be anticipated to remain the same under the Expanded Operations Alternative.

5.4.4.4 Surface Water Quantity

The method used to estimate the SNL/NM contribution to surface water quantity is described under the No Action Alternative (Section 5.3.4) and Appendix B. The analysis calculates the quantities of excess surface water runoff from developed areas of SNL/NM and the discharge of process and sanitary water to Albuquerque's Southside Water Reclamation Plant. Under the No Action Alternative, the estimated total excess surface water contribution to the Rio Grande would be between 40.7 and 41.3 M ft^3 annually. The vast majority of this contribution (40.6 M ft^3) would be from discharges to the water reclamation plant.

Storm Water Runoff

The Expanded Operations Alternative would result in only minor net differences in building and parking lot areas. These differences would not significantly change the developed (impervious) area of SNL/NM from the 0.72-mi^2 area projected under the No Action Alternative. Therefore, excess surface water runoff would continue at 100,000 to 700,000 ft^3 per year, as estimated under the No Action Alternative (Appendix B).

Discharge to Sanitary Sewer

The estimated annual volume of water to be discharged to the sanitary sewer under the Expanded Operations Alternative would be 43.0 M ft^3 (322 M gal), a 6 percent increase from the No Action Alternative (Section 5.3.4). Combined with the excess surface water runoff, the estimated total SNL/NM effect on surface water quantity would be between 43.1 and 43.7 M ft^3 annually. This would represent approximately 0.07 percent of Rio Grande flow at the discharge points. Under the Expanded Operations Alternative, no detrimental effects to the Rio Grande from the quantity of SNL/NM water discharged would be likely.

If implemented, the MESA Complex configuration would become operational after 2003 and the annual volume of water to be discharged to the sanitary sewer would increase by 0.4 M ft^3 (3 M gal). Combined with the excess surface water runoff, the estimated total SNL/NM effect on surface water quantity would increase by 0.4 M ft^3 (3 M gal).

5.4.5 Biological and Ecological Resources

Implementation of the Expanded Operations Alternative would result in impacts to biological and ecological resources similar to those under the No Action Alternative (see Section 5.3.5). There would be slightly increased levels of noise and activity under this alternative due to more frequent outdoor explosions. Impacts to biological and ecological resources would be minimal. Inventory and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to protect the animals, plants, and sensitive species on KAFB.

Outdoor activities would have a slight increase in the probability of unintended fires, off-road vehicular traffic, noise, small explosive debris, and plumes of smoke. The increased level of activity would be unlikely to cause the loss of any known species or plant community at KAFB. The area of disturbed vegetation would be increased, but the effect on the viability of plant communities would be negligible.

If implemented, the MESA Complex configuration would have a negligible effect on biological and ecological resources. The MESA Complex would be constructed in a heavily developed area on disturbed land that currently contains structures. There are no known Federally listed species or areas designated as critical habitat in the proposed facility's area of influence.

There would be no effect to the Federally endangered peregrine falcon, as discussed in Section 5.3.5. It is not anticipated that there would be adverse effects to the viability of populations of any sensitive species.

Potential increases in contaminant loads due to increased operations affecting animals and plants would be negligible based on annual ecological monitoring data (SNL/NM 1997u). See Section 5.4.3 for a discussion of contaminant loads and geology and soils impacts.

5.4.6 Cultural Resources

The implementation of the Expanded Operations Alternative would have low to negligible impacts to cultural resources due to 1) the absence of cultural resource sites on DOE-administered land, 2) the nature of the cultural resources found in the ROI (see Appendix C), 3) compliance with applicable regulations and established procedures for the protection and conservation of cultural resources on lands administered by the DOE and on lands administered by other agencies and used by the DOE (see Section 4.8.3.2 and Chapter 7), and 4) the largely benign nature of SNL/NM activities near cultural resources. Implementation of the regulations and procedures would make impacts from construction, demolition, decontamination, renovation, or ER Project activities unlikely.

If implemented, the MESA Complex configuration would have a negligible effect on cultural resources. The MESA Complex would be constructed in a heavily developed area on disturbed land that currently contains structures. There are no known cultural resources, including prehistoric or historic archaeological sites or buildings, in or near the area to be disturbed. If implemented, the DOE would comply with applicable regulations for the protection and preservation of cultural resources in case any are encountered before or during construction.

Under the Expanded Operations Alternative, prehistoric and historic cultural resources could potentially be affected by activities performed at five SNL/NM facilities, although the potential for impact would be low to negligible. These facilities consist of the Aerial Cable Facility, Lurance Canyon Burn Site, Thunder Range, Sled Track Complex, and Terminal Ballistics Complex. The first three facilities are located on land not owned by the DOE. Impacts could potentially result from three activities at these facilities: production of explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires and fire suppression. An increase in the frequency of these activities under the Expanded Operations Alternative would not result in a change in the potential for impacts from the No Action Alternative–the potential would remain low to negligible.

Another source of potential impact derives from the restricted access present at KAFB and at individual SNL/NM facilities. Restriction of access to areas within the ROI would have positive effects on cultural resources themselves. Under the Expanded Operations Alternative, current security levels that restrict access would be maintained for KAFB in general and would increase in frequency for specific SNL/NM facilities during various activities. These added restrictions would result in an increased level of protection for cultural resources located within the ROI and especially within the facility secure zones.

5.4.7 Air Quality

The implementation of the Expanded Operations Alternative would result in the nonradiological and radiological impacts to air quality described in Sections 5.4.7.1 and 5.4.7.2, respectively. The methods used to calculate these impacts are similar to those used to calculate air quality impacts for the No Action Alternative (Section 5.3.7).

5.4.7.1 Nonradiological Air Quality

Criteria Pollutants

Impacts of criteria pollutant concentrations resulting from the Expanded Operations Alternative were estimated by modeling emission sources using the EPA *ISCST3* (dated 97363) model. The emission rates for the steam plant, which were used as input in the model, are the same as those presented under the No Action Alternative. It is estimated that this level of operation would be sufficient to supply steam to all facilities under the Expanded Operations Alternative because no additional floor space is anticipated. In addition to the steam plant emissions, emissions from the four 600-kw emergency generators in Building 862, the boiler and emergency generator in Building 701, and the 600-kw generator in Building 870b were used as input into the model.

The OLM was used to calculate the nitrogen dioxide concentration as was done under the No Action Alternative. Background concentrations of nitrogen dioxide from monitoring station 2ZR for the 24-hour average concentration and the annual average concentration of 0.029 ppm (46 $\mu g/m^3$) and 0.008 ppm (13 $\mu g/m^3$) respectively, were added to the modeled nitrogen dioxide concentrations. The resulting concentrations of criteria pollutants are estimated to be comparable to the No Action Alternative concentrations presented in Table 5.3.7–1. Criteria pollutant concentrations under the Expanded Operations Alternative would be below applicable Federal and New Mexico state standards.

Airborne particulate matter (for example, dirt and equipment emissions) levels would be elevated during construction. Fugitive dust generated during the cleaning, grading, and other earthmoving operations is dependent on a number of factors, which include silt and moisture content of the soil, wind speed, and area disturbed. These temporary increases are expected to be too small to result in violation of the NAAQS beyond the SNL/NM boundary.

Mobile Sources

Mobile source (motor vehicle) emissions under the Expanded Operations Alternative would include carbon monoxide emissions estimated from increased commuter traffic. The estimated commuter traffic would be 110 percent of that under the No Action Alternative, or 14,940 commuter vehicles and 660 on-base vehicles. The carbon monoxide emission factor was determined by the EPA mobile source emission factor model *MOBILE5a*, projected to 2005, and would be 28.5 g per mile (SNL 1996c).

The projected carbon monoxide emissions for SNL/NM under the Expanded Operations Alternative, based on the aforementioned assumptions and modeled emission factor, would be 3,837 tons per year. This represents an increase of 348 tons per year from the No Action Alternative; however, this still represents a decrease of 250 tons per year from the 1996 baseline (see Table D.1–30). Projected carbon monoxide emissions for Bernalillo county for 2005 are 206 tons per day, or 75,190 tons per year (AEHD 1998). The contribution of carbon monoxide emissions from vehicles commuting to and from SNL/NM and SNL/NM-operated on-base vehicles in 2005, as a percent of the total county highway mobile source carbon monoxide emissions, would be 5.1 percent.

Total carbon monoxide emissions are shown in Table 5.4.7–1. Estimates from construction activities are included and are the same as those described in Section 5.3.7.1 for the No Action Alternative.

Total carbon monoxide emissions for the Expanded Operations Alternative are 243 tons per year less than the 1996 baseline, well below the 100 tons per year incremental increase above baseline that would require a conformity determination. In addition, the total carbon monoxide emissions for the Expanded Operations Alternative were found to be approximately 3 percent of the maintenance area's emissions of carbon monoxide. As a result, the DOE has concluded that no conformity determination is required for the Expanded Operations Alternative.

Table 5.4.7–1. Carbon Monoxide Emissions (tons per year) from SNL/NM under the Expanded Operations Alternative

STATIONARY SOURCES	MOBILE SOURCES	CONSTRUCTION ACTIVITIES	BURN SITE	TOTAL
18.36[a]	3,837	132	4.5[b]	3,991.86

Source: SNL/NM 1998a, SNL 1996c
lb: pound
SNL/NM: Sandia National Laboratories/New Mexico
[a] Includes incremental carbon monoxide emissions from an "insignificant" boiler and emergency generator in Building 701 and a 600-kw capacity generator in Building 870b added between 1996 and 2008.
[b] Represents carbon monoxide emissions from combustion of 400,200 lb of JP-8 fuel

Lurance Canyon Burn Site

Estimates of the criteria pollutant emissions under the Expanded Operations Alternative for the Lurance Canyon Burn Site were based on a reasonable upper bound quantity of JP-8 fuel burned (1,000 gal), which is equal to that used to estimate criteria pollutant emissions under the No Action Alternative. The frequency of tests is expected to increase for the Expanded Operations Alternative, therefore, increasing the throughput of JP-8 fuel burned for the year. The proposed operating permit limits for the Lurance Canyon Burn Site were based on the following fuel throughputs:

- 36,000 lb of sawdust or wood
- 12,000 lb for a sawdust-propellant-acetone mixture
- 400,200 lb of JP-8 fuel
- 14,400 lb of urethane foam
- 100 lb of explosives

Concentrations of pollutants resulting from test emissions were calculated using the *OBODM* (Bjorklund et al. 1997). The results for the criteria pollutants are presented in Table 5.4.7–2 along with applicable Federal (40 CFR Part 50) and New Mexico state standards (20 NMAC 2.3) for each pollutant. The maximum percent of a criteria pollutant standard is 4.3 percent for the NMAAQS for the 24-hour average PM_{10}.

Table 5.4.7–2. Criteria Pollutant Concentrations from Lurance Canyon Burn Site with Applicable National and New Mexico Ambient Air Quality Standards Under the Expanded Operations Alternative

POLLUTANT	AVERAGE TIME	NAAQS (ppm[μg/m³])	NMAAQS (ppm[μg/m³])	EXPANDED OPERATIONS CONCENTRATION (ppm[μg/m³])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.023[21.45]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.18[171.6]	1.4
Nitrogen Dioxide	Annual	0.053[83]	0.05[78]	6.4×10^{-7}[0.001]	< 1
	24 hours	-	0.10[156]	1.18×10^{-4}[0.184]	< 1
PM_{10}[a]	Annual	50	-	0.018[b]	< 1
	24 hours	150	-	6.51[b]	4.3
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	4.6×10^{-7}[0.001]	< 1
	24 hours	0.14[305]	0.10[218]	1.7×10^{-4}[0.367]	< 1
	3 hours	0.50[1,088]	-	0.001[2.94]	< 1
TSP[a]	Annual	-	60[b]	0.018[b]	< 1
	24 hours	-	150[b]	6.51[b]	4.3

Sources: 20 NMAC 2.3, 40 CFR 50, Bjorklund et al. 1997, SNL 1997a.
μg/m³: micrograms per cubic meter
°R: degrees Rankin
ft: feet
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: particulate matter smaller than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] PM_{10} assumed equal to TSP
[b] μg/m³
Note: The standards for some of the pollutants are stated in ppm. These values were converted to μg/m³ with appropriate corrections for temperature (530 °R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Eighty-nine chemical pollutants, resulting from the tests performed at the Lurance Canyon Burn Site, were also evaluated. Each of these pollutants was compared with the respective OEL/100 guideline and each comparison indicated the chemical concentrations would be below the guideline. Appendix D contains the list of chemical concentrations resulting from the estimated Expanded Operations Alternative tests at the Lurance Canyon Burn Site.

Noncarcinogenic Chemical Screening

Estimates of noncarcinogenic chemical emissions under the Expanded Operations Alternative were determined by extrapolating the No Action Alternative noncarcinogenic chemical emissions to the level of expanded operations for each of the selected facilities. The same screening process described for the No Action Alternative was performed to reduce the number of chemicals to those that exceed the screening level. The screening analysis considered those chemicals screened under the No Action Alternative from the same 12 facilities located in TAs-I, -II, -III, -IV, and -V and shown in Table 5.3.7–5. One noncarcinogenic chemical, chromium trioxide from Building 870, would exceed the screening level under the Expanded Operations Alternative.

Carcinogenic Chemical Screening

Carcinogenic chemical emissions under the Expanded Operations Alternative were determined by extrapolating the No Action Alternative carcinogenic chemical emissions to the level of expanded operations for each of the selected facilities. The same screening process described for the No Action Alternative was performed to reduce the number of carcinogenic chemicals to those that exceed the screening level. The screening analysis considered those chemicals screened under the No Action Alternative from the same 12 facilities in TAs-I, -II, -III, -IV, and -V and shown in Table 5.3.7–5. Ten carcinogenic chemicals from five facilities would exceed the screening level. Table 5.4.7–3 presents concentrations

Table 5.4.7–3. Annual Carcinogenic Chemical Concentrations from Facility Emissions Under the Expanded Operations Alternative

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	EXPANDED OPERATIONS CONCENTRATION (ppb[μg/m³])
Chloroform (Trichloromethane)	6580	1.09×10^{-3}[4.42×10^{-3}]
Dichloromethane (Methylene Chloride)	870	7.31×10^{-2}[2.11×10^{-1}]
Dichloromethane (Methylene Chloride)	878	3.53×10^{-3}[1.02×10^{-2}]
Formaldehyde	878	6.36×10^{-4}[6.49×10^{-4}]
Trichloroethene	878	1.16×10^{-2}[5.20×10^{-2}]
1,2-Dichloroethane (Ethylene Dichloride)	893	5.86×10^{-4}[1.97×10^{-3}]
1,2-Dichloroethane (Ethylene Dichloride)	MESA	NA
1,4-Dichloro-2-Butene	897	3.96×10^{-5}[1.68×10^{-4}]
Acrylonitrile	897	1.52×10^{-4}[2.74×10^{-4}]
Chloroform (Trichloromethane)	897	1.25×10^{-3}[5.07×10^{-3}]
Trichloroethene	897	1.58×10^{-3}[7.06×10^{-3}]

Source: SNL/NM 1998a
MESA: Microsystems and Engineering Sciences Applications
NA: not applicable
ppb: parts per billion
μg/m³: micrograms per cubic meter
Bldg. 6580 – Hot Cell Facility (HCF)
Bldg. 870 – Neutron Generator Facility (NGF)
Bldg. 878 – Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 – Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 – Integrated Materials Research Laboratory (IMRL)
[a] If implemented, the MESA Complex configuration would become operational after 2003, and CSRL operations would relocate to MESA. No new or additional carcinogenic chemicals would be associated with MESA emissions.

for carcinogenic chemicals with estimated emission rates greater than the screening level.

If implemented, the MESA Complex configuration would decrease the number of carcinogenic chemicals exceeding the screening level from 10 to 9. This would be a result of the replacement of the CSRL by the MESA Complex. For 1,2-dichloroethane, there would be no more emissions due to elimination of the chemical from the inventory, as noted in Table 5.4.7–3

Under the Expanded Operations Alternative, nonradiological air quality concentrations for criteria and chemical pollutants would be below regulatory standards and human health guidelines. Maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b would represent a maximum of 96 percent of the allowable regulatory limit at a public access area. Noncarcinogenic chemicals that exceed the screening levels, based upon emission rates calculated from purchased quantities (Appendix D, Tables D.1–6, D.1–10, D.1–14, and D.1–18), do not exceed the screening levels based upon process engineering estimates of actual emission rates, with the exception of chromium trioxide from Building 870 (Appendix D, Table D.1–21). Further analysis of chromium trioxide is performed in Section 5.3.8 to determine human health impacts from noncarcinogenic chemical emissions from SNL/NM. The risk due to exposure of the 10 carcinogenic chemicals that exceed the carcinogenic chemical screening guidelines (Appendix D, Table D.1–25) are further evaluated in Section 5.4.8, Human Health and Worker Safety.

5.4.7.2 Radiological Air Quality

The SWEIS analysis reviewed the radiological emissions from all SNL/NM facilities. Section 4.9.2 identifies 17 SNL/NM facilities as producing radiological emissions. Based on historic SNL/NM radionuclide emissions data, NESHAP compliance reports, and the FSID (SNL/NM 1998ee), 10 of the 17 SNL/NM facilities were modeled for radiological impacts (Table 5.4.7–4). ACRR operations under DP configuration were assumed comparable to Annular Core Pulsed Reactor II (ACPR-II) operations, and, for the purpose of conservative analysis, the ACRR was evaluated under simultaneous operation of both configurations. For analysis purposes, based on the review of historical dose evaluations, other facilities that would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI were screened from further consideration in the SWEIS. The modeled releases to the environment would result in a calculated dose to the MEI and the population within 50 mi of TA-V. TA-V was selected as a center for the population within a 50-mi radius, because the majority of radiological emissions would be from TA-V, specifically the HCF, and TA-V is historically addressed for annual SNL/NM NESHAP compliance (SNL/NM 1996u).

The *CAP88-PC* computer model (DOE 1997e) was used to calculate the doses. Details on the *CAP88-PC* model, radionuclide emissions, model and source parameters,

Table 5.4.7–4. Radiological Emissions from Sources at SNL/NM Under the Expanded Operations Alternative

FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	RELEASE (Ci/yr)
Annular Core Pulsed Reactor (ACPR-II DP configuration), Building 6588	V	Argon-41	7.8
Annular Core Research Reactor (ACRR, medical isotopes production configuration), Building 6588	V	Argon-41 Tritium	2.2 2.2
Explosive Components Facility (ECF), Building 905	II	Tritium	2.0×10^{-3}
High-Energy Radiation Megavolt Electron Source (HERMES III), Building 970	IV	Nitrogen-13 Oxygen-15	3.603×10^{-3} 3.603×10^{-4}
Hot Cell Facility (HCF), Building 6580	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	3.90 10 18 0.72 11 660 0.63 970 190 1,600 5.9 7,200 340 6,900 1,200
Mixed Waste Landfill (MWL)	III	Tritium	0.29
Neutron Generator Facility (NGF), Building 870	I	Tritium	156
Radioactive and Mixed Waste Management Facility (RMWMF), Building 6920	III	Tritium	2.203[b]
Radiographic Integrated Test Stand (RITS), Building 970	IV	Nitrogen-13	0.16
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	30

Source: SNL/NM 1998a
DP: Defense Programs
Ci/yr: curies per year
SNL/CA: Sandia National Laboratories/California
[a] Radiological emissions are projections based on planned activities, projects, and programs. Radionuclide releases are not the same as those presented in Chapter 4.
[b] Because SNL/CA tritium-contaminated oil levels handled at RMWMF during the base year were abnormally high, this maximum level of emissions was assumed to be released in any year and, therefore, was constant for all alternatives.

exposures, meteorological data, and population data are presented in Appendix D. Figure 5.3.7–3 shows the locations of the 10 facilities modeled in the SWEIS. Table 5.4.7–4 presents the estimated radiological emissions from the 10 SNL/NM facilities under the Expanded Operations Alternative. The radiological emissions from each facility were estimated based on SNL/NM planned operations and tests projected into the future. Detailed information is available in the FSID (SNL/NM 1998ee). The emission of argon-41 from the ACRR, under the medical isotope production configuration, would be lower than during the base year, 1996, because of the refurbishing operations conducted during 1996. The SPR emissions were estimated to be higher than emissions during the base year. This is due to instituting NESHAP requirements for "confirmatory measurements" of radiological air emissions where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emission factors. These measurements are source-specific to the SPR and ACRR and would not affect the calculations or measurements for other facilities.

Because the general public and USAF personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impact evaluations (see Appendix D.2). Based on NESHAP reports, 16 onsite and 6 offsite additional receptor locations were also evaluated. A total of 38 receptor locations were evaluated for dose impacts. The core receptor locations include schools, hospitals, a museum, and clubs, and were considered for analysis because of potential impacts to children, the sick, and the elderly. The 32 modeled onsite and core receptor locations are shown in Figure 5.3.7–4.

The dose to an individual at each receptor location and to the population within 50 mi from the radionuclide emission from each source were calculated using the *CAP88-PC* model. The public receptor receiving the maximum dose was identified as the MEI. The model-calculated dose contributions, including external, inhalation, and ingestion exposure pathways from each of the 10 sources, calculated individually at each receptor location, were combined at each modeled receptor to determine the overall SNL/NM site-wide normal operations dose to the MEI. Under the Expanded Operations Alternative, the maximum EDE to the MEI from all exposure pathways from all modeled sources was calculated to be 0.51 mrem/yr. The MEI having the highest combined dose would be located at the KUMMSC, north of TA-V. This location is consistent with the location of the MEI historically identified in the annual NESHAP compliance reports. The EDE contributions from these 10 sources to this combined MEI dose are presented in Table 5.4.7–5. Table 5.4.7–6 presents the doses at the 38 onsite, core, and offsite receptor locations. The potential doses for these additional locations would be much lower than the highest combined MEI dose. The total collective dose to the population of 732,523 within a 50-mi radius of TA-V was calculated to be 15.8 person-rem per year under the Expanded Operations Alternative. The contributions from all of the 10 modeled sources to the overall SNL/NM site-wide normal operations collective dose to the population within 50 mi are also presented in Table 5.4.7–4. The average dose to an individual in the population within 50 mi of TA-V (collective dose divided by the total population) would be 2.16×10^{-2} mrem/yr.

The calculated total MEI dose of 0.51 mrem/yr would be much lower than the regulatory limit of 10 mrem/yr to an MEI from SNL/NM site-wide total airborne releases of radiological materials (40 CFR Part 61). This dose would be small compared to an individual background radiation dose of 360 mrem/yr (see Figure 4.10–2). The calculated collective dose from SNL/NM operations to the population within 50 mi, 15.8 person-rem per year, would be much lower than the collective dose to the population from background radiation. Based on this individual background radiation dose, the population within 50 mi of TA-V would receive 263,700 person-rem per year.

Table 5.4.7–5. Summary of Dose Estimates from Radioactive Air Emissions to the SNL/NM Public Under the Expanded Operations Alternative

SOURCE	ANNUAL MEI DOSE, EDE (mrem)	ANNUAL POPULATION DOSE (person-rem)
Annular Core Pulsed Reactor II (ACPR-II) (DP configuration)	1.3×10^{-3}	2.16×10[illegible]
Annular Core Research Reactor (ACRR) (medical isotopes production configuration)	4.2×10^{-4}	1.07×10^{2}
Explosive Components Facility (ECF)	9.9×10^{-9}	4.19×10^{6}
High-Energy Radiation Megavolt Electron Source (HERMES III)	3.0×10^{-8}	6.06×10^{-7}
Hot Cell Facility (HCF)	5.0×10^{-1}	1.54×10^{1}
Mixed Waste Landfill (MWL)	4.0×10^{-6}	6.16×10^{-4}
Neutron Generator Facility (NGF)	7.4×10^{-4}	3.22×10^{-1}
Radioactive and Mixed Waste Management Facility (RMWMF)	7.5×10^{-6}	3.24×10^{-3}
Radiographic Integrated Test Stand (RITS)	1.3×10^{-6}	2.69×10^{-5}
Sandia Pulsed Reactor (SPR)	4.3×10^{-3}	8.01×10^{-2}
TOTAL MEI DOSE	**0.51**	-
50-MILE POPULATION COLLECTIVE DOSE	-	**15.8**

Sources: DOE 1997e, SNL/NM 1998a
DP: Defense Programs
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem
rem: Roentgen equivalent, man
Note: Although the Annular Core Pulsed Reactor-II is expected to be operated under DP configuration intermittently, for this analysis, it was assumed to be operated simultaneously with the ACRR under medical isotopes production configuration. Its contribution to the total dose would not be appreciable. If implemented, the addition of the MESA Complex configuration would be unlikely to contribute radiological emissions.

Table 5.4.7–6. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Expanded Operations Alternative

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
ONSITE AND NEAR-SITE RECEPTORS	
Albuquerque International Sunport (Bldg. 1064)	5.7×10^{-2}
Albuquerque International Sunport (Bldg. 760)	1.2×10^{-1}
Building 20706	7.8×10^{-2}
Building 24499	5.5×10^{-2}
Child Development Center-East	5.4×10^{-2}
Child Development Center-West	6.2×10^{-2}
Civil Engineering Research Facility (Bldg. 5701)	4.0×10^{-2}
Coronado Club	5.5×10^{-2}
Coyote Canyon Control Center	4.0×10^{-2}
Golf Course Clubhouse	2.3×10^{-2}
Golf Course Maintenance Area	1.5×10^{-1}
Kirtland Elementary School	6.1×10^{-2}
KAFB Firestation #4 (Bldg. 9002)	5.9×10^{-2}
KAFB Landfill	9.1×10^{-2}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	5.1×10^{-1}
Loop Housing	5.3×10^{-2}
Lovelace Hospital	4.5×10^{-2}
Lovelace Respiratory Research Institute	4.2×10^{-2}
Manzano Offices (Fire Station)	1.1×10^{-1}
Maxwell Housing	7.2×10^{-2}
National Atomic Museum	6.9×10^{-2}
Pershing Park Housing	5.1×10^{-2}
Riding Stables	2.1×10^{-1}
Sandia Base Elementary	4.3×10^{-2}
Sandia Federal Credit Union	7.7×10^{-2}
Shandiin Day Care Center	6.3×10^{-2}
Technical Onsite Inspection Facility	9.8×10^{-2}
Veterans Affairs Medical Center	8.4×10^{-2}
Wherry Elementary School	5.2×10^{-2}
Zia Park Housing	6.6×10^{-2}

Table 5.4.7–6. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Expanded Operations Alternative (concluded)

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
OFFSITE RECEPTORS	
Albuquerque City Offices	$1.5x10^{-1}$
East Resident	$5.8x10^{-2}$
Eubank Gate Area (Bldg. 8895)	$1.1x10^{-1}$
Four Hills Subdivision	$1.1x10^{-1}$
Isleta Gaming Palace	$6.6x10^{-2}$
Northeast Resident	$7.8x10^{-2}$
Seismic Center (USGS)	$6.8x10^{-2}$
Tijeras Arroyo (West)	$1.9x10^{-1}$

Sources: DOE 1997e, SNL/NM 1998a
EDE: effective dose equivalent
mrem: millirem
USGS: U.S. Geological Survey

5.4.8 Human Health and Worker Safety

Implementation of the Expanded Operations Alternative would result in the human health and worker safety impacts described in the following sections for normal operations and accident conditions.

5.4.8.1 Normal Operations

This section provides information on public health and worker health and safety under the Expanded Operations Alternative. It assesses the potential human health effects associated with routine releases of radioactive and nonradioactive hazardous material from SNL/NM normal operations. For detailed discussions of analytical methods and results, along with terminology, definitions, and descriptions, see Appendix E.

Health risk analyses are presented for potential exposures at specific receptor locations and for the potential maximum exposures to radiation and chemical air releases. For a description of receptor locations, exposure scenarios, and environmental pathways selected for assessing human health impacts, see Section 5.3.8.

Chemical Air Release Pathways

Under the Expanded Operations Alternative, chemical use would be more than the quantities projected under the No Action Alternative. As a result, air exposure concentrations at receptor locations are projected to increase slightly (Appendix E, Table E.3–3). The chemical assessment process, described in Section 5.3.8 for chemical air release pathways, identified seven COCs (see Appendix E, Table E.3–3). Three of the seven COCs are the same for different buildings. These COCs are associated with SNL/NM operations in Buildings 878 (AMPL), 893 (CSRL), 897 (IMRL), 6580 (HCF), and 870 (NGF).

If the CSRL were replaced by MESA Complex configuration, the number of COCs would decrease to six because there would no longer be emissions of 1,2-dichloroethane (see Table E.3–3).

Several receptor locations, individual exposure scenarios, and a hypothetical worst-case exposure scenario present the range of health risks from chemicals in the air in the SNL/NM vicinity. Adult, child, residential, and visitor risk assessments were calculated. Table 5.4.8–1 lists the human health impacts from the estimated exposures to chemical air releases from SNL/NM facility operations. These potential health risks are low and no adverse health effects would occur at these risk levels. Assessing the hypothetical worst-case exposure scenario establishes the upper bound value for health risk. Under the Expanded Alternative, the upper bound values for health risk from noncarcinogenic chemicals would be HIs of less than 1; the ELCRs would be less than 10^{-6} from carcinogenic chemicals (Table E.6–4). If implemented, the MESA Complex configuration would decrease chemical air emissions impacts by a small quantity.

Table 5.4.8–1. Human Health Impacts in the SNL/NM Vicinity from Chemical Air Emissions Under the Expanded Operations Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI (WITH MESA)
RESIDENTIAL SCENARIOS			
Four Hills Subdivision[a]	Adult	<0.01/<0.01	$2.1\times10^{-10}/1.3\times10^{-1}$[illegible]
	Child	<0.01/<0.01	$8.5\times10^{-11}/8.5\times10^{-11}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$4.6\times10^{-10}/4.7\times10^{-12}$ ($4.3\times10^{-10}/4.4\times10^{-12}$)
	Child	<0.01/<0.01	$3.2\times10^{-10}/3.6\times10^{-12}$ ($3.0\times10^{-10}/3.4\times10^{-12}$)
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$8.1\times10^{-10}/8.4\times10^{-12}$ ($7.2\times10^{-10}/7.4\times10^{-12}$)
	Child	<0.01/<0.01	$5.7\times10^{-10}/6.4\times10^{-12}$ ($5.0\times10^{-10}/5.7\times10^{-12}$)
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$5.5\times10^{-10}/6.2\times10^{-12}$ ($5.0\times10^{-10}/5.6\times10^{-12}$)
Child Development Center-West	Child	<0.01/<0.01	$1.2\times10^{-10}/1.4\times10^{-12}$ ($1.1\times10^{-10}/1.3\times10^{-12}$)
Coronado Club	Adult	<0.01/<0.01	$1.2\times10^{-9}/1.3\times10^{-11}$ ($8.8\times10^{-10}/9.0\times10^{-12}$)
	Child	<0.01/<0.01	$7.0\times10^{-10}/7.8\times10^{-12}$ ($6.1\times10^{-10}/6.9\times10^{-12}$)
Golf Course (Club House)	Adult	<0.01/<0.01	$5.1\times10^{-10}/5.3\times10^{-12}$ ($4.8\times10^{-10}/4.9\times10^{-12}$)
Kirtland Elementary School	Child	<0.01/<0.01	$4.7\times10^{-11}/5.2\times10^{-13}$ ($3.5\times10^{-11}/3.9\times10^{-13}$)
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)[b]	Adult	<0.01/<0.01	$3.5\times10^{-10}/3.7\times10^{-12}$ ($3.3\times10^{-10}/3.4\times10^{-12}$)
Lovelace Hospital	Adult	<0.01/<0.01	$2.8\times10^{-10}/2.9\times10^{-12}$ ($2.5\times10^{-10}/2.6\times10^{-12}$)
	Child	<0.01/<0.01	$1.9\times10^{-10}/2.2\times10^{-12}$ ($1.8\times10^{-10}/2.0\times10^{-12}$)
National Atomic Museum	Adult	<0.01/<0.01	$2.1\times10^{-9}/2.1\times10^{-11}$ ($1.7\times10^{-9}/1.8\times10^{-11}$)
	Child	<0.01/<0.01	$1.4\times10^{-9}/1.6\times10^{-11}$ ($1.2\times10^{-9}/1.4\times10^{-11}$)
Riding Stables	Adult	<0.01/<0.01	$3.0\times10^{-10}/3.1\times10^{-12}$ ($2.8\times10^{-10}/2.9\times10^{-12}$)

Table 5.4.8–1. Human Health Impacts in the SNL/NM Vicinity from Chemical Air Emissions Under the Expanded Operations Alternative (concluded)

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI (WITH MESA)
Sandia Base Elementary School	Child	<0.01/<0.01	$6.3x10^{-10}/7.2x10^{-12}$ ($5.8x10^{-10}/6.5x10^{-12}$)
Shandiin Day Care Center	Child	<0.01/<0.01	$8.2x10^{-10}/9.3x10^{-12}$ ($7.1x10^{-10}/8.0x10^{-12}$)
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$3.4x10^{-10}/3.5x10^{-12}$ ($3.0x10^{-10}/3.1x10^{-12}$)
Wherry Elementary	Child	<0.01/<0.01	$4.2x10^{-10}/4.7x10^{-12}$ ($3.7x10^{-10}/4.2x10^{-12}$)

Source: SmartRISK 1996
MESA: Microsystems and Engineering Sciences Applications
RME: Reasonable maximum exposed
AEI: Average exposed individual

[a] Four Hills Subdivision receptor location impacts were based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions; therefore, no change would be due to MESA Complex configuration
[b] This receptor location was analyzed using a worker scenario, as discussed in Appendix E 5
Note: See Section 5.3.8 for a discussion of selection of receptor locations

Radiation Air Release Pathways

Projected air releases of radionuclides under the Expanded Operations Alternative would result in slightly higher radiation exposures to both the potential MEI and the population in the ROI. The maximum radiation doses calculated are presented in Section 5.4.7.2. The risk estimator of 500 fatal cancers per 1 M person-rem to the public was used to convert dose to fatal cancer risk. The maximum annual exposure dose resulting from SNL/NM sources would occur in the KAFB boundary at the KUMMSC and would increase the MEI's lifetime risk of fatal cancer by $2.6x10^{-7}$. In other words, the likelihood of the MEI developing fatal cancer from a 1-year dose from SNL/NM operations would be less than 1 chance in 4 M. The annual collective dose to the population due to these releases would increase the number of fatal cancers in the entire population within the ROI by $7.9x10^{-3}$. This value is less than 1; therefore, no LCFs would be likely to occur in the ROI population due to SNL/NM radiological air releases.

To estimate a range in the potential for human health effects, radiation doses were calculated at specific receptor locations in the SNL/NM vicinity and are presented in Table 5.4.7–6. Table 5.4.8–2 lists the associated radiological health risks to receptors at several of these locations. Receptors at most of these locations would have a considerably lower risk than the highest lifetime risk determined for the potential onsite MEI at the KUMMSC.

Receptors in the SNL/NM vicinity also have the potential to be exposed to air releases of radionuclides by way of the indirect air pathway: ingesting food that contains radionuclides. *CAP88-PC* integrates doses from this pathway in the collective dose estimation for the population within the ROI, but does not integrate it into the dose evaluation for the potential onsite MEI receptor. The estimated percentage of the population dose from ingesting potentially contaminated food would be approximately 10 percent (1.62 person-rem of the 15.8 person-rem annual collective population dose), which means it would also account for approximately 10 percent of the health risk value. When the same percent contribution is assumed, the lifetime risk of fatal cancer to the MEI from a 1-year dose would be increased by $2.6x10^{-8}$ (10 percent). The overall cancer risk to the MEI from radiation would still remain less than 1 chance in 4 M.

Nonfatal Cancers and Genetic Disorders

Radiation exposures can cause nonfatal cancers and genetic disorders. The NCRP has adopted risk estimators recommended by the ICRP for the public for assessing these health effects from radiation (ICRP 1991). The SNL/NM maximum annual dose to the MEI would increase the lifetime risk of nonfatal cancers and genetic disorders by $5.1x10^{-8}$ and $6.6x10^{-8}$, respectively, which would be less than 1 chance in 15 M. The SNL/NM annual collective radiation dose to the population within the ROI would increase the number of nonfatal cancers

Table 5.4.8–2. Human Health Impacts in the SNL/NM Vicinity from Radiological Air Emissions Under the Expanded Operations Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	$2.7x10^{-8}$
Child Development Center-West	$3.1x10^{-8}$
Coronado Club	$2.8x10^{-8}$
Four Hills Subdivision	$5.5x10^{-8}$
Golf Course (Club House)	$1.2x10^{-7}$
Kirtland Elementary School	$3.1x10^{-8}$
KAFB Housing (Zia Park Housing)	$3.3x10^{-8}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)[a]	$2.6x10^{-7}$
Lovelace Hospital	$2.3x10^{-8}$
National Atomic Museum	$3.5x10^{-8}$
Riding Stables	$1.1x10^{-7}$
Sandia Base Elementary School	$2.2x10^{-8}$
Shandiin Day Care Center	$3.2x10^{-8}$
Isleta Gaming Palace	$3.3x10^{-8}$
Veterans Affairs Medical Center	$4.2x10^{-8}$
Wherry Elementary School	$2.6x10^{-8}$

Sources: DOE 1997e, SNL/NM 1998a
MEI: maximally exposed individual
[a] The radiological MEI location for normal operations.
Note: Calculations were completed using *CAP88-PC*

and genetic disorders by $1.6x10^{-3}$ and $2.1x10^{-3}$, respectively. This means that no additional nonfatal cancers or genetic disorders would be likely to occur within the ROI population from SNL/NM radiological air releases.

Transportation

The potential human health risks and accident fatalities for transporting of various radiological materials for SNL/NM operations are discussed in Section 5.4.9. The radiological dose to the population along the route within the ROI was estimated by assuming that 10 percent of the total travel distance would occur within the ROI. Therefore, 10 percent of the total radiological dose (off link and on link), calculated for all radiological materials transport, would be considered as an additional human health impact to the population along the route within the ROI (see Appendix G). This percentage of the annual collective population dose from transportation activity would increase the ROI number of LCFs by $2.5x10^{-3}$. Adding this to the number of LCFs associated with the annual collective population dose due to routine air releases would change the risk to $1.0x10^{-2}$. In other words, no additional LCFs in the ROI would likely occur from SNL/NM radiological materials transportation activities.

Composite Cancer Risk

Annual radiation dose accumulates over the total number of years the person is exposed. The radiological MEI lifetime risk of fatal cancer following a 30-year exposure time would be $7.8x10^{-6}$, or less than 1 chance in 128,000. Thirty years is consistent with the exposure used in calculating the lifetime chemical cancer risk. To assess a composite cancer risk capturing the greatest potential cancer risk from radiation exposure, the fatal cancer risk to the MEI and the chemical ELCR at the same location (KUMMSC) were summed. For the KUMMSC location, the contribution of risk from exposure to chemicals would not increase the risk from radiation exposure (the increased lifetime risk of fatal cancer would remain $7.8x10^{-6}$, and it was concluded that the majority of the risk would be from the potential exposure to radiation (see Table E.6–2).

To assess a composite cancer risk capturing the highest potential risk from chemicals, the upper bound risk value for cancer risk from chemicals, which assumes a hypothetical worst-case exposure scenario, was added to the radiological MEI (KUMMSC) cancer risk (see Table E.6–4). This is an implausible scenario used only to bound the analysis. The composite cancer risk would be $7.9x10^{-6}$. This would still be within the EPA's cancer risk range established for the protection of human health of 10^{-6} to 10^{-4} (40 CFR Part 300). This would be a risk of less than 1 chance in 126,000. The SNL/NM potential contribution (from potential exposures to chemicals and radiation) to an individual's lifetime cancer risk would be very low, considering that, overall in the U.S., men have a 1-in-2 lifetime risk of developing cancer and for women the risk is 1-in-3. Approximately 1 of every 4 deaths in the U.S. is from cancer (ACS 1997).

Worker Health and Safety

Under the Expanded Operations Alternative, worker safety impacts would vary only slightly from under the No Action Alternative. Impacts to the entire workforce were assessed based on a 10 percent increase in the worker population (see Section 5.4.12) and the assumption that the SNL/NM worker injury/illness rate per 100 workers would remain consistent with the 5-year average derived for 1992 through 1996. Impacts expected would be zero fatalities per year, approximately 326 nonfatal injuries/illnesses per year, an average of 47 mrem per year radiation dose (TEDE) to the radiation-badged worker, and 1 or 2 confirmed chemical exposures per year.

Routine air emissions evaluated for potential exposures to specific receptors in the SNL/NM vicinity would have the potential to impact noninvolved workers at SNL/NM. A noninvolved worker is not exposed to chemical or radiological work-related activities, but is potentially exposed because they work at SNL/NM in the vicinity of facility releases. Potential noninvolved worker exposures to airborne radiation were identified using the KUMMSC receptor location (Table 5.4.8–2). Potential noninvolved worker exposures to airborne chemicals were identified using a receptor location at the center of TA-I, near SNL/NM's chemical facility sources. Based on an exposure scenario for a worker, health risks from chemicals to the noninvolved worker would be below a HI of 1 and less than 10^{-6} for an ELCR (see Appendix E, Table E.6–4).

The risks of cancer fatality from the annual average individual worker dose, annual maximum worker dose, and annual workforce collective dose (to the radiation worker population) are shown in Table 5.4.8–3. Health risks from the annual average individual and annual maximum worker doses would remain constant for each alternative (based on the REMS database dose information for 1996) (see Appendix E, Section E.6.1.1). The ICRP risk estimator of 400 fatal cancers per 1 M person-rem among workers was used to convert dose to risk of LCF. The annual workforce collective dose would be associated with $7.6x10^{-3}$ additional fatal cancers for the entire radiation worker population (those working in radiation-designated areas). For assessment purposes, this would equate to no additional LCFs in the radiation worker population under the Expanded Operations Alternative.

Table 5.4.8–3. Radiation Doses (TEDE[a]) and Health Impacts to Workers from SNL/NM Operations Under the Expanded Operations Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY FROM A 1-YEAR DOSE
Annual Average Individual Worker Dose	47[b] (mrem/year)	$1.9x10^{-5}$
Annual Maximum Worker Dose	845[b] (mrem/year)	$3.4x10^{-4}$
RADIATION WORKER DOSE RATES	**RADIATION DOSE**	**NUMBER OF LCFs**
Annual Workforce Collective Dose	19 (person-rem/year)	$7.6x10^{-3}$

Source: SNL/NM 1997k
LCFs: latent cancer fatalities
mrem/yr: millirems per year
rem: roentgen equivalent, man
TEDE: total effective dose equivalent
[a]Average measured TEDE means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b]Annual average individual and annual maximum worker doses would be expected to remain consistent with the base year, 1996 (see Section 4.10).
Note: Because not all badged workers are radiation workers, "radiation workers" means those badges with greater than 10 mrem above background measurements used in the calculations.

Nonfatal Cancer and Genetic Disorders

The SNL/NM maximum annual dose to the radiation worker population would increase the number of nonfatal cancer and genetic disorders by 1.5×10^{-3}, based on the risk estimator of 80 health effects per 1 M person-rem used for both effects. In other words, no additional nonfatal cancers or genetic disorders would be likely to occur in the radiation worker population due to operations under the Expanded Operations Alternative.

Nonionizing Radiation

Sources of nonionizing radiant energy at SNL/NM include both laser and accelerator facilities. The SAs for the SNL/NM laser facilities report that the lasers are operated according to ANSI guidelines, which require that light paths are isolated from workers and from other equipment (SNL/NM 1996b). For accelerators that generate EMP and that could present a high-voltage hazard to personnel, ANSI guidelines require mitigation measures such as shielding to block high-voltage hazards from personnel and, during tests shots, exclude personnel from high-bay areas. Based on measurements from SNL/NM's pulsed power facilities, the EMP exposures to personnel outside the high-bay would be less than the American Conference of Governmental Industrial Hygienists (ACGIH) standard of 100 kV/m (SNL/NM 1996b). Therefore, routine high-voltage impacts to SNL/NM workers and the public would not occur.

5.4.8.2 Accidents

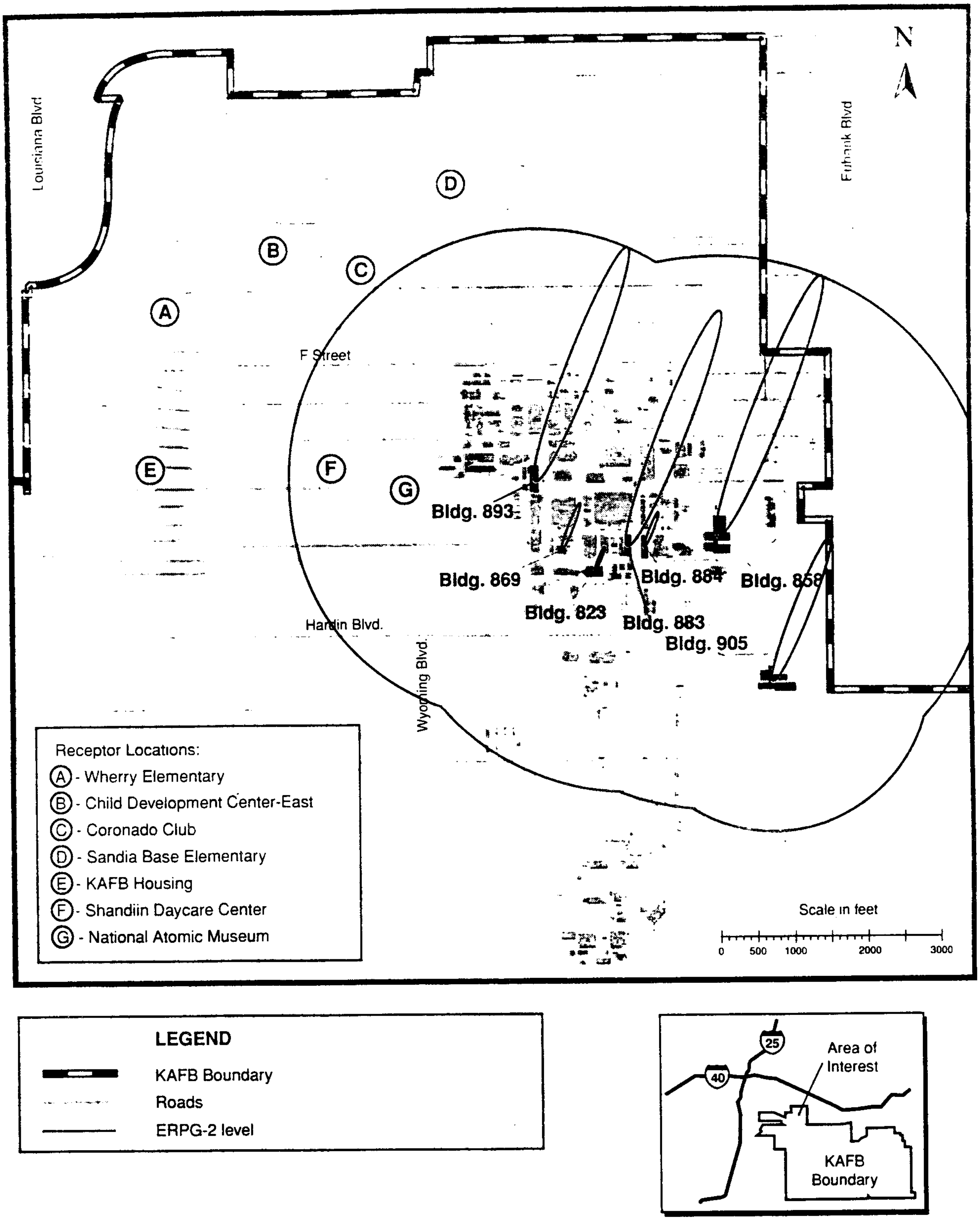
This section describes, under the Expanded Operations Alternative, the potential impacts to workers and the public of potential accidents involving the release of radioactive and/or chemical materials, explosions, and other hazards. Additional details on the accident analyses and impacts are presented in Appendix F.

Site-Wide Earthquake

An earthquake in the Albuquerque, New Mexico, area has the potential for human injury and building damage throughout the local region. Due to differences in structural design, SNL/NM buildings and structures vary in their capabilities to withstand earthquake forces. Any magnitude earthquake has the potential to cause injury to workers in and around buildings and damage to structures from the physical forces and effects of the earthquake. Additional injury to workers and the public would be possible from explosions and from exposure to chemical and radioactive materials that could be released from buildings and storage containers. Facilities in TA-I are the predominant source of chemical materials that could be released during an earthquake. Facilities in TA-V are the predominant source of radioactive materials that could be released. The ECF in TA-II is the predominant source of explosive materials. Lesser quantities of radioactive materials in TAs-I and -II could also be released and cause exposures to workers and the public.

The UBC specifies different levels of seismic design depending on the location and proposed use of a facility or structure. For office buildings and other nonhazardous use buildings, the UBC specifies an acceleration of 0.17 *g* for the Albuquerque area. This level seismic design would apply to most buildings in TA-I. For those facilities that would contain radioactive materials, the UBC specifies an acceleration of 0.22 *g*. In the event of an earthquake (UBC, 0.17 *g*), various buildings in TA-I could be affected and various chemicals could be released (see Appendix F, Table F.7–7). Larger magnitude earthquakes could cause more serious impacts. The only dominant chemical that changes among the alternatives is arsine, and it is not released in the earthquake at 0.17 *g* and lesser accelerations. Therefore, failure of facilities at lesser accelerations would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged. The shape and direction of the chemical plumes would depend upon local meteorological conditions and physical structures. The plumes shown on Figures 5.4.8–1 and 5.4.8–2 reflect the predominant wind direction during daylight hours. The daylight period was chosen to maximize the number of people potentially affected onsite because more people are working onsite during the day than at night. The shaded area represents the area that could be affected by other wind directions. This area is shown to indicate the potential areas that could be affected. For wind blowing toward the north-northeast, there would be up to 423 people exposed to chemical concentrations above ERPG-2.

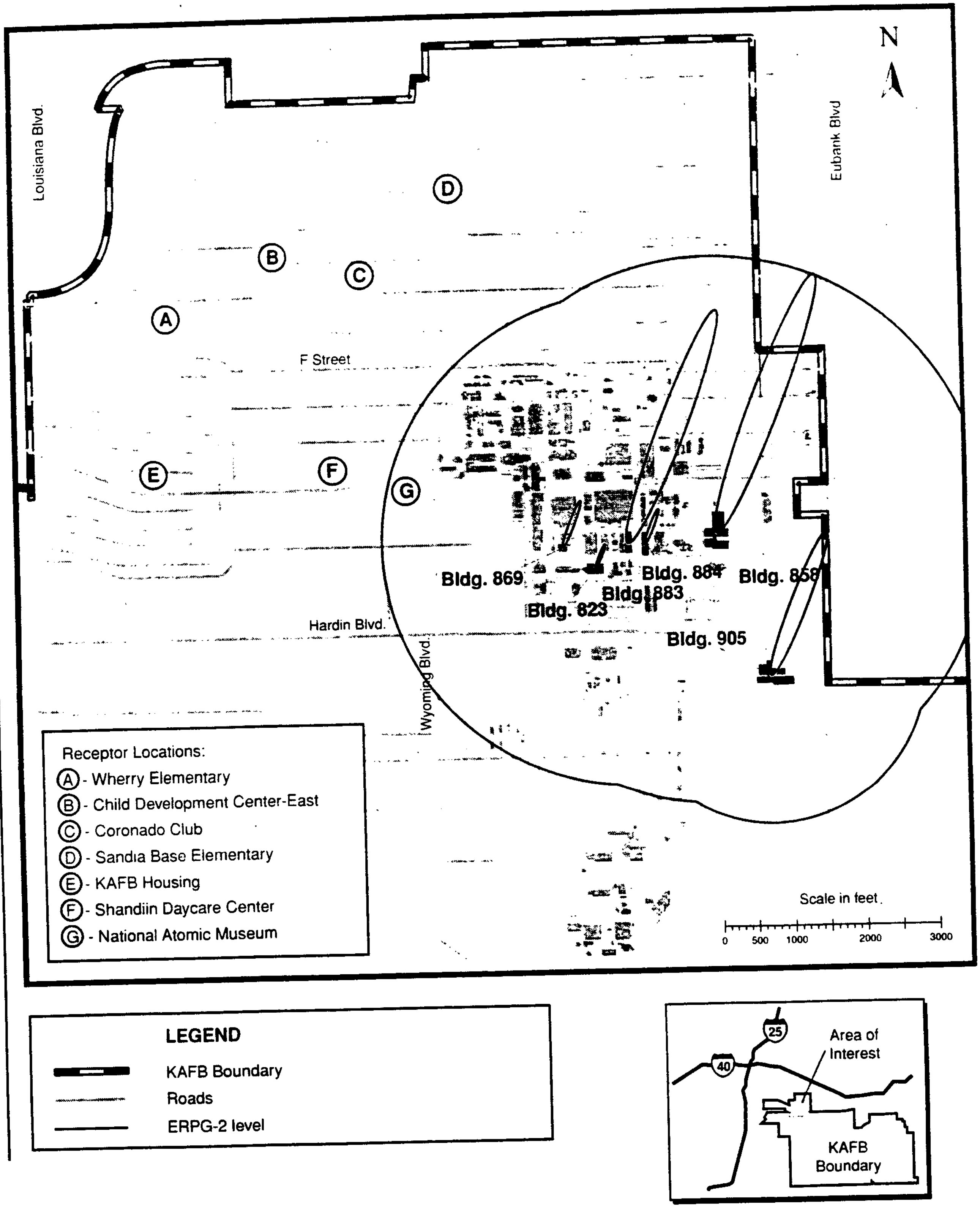
Under the Expanded Operations Alternative, the MDL and the CSRL could be configured in one of two ways. In the current configuration, simultaneous release of chemicals from several buildings, including the MDL and the CSRL, are possible in the event of an earthquake. As many as 423 individuals could be exposed to ERPG-2 in addition to exposures of other persons from chemicals released by other damaged facilities in TA-I (Figure 5.4.8–1). In the second configuration, the CSRL would be shut down and the MDL would be reconfigured as the MESA Complex. The chemical inventory and



Source: Original
Note: see Appendix F.7, Figure F.7–1

Figure 5.4.8–1. Areas Above Emergency Response Planning Guideline 2 from a Site-Wide Earthquake Under the Expanded Operations Alternative without the Microsystems and Engineering Sciences Applications Complex

The circled areas represent locations that could be above ERPG-2, depending on wind direction.



Sources: Original
Note: See Appendix F.7, Figure F.7-2

Figure 5.4.8–2. Areas Above Emergency Response Planning Guideline Level 2 from a Site-Wide Earthquake Under the Expanded Operations Alternative with the Microsystems and Engineering Sciences Applications Complex

The circled areas represent potential locations where released chemical concentrations could be above ERPG-2, depending on the wind direction.

operations that were part of the CSRL missions would be performed in the new MESA Complex. In the event of an earthquake. the new MESA gas storage facility would remain intact and no chemicals would be released. However, several other facilities could fail, releasing their chemical inventories and resulting in the exposure of as many as 306 individuals to ERPG-2 (Figure 5.4.8–2).

Mitigation features designed to limit the release of chemicals from storage containers, rooms, and buildings would limit or reduce plume size, concentration levels, and exposures. Emergency procedures and sheltering would also minimize exposures to workers and the public.

Nuclear facilities in TAs-I, -II, and -V could also be damaged during an earthquake. The frequency of an earthquake (0.17 g) that could cause the release of radioactive materials from TAs-I and -II facilities is 1.0×10^{-3} per year, or 1 chance in 1,000 per year. The frequency of an earthquake (0.22 g) that could cause the release of radioactive materials from TAs-I (NG-1), -II (ECF-1), and -V facilities is 7.0×10^{-4} per year, or 1 chance in 1,500 per year. The consequences are shown in Table 5.4.8–4. Descriptions of accident scenarios are given in Section 5.3.8.2 and Appendix F. If a 0.22-g earthquake was to occur, there would be an estimated 6.4×10^{-2} additional LCFs in the total population within 50 mi of the site associated with the HC-1 accident scenario. The MEI and noninvolved worker would have an increased probability of LCF of 6.9×10^{-6} and 3.0×10^{-2}, respectively, associated with the HC-1 accident. The risks for these receptors can be estimated by multiplying these consequence values by the probability (frequency) of earthquake. If a stronger earthquake was to occur, larger releases of radioactive materials would be possible and could cause greater impacts.

A severe earthquake could also cause damage to other SNL/NM facilities and result in environmental impacts. For example, the large quantities of oil stored in external tanks and in accelerator buildings in TA-IV could potentially be spilled and cause impacts to the ecosystem and water resources. Underground natural gas lines could break and ignite causing brush and forest fires that could further damage facilities and persons in the vicinity. Hydrogen storage tanks in TA-I could be damaged, causing hydrogen combustion or explosion and potential injury to persons in the vicinity. Explosives in the ECF in TA-II and smaller quantities in other facilities could also be accidentally detonated during an earthquake with an

Table 5.4.8–4. Site-Wide Earthquake Radiological Impacts Under the Expanded Operations Alternative

ACCIDENT ID[a]	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES IN 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
			MAXIMALLY EXPOSED INDIVIDUAL[b]	NONINVOLVED WORKER[c]
TECHNICAL AREA-I				
NG-1	7.0×10^{-4}	5.1×10^{-5}	1.4×10^{-9}	3.2×10^{-6}
TECHNICAL AREA-II				
ECF-1	7.0×10^{-4}	3.0×10^{-6}	1.5×10^{-10}	1.9×10^{-7}
TECHNICAL AREA-V				
AM-2	7.0×10^{-4}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
HC-1	7.0×10^{-4}	6.4×10^{-2}	6.9×10^{-6}	3.0×10^{-2}
SP-1	7.0×10^{-4}	9.2×10^{-3}	5.8×10^{-7}	2.7×10^{-4}

Source: Original (See also Appendix F, Tables F.7–4 and F.7–5)

[a] Facility Accident Descriptors:
Neutron Generator Facility: NG-1
Explosive Component Facility: ECF-1
Annular Core Research Reactor-Medical Isotope Production: AM-2
Hot Cell Facility: HC-1
Sandia Pulsed Reactor: SP-1

[b] The maximally exposed individual is located at the Golf Course and the consequences can be added.

[c] Because the uninvolved worker is located 100 meters from the release point, the location varies relative to each technical area. Therefore. the consequences to the noninvolved worker can only be added for a given technical area.

Note: The only earthquake radiological accident that changes among alternatives is AR-5, which contributes only 3.9 person-rem to the 150 person-rem population dose. Therefore, failure of facilities at lesser accelerations than 0.22 g would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged.

injury to persons in the vicinity. Occupants of all facilities would be at risk of injury as a result of the earthquake forces and building damage.

Facility Hazards

Some of the facilities at SNL/NM contain occupational hazards with the potential to endanger the health and safety of involved workers in the vicinity of an accident. Some of these facilities also contain hazardous materials that, in the event of an accident, could endanger the health and safety of people within the immediate vicinity and beyond. These people include noninvolved SNL/NM workers, members of the military assigned to KAFB, members of the public located within the KAFB boundary and offsite. Offsite consequences were determined to a 50-mi radius around the affected facility.

Radiological, chemical, and explosion accidents with the largest impacts to workers and the public have been analyzed as discussed in the following sections. Potential accidents associated with other facility hazards such as lasers, electricity, X-rays, transformer oil, noise, shrapnel, pyrotechnics, and compressed gases could affect the health and safety of the involved workers. However, the impacts to noninvolved workers and the public for these other accidents would be lower than the impacts from radiological, chemical, and explosion accidents described in the SWEIS (Appendix F, Table F.6–3).

The DOE recognizes the potential adverse effects for workers, the public, and the environment that could result for the deterioration of SNL/NM equipment, structures, and facilities. However, the analysis of potential accidents discussed in this section assumes that the expected deterioration of equipment, structures, and facilities would not affect the occurrence, progression, and effects of accidents. The basis for this assumption is that the DOE safety analysis process, specified in DOE Orders and standards, would require periodic assessments of facility safety to ensure that operations are being performed in an approved safety envelop. The process would also require an assessment of all unresolved safety questions that would result from any change in a facility or operation that could affect the operation's authorization basis. Depending on the results of the assessment, modifications to the facility and/or operational procedures would be implemented to maintain operations in the authorization basis.

Explosion Accidents

Explosive materials are stored, handled, transported, and used at some SNL/NM facilities. Administrative controls and facility design would help prevent an explosion accident and limit the impacts to personnel, if an accident was to occur. The ECF, for example, contains large quantities of explosives for use in its testing programs. Hydrogen trailers are another large source of explosive material. There would be approximately five hydrogen trailers parked near facilities or routinely transported to facilities from remote locations.

In the Final SWEIS the largest quantity of hydrogen with the highest potential for consequences to both SNL/NM workers and facilities would be in a cryogenic tank with a storage capacity of approximately 493,000 SCF (equivalent to 2,203 pounds of trinitrotoluene [TNT]), located northwest of MDL, Building 858, in TA-I. An explosion at the cryogenic tank was selected for detailed analysis to estimate the bounding impacts of an explosion accident. In the Draft SWEIS, a set of horizontally mounted cylinders, with storage capacity of approximately 90,000 SCF, located approximately east of the CSRL, Building 893, in TA-I, represented the bounding explosion accident. An explosion at the hydrogen storage cylinders located near the CSRL was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion were to occur in this relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 61 ft of an explosion could be seriously injured and would have a 50 percent chance of survival. Involved workers out to a distance of 126 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance.

The actual number of persons in the vicinity of the accident depends upon many factors and the actual number of potential fatalities is uncertain. Factors include the time of day (start of work day, lunchtime, after hours), the actual location of the people (amount of shielding between the hydrogen tank and the person), and the actual spread of the pressure waves in a very complex arrangement of buildings, alleys, and walkways.

In the Draft SWEIS, the bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen stored in a tank outside the CSRL caused by human errors (such as mishandling activities) or equipment failures (such as a pipe joint failure) and the presence of an ignition source (such as a spark) near the location of release. Because multiple failures would have to occur for an uncontrolled release of hydrogen to lead to an

Table 5.4.8–5. Impacts of an Explosion Accident Under the Expanded Operations Alternative

P_r (psi)	PHYSICAL EFFECTS	DISTANCE (ft)	
		472-lb TNT	2203-lb TNT
50	50% survival rate for pressures in excess of 50 psi	61	101
10	50% rate of eardrum rupture and total destruction of buildings for pressures in excess of 10 psi	126	210
2.0	Pressures in excess of 2-3 psi will cause concrete or cinder block walls to shatter.	370	617
1.0	Pressures in excess of 1 psi will cause a house to be demolished.	657	1,096

Source: Original. DOE 1992b (See also Appendix F. Table F.4–1)
ft: feet
lbm: pound mass
psi: pounds per square inch
TNT: trinitrotoluene

explosion, this accident scenario would be extremely unlikely (that is, between $1x10^{-6}$ and $1x10^{-4}$ per year).

Based on additional information, the Final SWEIS bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen stored in a tank outside the MDL (see Section 5.3.8.2, Explosion Accidents).

The human organs most vulnerable to shock explosions are the ears and lungs because they contain air or other gases. The damage would be done at the gas-tissue interface, where flaking and tearing could occur. Both the ear and the lung responses would be dependent not only on the overpressure, but also on impulse and body orientation. The shorter the pulse width, the higher the pressure the body could tolerate. An overpressure of approximately 50 psi would result in a 50 percent fatality rate; approximately 10 psi would result in eardrum rupture. These overpressure estimates are based on a square pressure wave with a pulse duration greater than 10 msec, and their effects could vary depending on body orientation to the pressure wave.

Structural damage produced by air blasts would depend on the type of structural material. An overpressure of on the order of 1 psi would cause partial demolition of houses (rendering them uninhabitable). An overpressure of 2 to 3 psi would shatter unreinforced concrete or cinder block walls; and an overpressure of 10 psi would probably cause total destruction of buildings.

Radiological Accidents

The largest quantities of radioactive materials at risk for radiological accidents are located in TA-V. The Manzano Waste Storage Facilities and TAs-I, -II, and -IV also contain radioactive material, but in smaller amounts. The nuclear facilities in TA-V include the ACRR, SPR, HCF and GIF. The NGIF is under construction in TA-V. The planned primary use of the ACRR is medical isotope production (primarily molybdenum-99). The HCF has been reconfigured for medical isotope production and the accidents analyzed reflect this mode of operation. The DP configuration would be conducted in a new Annular Core Pulsed Reactor II (ACPR-II) located in TA-V. It was assumed that the ACPR-II would be a reconstituted version of the ACRR and would behave during accidents exactly as described in the ACRR SAR. Accidents have also been analyzed for storage of radioactive materials in the HCF not associated with molybdenum-99 production. Potential accidents at TA-I, TA-IV, and the Manzano Waste Storage Facilities are discussed in Appendix F.2.

The most serious radiological accident impacts under the Expanded Operations Alternative are shown in Table 5.4.8–6. The table lists a set of accidents and their consequences in terms of an increased probability of an LCF for an exposed individual and an increased number of LCFs for the offsite population. Other radiological accidents could also occur at these facilities, but their consequences would be within the envelope of the selected set of accidents.

The accident with the highest consequences to the public would be a fire in Room 108 at the HCF in TA-V (HS-2). If this accident was to occur, there would be $7.9x10^{-2}$ additional LCFs in the offsite population within 50 mi of the site. There would be increased probabilities of an LCF for the MEI and a noninvolved worker of $6.6x10^{-6}$ and $7.4x10^{-6}$, respectively. The estimated frequency of occurrence for this accident would be

Table 5.4.8–6. Potential Impacts of Radiological Facility Accidents Under the Expanded Operations Alternative

FACILITY	ACCIDENT ID	SCENARIO	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Annular Core Research Reactor-Medical Isotopes Production Configuration	AM-1	Airplane crash - collapse of bridge crane	$6.3x10^{-6}$	$2.0x10^{-3}$	$2.4x10^{7}$	$7.4x10^{5}$
	AM-3	Rupture of waterlogged fuel element	$1.0x10^{-2}$ to $1.0x10^{-4}$	$4.9x10^{4}$	$5.4x10^{-8}$	$3.8x10^{6}$
	AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{-6}$	$3.9x10^{4}$	$4.3x10^{8}$	$3.0x10^{6}$
	AM-5	Fuel handling accident - irradiated element	$1.0x10^{-4}$ to $1.0x10^{-6}$	$4.9x10^{3}$	$6.1x10^{7}$	$7.6x10^{5}$
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3x10^{-6}$	$1.6x10^{-6}$	$1.0x10^{10}$	$4.9x10^{8}$
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0x10^{-6}$	$3.9x10^{-4}$	$4.9x10^{8}$	$1.4x10^{-5}$
Hot Cell Facility-Medical Isotopes Production	HM-1	Operator error - molybdenum-99 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	$3.8x10^{5}$	$3.3x10^{9}$	$1.6x10^{7}$
	HM-2	Operator error iodine-125 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	$1.6x10^{-6}$	$1.0x10^{10}$	$4.2x10^{9}$
	HM-4	Fire in steel containment box	$1.0x10^{-2}$ to $1.0x10^{-4}$	$2.6x10^{3}$	$2.4x10^{7}$	$2.3x10^{6}$
Hot Cell Facility Room 108 Storage	HS-1	Fire in room 108, average inventories	$3.3x10^{5}$	$2.1x10^{3}$	$1.8x10^{7}$	$2.0x10^{7}$
	HS-2	Fire in room 108, maximum inventories	$2.0x10^{-7}$	$7.9x10^{2}$	$6.6x10^{6}$	$7.4x10^{6}$

Table 5.4.8–6. Potential Impacts of Radiological Facility Accidents Under the Expanded Operations Alternative (concluded)

FACILITY	ACCIDENT ID	SCENARIO	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Sandia Pulsed Reactor	S3M-2	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	$1.2x10^{3}$	$1.5x10^{7}$	$2.5x10^{4}$
	S3M-3	Failure of a fissionable experiment	$1.0x10^{-4}$ to $1.0x10^{-6}$	$7.9x10^{3}$	$8.4x10^{7}$	$3.8x10^{1}$
	SS-1	Airplane crash into North Vault storage vault	$6.3x10^{-6}$	$9.2x10^{3}$	$5.8x10^{7}$	$5.5x10^{4}$
	S4-1	Control-element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	$2.2x10^{3}$	$2.7x10^{7}$	$4.7x10^{4}$
Annular Core Pulsed Reactor-II, Defense Programs	AR-1	Uncontrolled addition of reactivity	$<1.0x10^{-6}$	$7.3x10^{-3}$	$9.3x10^{7}$	$1.2x10^{4}$
	AR-2	Rupture of waterlogged fuel element	$1.0x10^{1}$ to $1.0x10^{2}$	$1.3x10^{3}$	$1.7x10^{7}$	$1.2x10^{5}$
	AR-4	Fire in reactor room with experiment present	$1.0x10^{-4}$ to $1.0x10^{-6}$	$9.0x10^{3}$	$1.0x10^{6}$	$1.4x10^{4}$
	AR-6	Airplane crash, collapse of bridge crane	$6.3x10^{-6}$	$5.9x10^{3}$	$8.4x10^{7}$	$2.2x10^{4}$

Source: Original
ACPR: Annular Core Pulsed Reactor
ACRR: Annular Core Research Reactor
SPR: Sandia Pulsed Reactor
TA: technical area
TA-V Facility Accident Descriptors:
ACRR - Medical Isotope Production: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell - Medical Isotope Production: HM-1, HM-2, HM-4
Hot Cell - Room 108 Storage: HS-1, HS-2
SPR: S3M-2, S3M3, SS-1, S4-1
ACPR-II-Defense Programs: AR-1, AR-2, AR-4, AR-6

2.0x10⁻⁷ per year or less than 1 chance in 5,000,000 per year.

Involved workers run the highest risk of injury or fatality in the event of many radiological accidents discussed in this section as well as the many others that could occur. Although there are protective measures and administrative controls to protect involved workers, they are usually in the immediate vicinity of the accidents where they could be exposed to radioactivity.

Accident scenarios for the Expanded Operations Alternative have been described in Section 5.3.8.2.

The impacts to all other receptors would be less than for the MEI. Details on the impacts to all receptors analyzed are provided in Appendix F.2.

Chemical Accidents

Many SNL/NM facilities store and use a variety of hazardous chemicals. For the chemical with the highest RHI in a building, a catastrophic accident and total release of the building inventory was postulated as the bounding event, and estimates were made of the chemical's concentrations at various distances from the accident. The source terms are shown in Table 5.4.8–7. "Building inventory" source term release reflects the variability and uncertainty in the actual amount of the chemical that could be present in inventory at the time of an accident. Similarly, estimates are shown for the range of distances within which the ERPG-2 would be exceeded. The ERPG-2 is an accepted guideline for public exposure (see Appendix F.3 for an explanation of ERPG levels).

In the event of a severe chemical accident in TA-I, involved workers, noninvolved workers, KAFB personnel, onsite residents, and onsite and offsite members of the public would be at risk of being exposed to chemical concentrations in excess of ERPG-2. The number of individuals at risk during normal business hours is shown in Table 5.4.8–8. Although Table 5.4.8–8 shows the number of people at risk, the actual number exposed would depend on the time of day, location of people, wind conditions, and other factors.

Under the Expanded Operations Alternative, the MDL and the CSRL could be configured in one of two ways. In the first, MDL and CSRL would remain in their present configuration. In the event of a catastrophic accident such as an airplane crash into either facility (but not both), the impacts from the dominant chemical release is shown in Figure 5.4.8–3. As many as 409 people could be exposed to chemical concentrations above ERPG-2. In the second configuration, CSRL would be shutdown and MDL would be reconfigured and designated as part of the MESA Complex. The chemical inventory and operations that were part of the CSRL mission would be performed in the new MESA Complex. In this case, the dominant chemical accident release would be 80 pounds of arsine under the conservative assumption that all arsine is stored in one location (Figure 5.4.8–4). As many as 558 people could be exposed to chemical concentrations above ERPG-2. The option exists for the arsine and other similar chemicals to be stored in two separate locations, each containing one half of the amount. The potential and impacts for overlapping plumes are discussed in Section 5.3.8.2 and Appendix F.3.

In the event of an aircraft crash or earthquake involving buildings with various chemical inventories, multiple chemicals would be released. Although the impacts of mixed chemicals could be greater than individual chemicals, their behavior, dispersion, and health effects can be complex and have therefore, not been considered quantitatively. An earthquake could also cause the release of like chemicals from multiple buildings and lead to increased concentration where individual plumes overlap. The potential and impacts for overlapping plumes are discussed in Section 5.3.8.2 and Appendix F.3.

Other Accidents

Other types of potential accidents were identified whose impacts are not measured in terms of LCFs or chemical concentrations. These could cause serious injury or fatality for humans and/or impacts to the nonhuman environment such as the ecology, historical sites, or sensitive cultural sites.

- *Brush Fires*—Small fires are expected and planned for during outdoor testing that involves propellants and explosives. The potential exists for brush and forest fires when hot test debris or projectiles come in contact with combustible elements in the environment. One such incident was reported in 1993 in TA-III when a rocket motor detonated during a sled track impact test and resulted in a 40-ac brush fire. Another accident occurred at the Aerial Cable Facility in the Coyote Test Field, which resulted in a fire that swept up the side of a mountain before being extinguished by SNL/NM workers. Many others have also occurred that were contained in the immediate vicinity of the test area. Measures would be taken to prevent fires and, should a fire occur, the

Table 5.4.8–7. Potential Impacts of Chemical Accidents Under the Expanded Operations Alternative

BUILDING	CHEMICAL	SOURCE TERM	ERPG-2 LEVEL OF CONCERN (ppm)	EXCEEDANCE DISTANCE	FREQUENCY (per year)
		BUILDING INVENTORY (lb)		BUILDING INVENTORY (ft)	
823	Nitrous oxide	30.53	125	351	$1.0x10^{-3}$ to $1.0x10^{-4}$
858	Chlorine	106.4	3	3,726	$1.0x10^{-3}$ to $9.7x10^{-5}$
858	Arsine	40	0.5	5,578	$1.0x10^{-3}$ to $4.9x10^{-5}$
MESA Complex	Arsine[a]	80	0.5	7,920	$1.0x10^{-3}$ to $4.9x10^{-5}$
869	Nitric acid	18.6	15	666	$1.0x10^{-3}$ to $1.0x10^{-4}$
878	Nitrous oxide	50	125	426	$1.0x10^{-3}$ to $3.2x10^{-5}$
880	Hydrofluoric acid	2	20	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
883	Phosphine	6.8	0.5	3,357	$1.0x10^{-3}$ to $1.0x10^{-4}$
884	Hydrofluoric acid	10	20	504	$1.0x10^{-3}$ to $1.0x10^{-4}$
888	Fluorine	0.07	1	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
893[b]	Arsine	65	1	6,891	$1.0x10^{-3}$ to $1.0x10^{-4}$
897	Chlorine	4.4	3	699	$1.0x10^{-3}$ to $6.6x10^{-5}$
905	Thionyl chloride	101.1	5	2,067	$1.0x10^{-3}$ to $9.0x10^{-5}$

Sources: NSC 1995, SNL/NM 1998a, SNL/NM 1998b (See also Appendix F, Tables F.3–3 and F.3–4)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound
MESA: Microsystems and Engineering Sciences Applications
NR: Not Reported due to model limitations
ppm: parts per million
823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6 MeV Van der Graal Tandem Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility

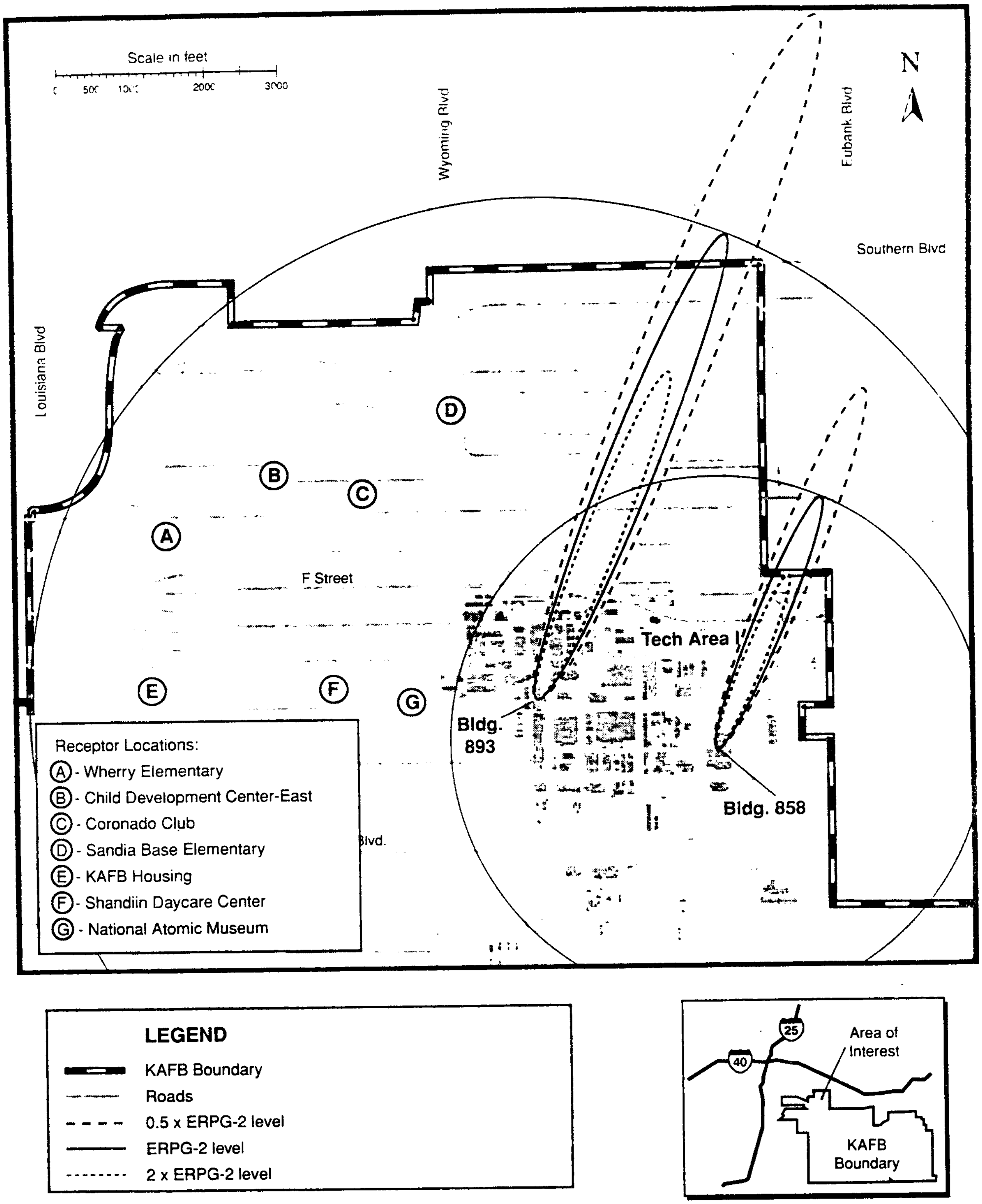
[a] If the MESA Complex is not constructed, this facility would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.

[b] If the MESA Complex is constructed, this facility would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.

Table 5.4.8–8. Maximum Impacts of Chemical Accidents on Individuals Within the KAFB Under the Expanded Operations Alternative

BUILDING	CHEMICAL NAME	RELEASE (lb)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)	NUMBER OF PEOPLE WITHIN ERPG-2
823	Nitrous oxide	32.17	348	2
858	Chlorine	106.41	3,726	141
MESA Complex	Arsine[a]	80	7,920	558
869	Nitric acid	18.6	666	6
878	Nitrous Oxide	50	438	3
880	Hydrofluoric acid	2	NR	
883	Phosphine	6.8	3,357	100
884	Hydrofluoric acid	10	504	2
888	Fluorine	0.07	NR	NR
893	Arsine[b]	65	4,884	409
897	Chlorine	4.4	699	5
905	Thionyl chloride	101.1	2,067	55

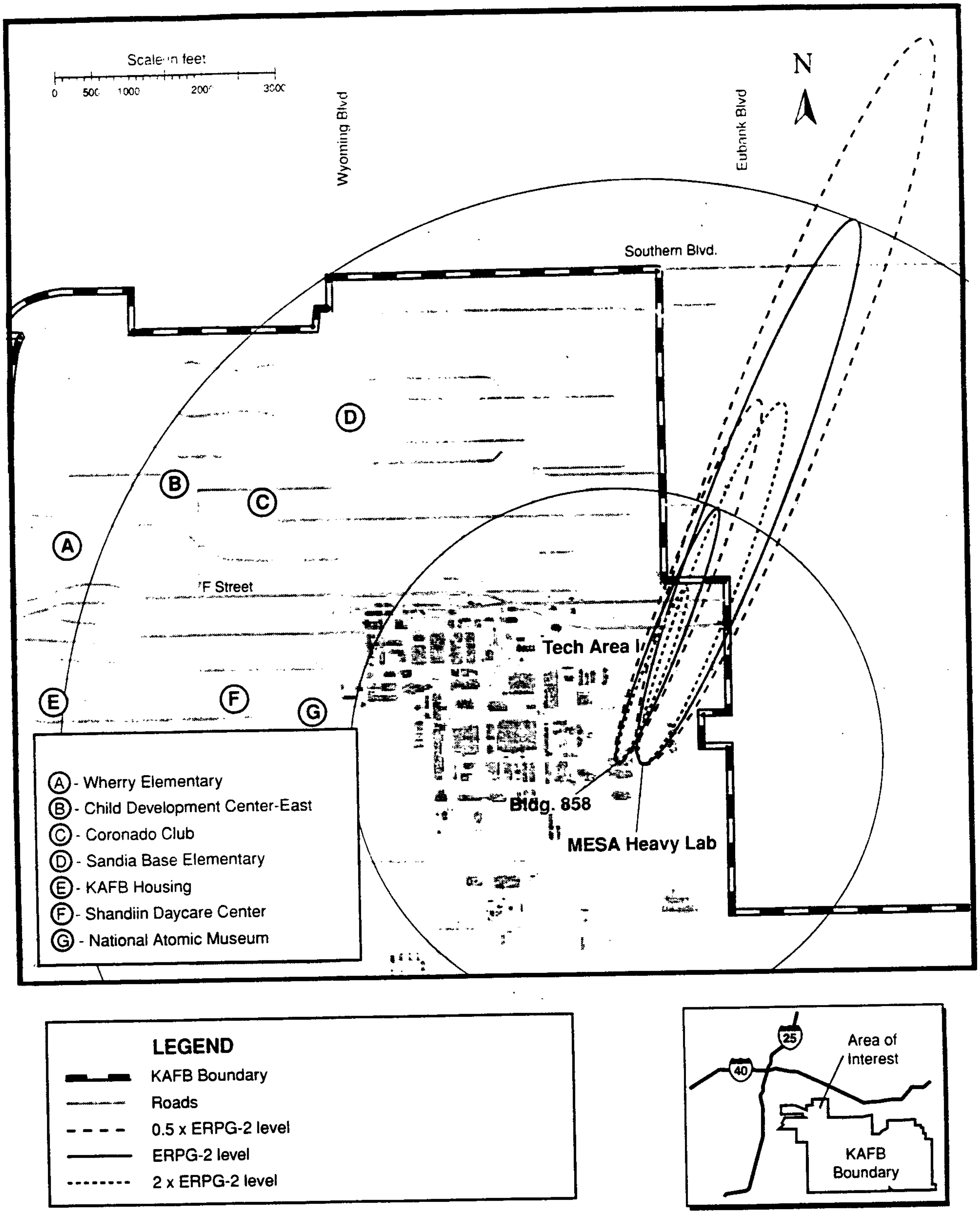
Source: See Appendix F. Table F.3–6
ALOHA: Areal Locations of Hazardous Atmospheres (model)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound
MESA: Microsystems and Engineering Sciences Applications
NR: Not reported. the model did not provide a plume footprint due to near-field unreliability. No population estimates are available.
823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Van der Graaf Tandem Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility
[a] If the MESA Complex is not constructed, it would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.
[b] If the MESA Complex is constructed, this facility would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.



Sources: Original
Note: See Table 5.4.8–8

Figure 5.4.8–3. Areas Above Emergency Response Planning Guideline 2 from Accidental Release of Arsine (Building 893) and Chlorine (Building 858)

The encircled areas represent potential locations that could be above ERPG-2, depending upon the wind direction for an accidental release of arsine (Building 893) or chlorine (Building 858) under the Expanded Operations Alternative without the MESA Complex.



Sources: Original
Note: See Table 5.4.8–8

Figure 5.4.8–4. Areas Above Emergency Response Planning Guideline 2 from Accidental Release of Arsine (Microsystems and Engineering Sciences Application Complex) and Chlorine (Building 858)

The encircled areas represent potential locations that could be above ERPG-2, depending upon the wind direction for an accidental release of arsine (MESA Complex) or chlorine (Building 858) under the Expanded Operations Alternative, the MESA Complex configuration.

effects would be reduced by activating fire fighting facilities in the test area (DOE 1995a, SNL/NM 1993d, SNL/NM 1998i).

- *Natural Phenomena*—Naturally occurring events such as tornadoes, lightning, floods, and heavy snow, as documented in existing SNL/NM safety documentation, have been considered for their potential to initiate the accidental release of radioactive, chemical, and other hazardous materials that affect workers and the public. Any of these events, should they occur, could also lead to serious injury or fatality as a result of the physical and destructive forces associated with the events. The risks of such events to workers and the public would be equivalent to everyday risks from naturally occurring events to the general public wherever they work and reside.
- *Spills and Leaks*—The potential would exist throughout SNL/NM for the accidental spill of radioactive, chemical, or other hazardous materials. The effects of such spills on workers and the public through airborne pathways were considered earlier in this section. The impacts from pathways other than airborne would normally be bounded by exposure from airborne pathways. Any spill of a hazardous substance would have the potential for impacts to the nonhuman elements of the environment. A spill could make its way into surface and groundwater systems, affecting water quality and aquatic life. Spills of flammable substances could cause fires that damage plant and animal life and other land resources. There have been spills of hazardous substances at the SNL/NM site that had the potential to affect the nonhuman elements of the environment. In 1994, over 100 gal of oil were spilled at the Centrifuge Complex in TA-III when a hydraulic pump failed during a centrifuge test, causing a potential impact to the nonhuman elements of the environment. Also in 1994, a small spill of transformer oil occurred from an oil storage tank in TA-IV when a gasket failed and, at the Coyote Test Field, a leaking underground storage tank containing ethylene glycol was discovered.
- *Radiological and Chemical Contamination*—Some accidents analyzed in this section and others, that were considered but not analyzed, could potentially impact the nonhuman elements of the environment. Any accidentally released chemicals would result in concentrations that would typically decrease with increasing distance from the point of release. While chemical concentrations would diminish over distance to a point where a human hazard would no longer be present, the concentrations could still affect other elements of the environment such as the ecology, water quality, and cultural resources. Radiological releases could also affect nonhuman elements of the environment. After an accident, SNL/NM, through their spill and pollution control and radiological emergency response plans, would be required to assess the potential for ground contamination; if contamination exceeds guidance levels, plans would be developed for remediation.
- *Industrial*—Besides radioactive and chemical materials and explosives, many SNL/NM facilities conduct operations and use materials and equipment that could be potentially hazardous to workers. These hazards are typically referred to as normal industrial hazards, not unlike similar hazards that workers are exposed to throughout the nation, and include working with electricity, climbing ladders, welding, and driving forklifts. All operations and activities at SNL/NM facilities, as well as all DOE facilities, would be subject to administrative procedures and safety features designed to prevent accidents and mitigate their consequences should they occur.

5.4.9 Transportation

The implementation of the Expanded Operations Alternative would result in transportation impacts for each of three ROIs: KAFB; major Albuquerque roadways; and major roadways between Albuquerque and specific waste disposal facilities, vendors, and other DOE facilities. This analysis involved estimating the number of trips made by SNL/NM-associated vehicles under normal operations in each of these transportation corridors. Transportation evaluation and multipliers are discussed in Section 5.3.9, Appendix A, and Appendix G.

If implemented, the MESA Complex configuration would not increase the number of material shipments, material receipts, and waste shipments projected under the Expanded Operations Alternative. The amount of material shipped per trip could vary to accommodate the material and waste shipment requirements resulting from the addition of MESA. Overall traffic volume would not increase beyond the current projected Expanded Operations Alternative increase of 10 percent. MESA would not increase employment levels. The construction of the MESA Complex, however, could result in a temporary increase in onsite and area material transportation during a 36-month period.

5.4.9.1 Transportation of Material and Wastes

In general, the number of material shipments received by SNL/NM would be proportional to total SNL/NM material consumption. According to facility projections, material consumption under the Expanded Operations Alternative would increase by 484 percent over baseline levels. Thus, total material shipments would also increase, although not necessarily for all types of material.

Radioactive and explosive material shipments are often delivered by government carriers, unless the quantities and activities being transported are low enough to meet the Federal guidelines and restrictions in place for authorized commercial transporters. Government carriers operate on an as-needed basis, thus the general increase in material inventory under the Expanded Operations Alternative would result in a similar increase in these kinds of shipments.

Due to their shipment method, there would be very little impact to the number of chemical shipments that are made to SNL/NM. JIT chemicals, which are ordered infrequently and in small quantities, are usually shipped to SNL/NM by way of commercial carriers such as Federal Express and UPS. These carriers make daily shipments to SNL/NM to deliver packages other than chemicals, and an increase in the volume of chemicals they handle per shipment would not increase their frequency. Similarly, major chemical vendors who deliver their own material, rather than use a commercial carrier, also generally make daily shipments to SNL/NM. Therefore, any increase in the volume of material that major vendors ship per load would not have an impact on the frequency of those shipments. Thus, chemical shipments would remain at approximately the same level regardless of the fluctuations in material consumption.

Considering the above factors, overall material transportation due to normal operations would increase by 123 percent over baseline levels. The anticipated changes in annual and daily material shipments for each material category are presented in Table 5.4.9–1. The analysis assumed that SNL/NM has 250 work days per calendar year.

Waste Transportation

The amount of waste shipped from SNL/NM to disposal facilities would correlate directly to SNL/NM waste generation levels. The overall offsite waste shipments would increase by 320 percent under the Expanded Operations Alternative. Of this increase, 285 percent is considered to be waste currently disposed of at the KAFB landfill. This leaves a real projected increase of 35 percent under the Expanded Operations Alternative. The total anticipated changes in waste shipments during all operations for each type of waste are presented in Table 5.4.9–2 and Appendix G, Table G.3–3.

Specials Projects

Two special project wastes, ER Project and legacy, were addressed separately due to their one-time operation/project status and in order to avoid skewing the SNL/NM normal operations impact. Legacy wastes would be anticipated to account for an additional 18 shipments of LLW, 3 shipments of LLMW, and 2 shipments of TRU/MTRU wastes over the 10-year time frame (see Figures 4.12–1, 4.12–2, and 4.12–3). In 1998 through 2000, the ER Project could account for up to an additional 312 offsite shipments of LLW, 101 offsite shipments of LLMW, 2 offsite shipments of RCRA waste, 5 offsite shipments of TSCA waste, and 75 shipments of nonhazardous waste. Both of these special projects have been included within the total facility risks.

Offsite Receipts and Shipments of Material and Waste

The bounding case for this analysis assumed that each material and waste shipment is composed of two trips: one to and one from SNL/NM. Thus, the total number of trips made by material and waste transporters under the Expanded Operations Alternative would be 17,182 (total shipments x 2). Assuming that the year is comprised of 250 work days, the average work day traffic within KAFB contributed by these carriers would be 69 trips. This would be small in comparison to the 29,880 trips of SNL/NM vehicles entering and exiting KAFB under this alternative (SNL/NM 1998a, SNL 1996c). Therefore, the overall traffic impacts on KAFB from increased SNL/NM material and waste shipments under the Expanded Operations Alternative would be negligible.

Shipments of Material and Waste in the Albuquerque Area

The total SNL/NM placarded material and waste shipment traffic would comprise 1.9 percent, or 69 trips per day, of the total placarded truck traffic (1,767) entering the greater Albuquerque area during the applicable base year (1996 or 1997). Although a 137-percent increase in SNL/NM placarded material and waste truck traffic would be expected, this increase would represent the inclusion of waste currently managed at the KAFB landfill and new shipments from the MIPP. ER Project wastes and legacy wastes are addressed

Table 5.4.9–1. SNL/NM Annual Material Shipments Under the Expanded Operations Alternative

MATERIAL TYPE		ANNUAL SHIPMENTS	
		BASE YEAR[a]	EXPANDED OPERATIONS
Radioactive		305	1,782
Radioactive (medical isotopes production configuration)	*Receiving*	0	55
	Shipping	0	1,140
Chemical		2,750	2,750
Explosive		303	1,771
TOTAL		**3,358**	**7,498**

Sources: SNL/NM 1997b, 1998a
MESA: Microsystems and Engineering Sciences Applications
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Note: No shipment increases would be due to MESA, because the amount of material shipped could vary to accommodate the material shipment requirements resulting from the construction and operation of MESA.

Table 5.4.9–2. Annual Waste Shipments from Normal Operations Under the Expanded Operations Alternative

WASTE TYPE	BASE YEAR SHIPMENTS	EXPANDED OPERATIONS SHIPMENTS
LLW[a] (1996)	4	21
LLMW (1996)	1	3
Hazardous (RCRA+TSCA)[a] (1997)	102	150
Recyclable (Hazardous and Nonhazardous)[a,b] (1997)	86	233
Solid[a] (Municipal, Construction, and Demolition)[b] (1996)	51	650

Sources: Rinchem 1998a; SNL/NM 1998a, 1998y, n.d. (d)
LLMW: low-level mixed waste
LLW: low-level waste
MESA: Microsystems and Engineering Sciences Applications
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Excludes decontamination and decommissioning
[b] Recyclable and solid wastes currently handled by the KAFB landfill could be shipped offsite, contributing an additional 741 shipments.
Note: No shipment increases would be due to MESA, because the amount of material shipped could vary to accommodate the material shipment requirements resulting from the construction and operation of MESA.

separately under special projects. Thus, the impacts under the Expanded Operations Alternative would be minimal.

Shipments of Material and Waste Outside of Albuquerque

All material and waste transported to and from SNL/NM from outside Albuquerque must enter and depart the city by way of Interstate-25 or Interstate-40. Table 5.4.9–3 presents the impacts to those corridors from material and waste shipments under the Expanded Operations Alternative. Specific remote facility locations are listed in Section 4.11. Daily SNL/NM shipment figures were derived for comparison purposes by dividing the annual waste and material shipment totals in Tables 5.4.9–1 and 5.4.9–2 by the approximately 250 work days in a calendar year.

Based on this analysis, SNL/NM material and waste shipments would be expected to increase in frequency by 137 percent under this alternative. However, the SNL/NM truck traffic would only comprise 0.021 percent, or 34.4 shipments per day, of all traffic (165,000 vehicles per day), including all types of vehicles, projected to be entering and departing Albuquerque by way of interstates. For the applicable base year (1996 or 1997), waste leaving Albuquerque represented 35 percent of the total shipments, with an additional 20 percent going to Rio Rancho. Because most materials are supplied through the JIT vendors,

Table 5.4.9–3. 24-Hour Placarded Material and Waste Truck Traffic Counts Under the Expanded Operations Alternative

ROUTE (ALL TRAFFIC)[a]	BASE YEAR[b]	EXPANDED OPERATIONS
I-25 North (52,400)	230	268
I-25 South (18,000)	94	110
I-40 West (16,400)	621	725
I-40 East (54,200)	569	664
TOTAL (141,000)	**1,514**	**1,767**
SNL/NM[c]	**14.5**	**34.4**

Sources: SNL/NM 1997b. 1998a; Scientific Services 1995
I: Interstate
[a] Total vehicle count for all types of vehicles entering and departing Albuquerque
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] SNL/NM placarded trucks

origination points are generally not known. However, most vendors use local suppliers; therefore, in the base year, 82 percent of material was assumed to be provided locally, with the remaining 18 percent coming from outside Albuquerque. Thus, the impact to this ROI from the Expanded Operations Alternative would be negligible.

5.4.9.2 Other Transportation (Traffic)

Overall vehicular traffic impacts under the Expanded Operations Alternative were assessed by projecting the total increased number of SNL/NM commuter vehicles traveling to and from SNL/NM. The term commuter includes all vehicles operated by SNL/NM employees, contractors, and visitors; DOE employees; and additional traffic, such as delivery vehicles.

Traffic on KAFB

Table 5.4.9–4 presents general anticipated traffic impacts at KAFB under the Expanded Operations Alternative. The number of SNL/NM commuter vehicles traveling to and from the site each work day was conservatively assumed to increase at the same rate as the SNL/NM work force level (see Section 5.4.12). Based on this analysis, overall KAFB traffic would increase by 3.6 percent under this alternative.

Table 5.4.9–5 shows projected 24-hour KAFB vehicular flow for each of the three main gates under the Expanded Operations Alternative. It was assumed that the Carlisle and Truman gates would be used primarily by KAFB personnel and not by SNL/NM employees. For the bounding case for this analysis, it was assumed that the SNL/NM contribution to total KAFB flow at each gate would fluctuate by the same factor as the total fluctuation in SNL/NM traffic under the Expanded Operations Alternative.

Based on this analysis, the daily KAFB gate traffic would increase by 3.6 percent under the Expanded Operations Alternative (Table 5.4.9–5). This minimal change would not have an appreciable impact on service at the gates.

Short-term adverse traffic impacts would potentially occur onsite during routine construction activities at KAFB due to traffic lane restrictions, reduced speeds in construction areas, and traffic increases in slower moving heavy equipment. These common occurrences would be similar to those under the No Action Alternative. If implemented, the construction of the MESA Complex would result in a temporary increase in onsite and area traffic during a 36-month period. Building construction and onsite roadway rehabilitation are currently planned under the Expanded Operations Alternative. Short-term circulation impacts would potentially occur if vehicles are rerouted to avoid construction areas. However, it is anticipated that adequate detour routes and signage would be provided and that the impacts would be minimal and limited in duration.

Traffic in the Albuquerque Area

To determine the traffic impacts in the Albuquerque traffic corridor, roadways most likely to be affected by SNL/NM traffic were selected for analysis. The bounding case used the projected SNL/NM traffic contributions from Table 5.4.9–5 to approximate the SNL/NM component of the total traffic count for each roadway. For worst-case impacts, the SNL/NM traffic component was assumed to be equivalent to the total SNL/NM traffic at the nearest gate. In actuality, a significant percentage of traffic would likely diffuse onto other nearby roads, which would greatly reduce the magnitude of the SNL/NM component. The projected impacts to these roadways under the Expanded Operations Alternative, according to the bounding case factors, are presented in Table 5.4.9–6.

This represents an overall average increase of 10 percent of the SNL/NM traffic component on these roadways. However, the total traffic on these roadways would only increase by 2.9 percent overall under the Expanded Operations Alternative.

Table 5.4.9–4. KAFB Daily Traffic Projections Under the Expanded Operations Alternative

COMPONENT	BASE YEAR[a]			EXPANDED OPERATIONS			% CHANGE IN BASE YEAR VERSUS EXPANDED
	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	
SNL/NM Commuters	36	13,582	27,164	38	14,940	29,880	10
KAFB Commuters	64	24,145	48,290	63	24,145	48,290	0
TOTAL KAFB COMMUTER TRAFFIC	**100**	**37,727**	**75,453**	**100**	**39,085**	**78,170**	**3.6**
SNL/NM Waste & Material Transporters	0.04	14.5	29	0.09	34.4	69	137[b]

Sources: SNL/NM 1997a, 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] SNL/NM commuter and transporter trips per day equals 36 percent of total KAFB trips per day

Table 5.4.9–5. Total KAFB Gate Traffic Under the Expanded Operations Alternative

GATE	BASE YEAR[a]			EXPANDED OPERATIONS ALTERNATIVE			% CHANGE
	24-HOUR SNL/NM[b]	24-HOUR TOTAL[c]	PEAK HOUR[d]	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	GATE TOTAL
Wyoming	7,141	19,835	1,941	7,855	20,549	2,011	3.6
Eubank	5,324	14,788	2,683	5,856	15,320	2,951	3.6
Gibson	8,108	22,523	1,571	8,919	23,334	1,628	3.6
AVERAGE	**6,858**	**19,048**	**2,065**	**7,543**	**19,734**	**2,197**	**3.6**

Sources: SNL/NM 1997a, 1997b; USAF 1995e

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] This increase represents inclusion of waste managed at the KAFB landfill and new shipments from medical isotopes production.

[c] Total KAFB trips per day.

[d] Total KAFB trips per hour, traffic counts

Table 5.4.9–6. Albuquerque Daily Traffic Counts Under the Expanded Operations Alternative

ROADWAY		BASE YEAR[a]		EXPANDED OPERATIONS		% CHANGE
		DAILY[b]	PEAK[c]	DAILY	PEAK	DAILY
Gibson West at Louisiana	Total	15,671	2,066	16,482	2,172	+5
	SNL/NM	8,108	1,069	8,919	1,176	+10
	% SNL/NM	52		54		+4
Wyoming South of Lomas	Total	37,639	2,293	38,353	2,337	+2
	SNL/NM	7,141	435	7,855	479	+10
	% SNL/NM	19		20		+5
Eubank South of Copper	Total	14,572	1,852	15,104	1,920	+4
	SNL/NM	5,324	677	5,856	744	+10
	% SNL/NM	37		39		+5
Interstate-25 at Gibson[d]	Total	91,000	-	91,811	-	+1
	SNL/NM	8,108	-	8,919	-	+10
	% SNL/NM	8.9		9.7		+9
Interstate-40 at Eubank[d]	Total	90,300	-	90,832	-	+0.6
	SNL/NM	5,324	-	5,856	-	+10
	% SNL/NM	5.9		6.5		+10
Wyoming North of KAFB Gate	Total	20,272	1,749	20,986	1,811	+4
	SNL/NM	7,141	612	7,855	673	+10
	% SNL/NM	35		37		+6

Sources: MRGCOG 1997b. 1997c: SNL/NM 1997b. 1998a: UNM 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Vehicles per day, *1996 Traffic Flows for the Greater Albuquerque Area*

[c] Vehicles per hour, *1996 – 1998 Traffic Counts*

[d] Peak hour counts for this intersection are not available.

Traffic Outside of Albuquerque

The additional local SNL/NM traffic under the Expanded Operations Alternative would have minimal impacts on transportation routes between Albuquerque and other DOE facilities, vendors, and disposal facilities (see Section 4.11 for a list of these facilities). In a worst-case assessment, the applicable base year (1996 or 1997) SNL/NM component represents an average 19 percent of the total traffic count (141,000 vehicles per day) on major roadways entering and departing Albuquerque (MRGCOG 1997b). Under the Expanded Operations Alternative, the SNL/NM component would decrease to 18.1 percent of total vehicular traffic due to the increase in Albuquerque population and commuters. This assumes that all SNL/NM traffic would actually enter and depart Albuquerque by way of the interstates every day, although a significant portion of SNL/NM traffic would more likely diffuse onto other roadways and remain in Albuquerque.

5.4.9.3 Transportation Risk Associated with Normal Operations

Incident-Free Exposure

The representative conservative case for this analysis used the distances traveled by SNL/NM waste and material carriers, as listed in Table 5.3.9–7. These distances were based on the average distance traveled by trucks in route to other facilities under all alternatives.

Truck emissions impacts are a function of the number of truck shipments to and from SNL/NM. The bounding case for truck emissions impact analysis assumed that the greatest risk is when these shipments are transported through urban areas, such as the Albuquerque transportation corridor, because these areas are most susceptible to emissions related problems. To evaluate the actual risk associated with SNL/NM truck shipments, the most common origin and destination of all shipments of concern were compiled to determine the urban distance each material or waste would be transported (Section 4.11). Table 5.4.9–7 presents projected truck emissions impacts resulting from the Expanded Operations Alternative.

Based on this analysis, the emissions impacts due to increased truck traffic under the Expanded Operations Alternative would increase from 1.33×10^{-2} to 6.4×10^{-2} annual LCFs.

The radiological impact exposure to incident-free routine transportation of radioactive materials was analyzed using *RADTRAN 4* (SNL 1992a), as described in Appendix G. Routes and population densities were modeled using *HIGHWAY* (Johnson et al. 1993). Results of these calculations are presented in Table 5.4.9–8.

In the absence of an accident that compromises package integrity, no incident-free chemical or explosive exposure would be foreseen to affect the public, workers, or vehicle transport crews under this alternative.

5.4.9.4 Transportation Risks Associated with Accidents

General Accidents

The bounding case for general vehicular traffic impacts under the Expanded Operations Alternative assumes that the percent increase in accidents would be equal to the percent increase in SNL/NM traffic. Therefore, SNL/NM traffic accidents would increase by 10 percent under this alternative.

Hazardous Material/ Waste-Related Accidents

In conjunction with traffic fatality statistics (SNL 1986), the SNL/NM material and waste shipments projected in Tables 5.4.9–1 and 5.4.9–2 were used to project the truck accident fatality incidence rate that would be expected under the Expanded Operations Alternative. These impacts for the bounding case are presented in Table 5.4.9–9 with details in Appendix G. Based on this analysis, accident fatalities due to SNL/NM truck transportation would increase from 0.22 to 1.9 (1.2 plus 7.1×10^{-2}) under this alternative.

5.4.9.5 Radiological Transportation Accidents

The annual risk to population due to transportation accidents that potentially involve radiological releases resulting from the Expanded Operations Alternative are presented in Table 5.4.9–10.

This analysis indicates that under normal routine operations, LCFs would increase from 1.2×10^{-3} to 6.8×10^{-3} in incidents of LCFs due to the worst-case radiological transportation accident under the Expanded Operations Alternative. In addition, 5.5×10^{-5} LCFs would result from legacy and ER Project waste shipments. For more information, see Appendix G.

Risks due to radiological, chemical, and explosives accidents are evaluated in detail in Appendix F. The bounding transportation accident analysis involves explosion of a

Table 5.4.9–7. Expanded Operations Alternative Incident-Free Exposure: Truck Emissions

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[b]	EXPANDED OPERATIONS	BASE YEAR[b]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS							
RAD Materials	$1.0x10^{-7}$	73	$1.5x10^{-5}$	305	1,782	$4.6x10^{-3}$	$2.8x10^{-2}$
Explosives	$1.0x10^{-7}$	48	$9.6x10^{-6}$	303	1,771	$2.9x10^{-3}$	$1.7x10^{-2}$
Chemicals	$1.0x10^{-7}$	8	$1.6x10^{-6}$	2,750	2,750	$4.4x10^{-3}$	$4.4x10^{-3}$
LLW	$1.0x10^{-7}$	33	$6.6x10^{-6}$	4	21	$2.6x10^{-5}$	$1.4x10^{-4}$
Medical Isotopes Production (Receipts)	NA	NA	NA	0	55	0	$1.0x10^{-2}$
Medical Isotopes Production (Shipments)				0	1,140		
LLMW (Shipments)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	1	3	$8.1x10^{6}$	$2.4x10^{-5}$
LLMW (Receipts)	$1.0x10^{-7}$	35.6	$7.1x10^{-6}$	0	1	0	$7.1x10^{-6}$
Hazardous Waste	$1.0x10^{-7}$	33	$6.6x10^{-6}$	64	112	$4.2x10^{-4}$	$7.4x10^{-4}$
Recyclable Hazardous to CA	$1.0x10^{-7}$	23	$4.6x10^{-6}$	2	4	$9.2x10^{-6}$	$1.8x10^{-5}$
Recyclable Hazardous to NM	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	6	11	$7.8x10^{-6}$	$1.4x10^{-5}$
Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	51	51	$1.0x10^{-4}$	$1.0x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$1.0x10^{-7}$	33	$6.6x10^{-6}$	1	1	$6.6x10^{-6}$	$6.6x10^{-6}$
D&D Hazardous Waste TSCA-Asbestos	$1.0x10^{-7}$	10	$2.0x10^{-6}$	14	14	$2.8x10^{-5}$	$2.8x10^{-5}$
Biohazardous Waste	$1.0x10^{-7}$	24	$4.8x10^{-6}$	1	1	$4.8x10^{-6}$	$4.8x10^{-6}$
Recyclable D&D Hazardous Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	22	22	$2.9x10^{-5}$	$2.9x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	78	78	$1.0x10^{-4}$	$1.0x10^{-4}$
Nonhazardous Landscaping Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	142	NA	$2.8x10^{-4}$
Construction and Demolition Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	599	NA	$1.2x10^{-3}$
RCRA Hazardous Waste (Receipt)	$1.0x10^{-7}$	3	$6.0x10^{-7}$	12	25	$7.2x10^{-6}$	$1.5x10^{-5}$
LLW (D&D)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	4	4	$2.6x10^{-5}$	$2.6x10^{-5}$
TOTAL[b,c]						**$1.33x10^{-2}$**	**$6.2x10^{-2}$**

Table 5.4.9–7. Expanded Operations Alternative Incident-Free Exposure: Truck Emissions (concluded)

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[b]	EXPANDED OPERATIONS	BASE YEAR[b]	EXPANDED OPERATIONS
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS							
TRU/MTRU	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	4	0	$6.8x10^{-6}$
TRU/MTRU (Legacy)	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	2	0	$3.4x10^{-6}$
LLW (Legacy)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	56	0	$3.7x10^{-4}$
LLMW (Legacy)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	8	0	$6.5x10^{-5}$
LLW (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	136	0	$9.0x10^{-4}$
LLMW (ER)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	5	0	$4.1x10^{-5}$
Hazardous Waste (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	113	0	$7.5x10^{-4}$
Nonhazardous Solid Waste (ER)	$1.0x10^{-7}$	10	$2.0x10^{-6}$	0	9	0	$1.8x10^{-5}$
TOTAL[b,c]						**0**	**$2.1x10^{-3}$**

Sources: DOE 1996n; SNL 1992a; SNL/NM 1997b, 1982, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
km: kilometers
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] LCFs per km of urban travel
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated total LCFs

Table 5.4.9–8. Doses to Crew and Public Under the Expanded Operations Alternative

CARGO	ANNUAL DOSE/TRUCK CREW (person-rem)		ANNUAL DOSE/GENERAL PUBLIC (person-rem)		ANNUAL LCFs	
	BASE YEAR[a]	EXPANDED OPERATIONS	BASE YEAR[a]	EXPANDED OPERATIONS	BASE YEAR[a]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS						
RAD Materials[b]	9.8	57.0	82.4	481.1	4.5×10^{-2}	0.26
LLW	0.21	1.1	0.6	3.2	3.8×10^{-4}	2.0×10^{-3}
LLMW[f]	$1.6\times10^{-[illegible]}$	5.9×10^{-4}	1.6×10^{-3}	6.4×10^{-3}	8.6×10^{-7}	$3.4\times10^{[illegible]}$
Medical Isotopes Production	0	25.4	0	73	0	4.7×10^{-2}
LLW (D&D)	0.21	0.21	0.60	0.60	3.8×10^{-4}	3.8×10^{-4}
TOTAL[d]					**4.6×10^{-2}**	**0.31**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS						
TRU/MTRU[e]	0	6.4×10^{-3}	0	3.5×10^{-2}	0	2.0×10^{-5}
TRU/MTRU[e] *(Legacy)*	0	3.2×10^{-3}	0	1.8×10^{-2}	0	1.0×10^{-5}
LLW (Legacy + ER)	0	10	0	28.8	0	1.8×10^{-2}
LLMW[c] *(Legacy + ER)*	0	2.1×10^{-3}	0	2.1×10^{-2}	0	1.1×10^{-5}
TOTAL[d]					**0**	**1.8×10^{-2}**

Sources: DOE 1996h, SNL 1992a; SNL/NM 1997b, 1998a
Ci: curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RAD: radiological
rem: Roentgen equivalent, man
TRU: transuranic

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b. Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium.
[c] 1996 shipment of 7.2 x 10-6 Ci of sodium -24; Transport Index = 0.1.
[d] Lifetime estimated total fatalities from annual shipments and total special shipments
[e] 1997 shipment of americium -241, europium -152, cesium -137; Transport Index = 1.0.

Table 5.4.9–9. Truck Transportation Traffic Fatalities Under the Expanded Operations Alternative

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS			
RAD Materials	3.5×10^{-4}	0.11	0.62
Explosives	2.9×10^{-4}	8.8×10^{-2}	0.51
Chemicals	2.1×10^{-6}	5.8×10^{-3}	5.8×10^{3}
LLW	2.2×10^{-4}	8.8×10^{-4}	4.6×10^{-3}
Medical Isotopes Production	NA	NA	2.1×10^{-2}
LLMW (Shipments)	3.0×10^{-4}	3.0×10^{-4}	9.0×10^{-4}
LLMW (Receipts)	2.1×10^{-4}	0	2.1×10^{-4}
Hazardous Waste	2.2×10^{-4}	1.4×10^{-2}	2.5×10^{-2}
Recyclable Hazardous to California	1.5×10^{-4}	3.0×10^{-4}	6.0×10^{-4}
Recyclable Hazardous to New Mexico	1.6×10^{-6}	9.6×10^{-6}	1.8×10^{-5}
Solid Waste	2.6×10^{-6}	1.3×10^{-4}	1.3×10^{-4}
D&D Hazardous Waste TSCA-PCBs	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
D&D Hazardous Waste TSCA-Asbestos	2.2×10^{-5}	3.1×10^{-4}	3.1×10^{-4}
Biohazardous Waste	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}
Recyclable D&D Hazardous Waste	1.6×10^{-6}	3.5×10^{-5}	3.5×10^{-5}
Recyclable Nonhazardous Solid Waste	1.6×10^{-6}	1.2×10^{-4}	1.2×10^{-4}
Nonhazardous Landscaping Waste	2.6×10^{-6}	NA	3.7×10^{-4}
Construction and Demolition Solid Waste	2.6×10^{-6}	NA	1.6×10^{-3}
RCRA Hazardous Waste (Receipt)	6.7×10^{-7}	8.0×10^{-6}	1.7×10^{-5}
Low Level Waste (D&D)	2.2×10^{-6}	8.8×10^{-4}	8.8×10^{-4}
TOTAL[b]		**0.22**	**1.2**
SPECIAL PROJECT OPERATIONS			
TRU/MTRU	1.9×10^{-5}	0	3.8×10^{-5}
TRU/MTRU (Legacy)	1.9×10^{-5}	0	3.8×10^{-5}
LLW (Legacy)	2.2×10^{-4}	0	1.2×10^{-2}
LLMW (Legacy)	3.0×10^{-4}	0	2.4×10^{-3}
LLW (ER)	2.2×10^{-4}	0	3.0×10^{-2}

Table 5.4.9–9. Truck Transportation Traffic Fatalities Under the Expanded Operations Alternative (concluded)

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	EXPANDED OPERATIONS
LLMW (ER)	3.0×10^{-4}	0	1.5×10^{-3}
Hazardous Waste (ER)	$2.2\times10^{-}$[illegible]	0	2.5×10^{-2}
Nonhazardous Solid Waste (ER)	2.6×10^{-6}	0	2.3×10^{-5}
TOTAL[b]		**0**	$\mathbf{7.1\times10^{-2}}$

Sources: SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: Transuranic
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Lifetime estimated total traffic fatalities from annual shipments

Table 5.4.9–10. Dose Risk to Population Due to Transportation Radiological Accident, Maximum Annual Radiological Accident Risk for Highway Shipments

CARGO	ANNUAL DOSE RISK TO POPULATION person-rem		LCFs	
	BASE YEAR[a]	EXPANDED OPERATIONS	BASE YEAR[a]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS				
Radioactive[b]	2.3	13.5	1.2×10^{-3}	6.8×10^{-3}
LLW	2.3×10^{-3}	1.2×10^{-2}	1.2×10^{-6}	6.0×10^{-6}
LLMW[c]	4.6×10^{-11}	1.7×10^{-10}	2.3×10^{-14}	8.5×10^{-14}
Medical Isotopes Production	0	5.2×10^{-2}	0	3.0×10^{-5}
LLW (D&D)	2.3×10^{-3}	2.3×10^{-3}	1.2×10^{-6}	1.2×10^{-6}
TOTAL[d]			$\mathbf{1.2\times10^{-3}}$	$\mathbf{6.8\times10^{-3}}$
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS				
TRU/MTRU[e]	0	9.6×10^{-8}	0	4.8×10^{-11}
TRU/MTRU[e] *(Legacy)*	0	4.8×10^{-8}	0	2.4×10^{-11}
LLW (Legacy+ER)	0	0.11	0	5.5×10^{-5}
LLMW[e] *(Legacy+ER)*	0	6.0×10^{-10}	0	3.0×10^{-13}
TOTAL[d]			**0**	$\mathbf{5.5\times10^{-5}}$

Sources: DOE 1996a, SNL 1992a, SNL/NM 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
rem: roentgen equivalent, man
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium.
[c] 1996 shipment of 7.2 x 10-6 Ci of sodium -24; Transport Index - 0.1.
[d] Lifetime estimated LCFs
[e] 1997 shipment of americium -241, europium -152, cesium -137; Transport Index = 1.0

tractor-trailer containing 40,000 ft^3 of hydrogen. Based on the results presented in Appendix F, Table F.4–1, the hydrogen explosion would result in structural damage to buildings up to a distance of 91 m from the truck. Fatalities would result up to a distance of 15 to 18 m from the truck, while eardrum ruptures would occur up to a distance of 36 m from the truck.

5.4.10 Waste Generation

The implementation of the Expanded Operations Alternative would not result in any major changes in the types of waste streams generated onsite. However, waste generation activities would increase overall if each facility were to operate at total production capacity. These increased waste volumes would be partially offset by increased waste minimization and pollution prevention programs, which project a 33-percent overall decrease in total waste disposal needs by FY 2000. The waste projections used for analysis did not take credit for potential waste minimization techniques that have not yet been implemented. Regardless, the increased generation activities would not exceed existing waste management disposal capacities.

For projection purposes, the baseline waste generation data were considered to be constant for existing facilities, with no major increases or decreases in the amount of wastes generated. Operations waste are considered to be derived from missions-related work. Nonoperations waste are generated from special programs. New operations are discussed separately in order to show the maximum existing operational increases that could be expected. Waste generation levels for special program waste, such as for the ER Project, are derived separately from the representative facilities projections under special operations. The waste quantities projected, listed in Table 5.4.10–1, represent a site-wide aggregate of quantities for each type of waste stream from existing selected facilities. As appropriate, the balance of operations (not selected facilities or special projects) waste generated is discussed within the individual waste sections. Units shown for each waste type are based on how industrial facilities charge commercial clients for disposal of these wastes.

5.4.10.1 Radioactive Wastes

Under the Expanded Operations Alternative, SNL/NM would potentially generate LLW, LLMW, and TRU and MTRU waste. However, SNL/NM would not generate any high-level waste. Projections for waste generation at selected facilities from new and existing operations are shown in Appendix H.

Existing Operations

Under the Expanded Operations Alternative, SNL/NM anticipates a maximum 61 percent increase in the generation of LLW from existing operations at selected facilities over the next 10 years. LLW generated by SNL/NM is and will continue to be transported offsite to appropriate DOE-approved disposal facilities, such as the NTS. Similarly, LLMW generation would increase by 49 percent for existing operations at selected facilities through 2008. Under the *Resource Conservation and Recovery Act Part B, Permit Application for Hazardous Waste Management Units* (SNL/NM 1996a), some treatment of the hazardous component of LLMW could be performed at SNL/NM (Table 4.12–2). LLMW for which no onsite treatment is available would be shipped offsite for treatment and disposal. SNL/NM also projects that approximately 0.59 m^3 of TRU waste would be generated annually. The existing TRU/MTRU wastes stored onsite, as well as future TRU/MTRU wastes, would be transferred to LANL for certification, prior to their disposal at the WIPP as indicated in the Waste Management Programmatic Environmental Impact Statement (DOE 1997i) ROD (DOE 1998n). Projected MTRU waste generated would increase 100 percent to a level of 0.91 m^3 annually. Existing SNL/NM operations would use less than 1 percent annually of the available radioactive waste storage capacity. This would be a minimal impact.

The DOE anticipates that MESA Complex operations would generate 0.1 ft^3 of low-level waste each year. If implemented, this would be of minimal impact.

New Operations

SNL/NM anticipates a maximum of 181 m^3 of LLW would be generated from new operations annually over the next 10 years. The majority of the increase would be due primarily to the full implementation of the medical isotopes production operations in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for more than 83 percent of the total projected LLW under the Expanded Operations Alternative. However, due to the nature of the waste, it would be managed at the generation facility to minimize worker exposure until disposal offsite. LLMW generation from all new onsite sources would be a maximum of 7.31 m^3 annually through 2008.

SNL/NM does not expect to generate TRU and MTRU wastes from new operations. Approximately 399 kg of

Table 5.4.10–1. Waste Generation for Existing Selected SNL/NM Facilities Under the Expanded Operations Alternative

ALL WASTE		UNIT	BASE YEAR[a]	EXPANDED OPERATIONS ALTERNATIVE[b]
RADIOACTIVE WASTE				
Low-Level Waste (500 kg/m³)	Existing Operations	m³(kg)	16(8,000)	26(13,000)
	New Operations	m³(kg)	4(2,000)	181(90,500)
	SNL/NM Balance of Operations	m³(kg)	74(37,000)	74(37,000)
	SNL/NM Total LLW	m³(kg)	94(47,000)	280(140,000)
	Percent change	m³(kg)	0.0%	197.9%
Low-Level Mixed Waste (550 kg/m³)	Existing Operations	m³(kg)	3.85(2,120)	5.75(3,160)
	New Operations	m³(kg)	0.20(110)	1.27(700)
	SNL/NM Balance of Operations	m³(kg)	0.28(150)	0.28(40)
	SNL/NM Total LLMW	m³(kg)	4.33(2,380)	7.31(3,900)
	Percent change	m³(kg)	0.0%	68.7%
TRU Waste (310 kg/m³)	Existing Operations	m³(kg)	-	0.59(180)
	New Operations	m³(kg)	-	0.14(40)
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total TRU	m³(kg)	-	0.74(210)
MTRU Waste (76 kg/m³)	Existing Operations	m³(kg)	0.45(34)	0.91(70)
	New Operations	m³(kg)	-	0.14(10)
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total MTRU	m³(kg)	0.45(34)	1.05(80)
	Percent change		0.0%	131.3%
RADIOACTIVE WASTE TOTAL[c]	**Existing Operations**	**m³(kg)**	**20.34 (10,154)**	**33.06(16,550)**
	New Operations	**m³(kg)**	**4.62(2,110)**	**182.41(91,450)**
	SNL/NM Balance of Operations	**m³(kg)**	**73.92 (37,150)**	**73.92(37,050)**
	SNL/NM Total Radioactive Waste	**m³(kg)**	**98.88 (49,414)**	**289.39(145,050)**
	Percent change		**0.0%**	**192.7%**

Table 5.4.10–1. Waste Generation for Existing Selected SNL/NM Facilities Under the Expanded Operations Alternative (concluded)

ALL WASTE	UNIT	BASE YEAR[a]	EXPANDED OPERATIONS ALTERNATIVE[c]
RCRA HAZARDOUS WASTE			
Existing Operations (with MESA)[b]	kg	16,187	25,074 (26,274)[b]
New Operations	kg	398	2,337
SNL/NM Balance of Operations	kg	39,267	64,902
SNL/NM Total RCRA Hazardous (with MESA)[b]	kg	55,852	92,314 (93,514)[b]
	m^3	44.3	73.2
Percent Change		0.0%	65.3%
SOLID WASTE			
SNL/NM Total Solid Waste[d,e]	m^3(kg)	2,022 (0.6M)	2,022 (0.6M)
Percent Change		0.0%	0.0%
WASTEWATER			
Existing Operations (with MESA)[b]	M gal	49	85.5 (89.3)[b]
New Operations	M gal	0	5
SNL/NM Balance of Operations	M gal	231	231
SNL/NM Total Wastewater (with MESA)[b]	M gal	280	322 (325)[b]
Percent Change		0.0%	15%

Sources: SNL/NM 1998a, 1997b, 1998c, 1998t
ft3: cubic feet
kg: kilogram
LLMW: low-level mixed waste
LLW: low-level waste
M: million
M gal: million gallons
m^3: cubic meters
MESA: Microsystems and Engineering Sciences Applications
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] If implemented, MESA would become operational after 2003, and hazardous waste and wastewater would increase by 1,200 kg per year and 3.8 M gals per year, respectively.
[c] Numbers are rounded and may differ from calculated values.
[d] Individual breakdowns of solid waste for existing, new, and balance of operations are unavailable because of tracking methods.
[e] The addition of MESA would not increase solid waste generation, in part, because there would be no new employees.

Note: MESA operations would generate minimal amounts of low-level waste (0.1 ft3 per year), which the table does not reflect.

spent fuel would be generated over the 10-year period. Spent fuel is further discussed in Appendix A as a material resource.

Balance of Operations

The waste generation level for the balance of operations was determined for each type of radioactive waste (Table 5.4.10–1). Only LLW and LLMW would be affected. Balance of operations mission operations at SNL/NM would account for an additional 74 m^3 per year of LLW. These same operations would account for an additional 0.28 m^3 of LLMW per year. The overall operations impacts for this alternative would increase by approximately 198 percent for LLW and 69 percent for LLMW.

Current Capacity

Previously generated radioactive wastes (legacy waste) occupy approximately 494 m^3 of the available 11,866 m^3 of total radioactive waste storage capacity at the RMWMF and its associated storage areas. This represents approximately 4.2 percent of the total available capacity. Therefore, there would be sufficient capacity to accommodate the anticipated increases in radioactive wastes.

Special Projects

Projections indicate that the ER Project, a special project beyond the scope of existing operations, will be the single largest waste generator at SNL/NM in 1998. Before it ends, the ER Project would produce approximately 2,862 m^3 of LLW and 221 m^3 of LLMW, primarily contaminated soil and debris. Projected ER Project radioactive waste volumes are listed in Table 5.3.10–2. ER Project wastes are stored and handled at the point of generation prior to offsite disposal. Management of ER Project waste would not be expected to impact overall SNL/NM waste management operations. The DOE expects actual cleanup to be completed between FY 2003 and FY 2005, with ER waste disposed of before the end of the project. ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

5.4.10.2 Hazardous Waste

Existing Operations

As shown on Table 5.4.10–1, under the Expanded Operations Alternative, SNL/NM anticipates an increase in the generation of RCRA hazardous waste from existing operations from 16,187 kg in the base year to 25,074 kg per year. If the MESA Complex configuration is implemented, it would become operational after 2003; an additional 1,200 kg per year of hazardous waste would be generated. Projections for selected facilities for new and existing operations are shown in Appendix H. Projected RCRA hazardous waste generation is presented in Figure 4.12–4.

No appreciable change in the generation of explosive waste would occur. Therefore, the TTF, with a treatment capacity of 9.1 kg of waste per burn, would continue to accommodate those wastes generated from the Light-Initiated High Explosive Facility at SNL/NM. The majority of explosive waste would be disposed of at SNL/NM or through KAFB.

New Operations

SNL/NM anticipates annual generation of a maximum of 2,337 kg of hazardous waste by new operations over the next 10 years. The majority of the increase would be primarily due to the full implementation of medical isotopes production operation, associated with the MIPP in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for less than 3 percent (2.5 percent) of the total projected hazardous waste generation under the Expanded Operations Alternative.

New SNL/NM operations would use less than 1 percent annually of the available hazardous waste storage capacity, which is considered to be a minimal impact.

Balance of Operations

It was assumed that the RCRA hazardous waste levels for the balance of operations at SNL/NM would increase by the same proportion as RCRA waste for selected facilities, because selected facilities represent the overall plant. Consequently, multipliers were used to project RCRA hazardous waste levels under all three alternatives. In the base year, balance of operations generated 39,267 kg of RCRA hazardous waste. For the Expanded Operations Alternative, the maximum projected balance of operations amount would be 64,902 kg.

Current Capacity

Under the Expanded Operations Alternative, the total volume of hazardous waste generated at SNL/NM requiring offsite disposal at licensed/approved facilities, would not exceed the existing 286.5 m^3 of storage and handling capacities at the HWMF and its associated storage buildings. The outside nonpermitted bermed storage area for nonhazardous waste was not included in the onsite storage capacity calculations. SNL/NM routinely ships hazardous waste to various offsite commercial disposal facilities. Projections provide that a maximum of 26 percent of the existing hazardous waste capacity would be used. Most, if not all, waste would be shipped in less than 1 year to meet regulatory requirements. Based on these projections and on continued operations at selected facilities under the Expanded Operations Alternative, the hazardous waste generation impacts would continue to be minimal.

Special Projects

During field remediation, the ER Project would be the single largest waste generator at SNL/NM and would produce approximately 26 M kg of hazardous waste by 2002. Final disposal would be accomplished by 2004. Projected ER hazardous waste volumes are presented in Table 5.3.10–2. ER waste handling is discussed in Section 4.12.3.3.

D&D operations would continue (as outlined in Section 2.3.5). This program would directly impact the quantity of TSCA hazardous waste requiring disposal. Under this modernization program, SNL/NM would continue to generate TSCA hazardous waste, primarily PCBs and asbestos that are removed from transformers and buildings. Since the main PCB relamping and transformer removal has been completed, quantities of TSCA waste have dropped to approximately 122,000 kg per year and should remain at that level (Figures 4.12–5 and 4.12–6).

The total volume of TSCA waste would eventually decrease as the targeted facilities are removed. Currently, SNL/NM has 674 buildings providing a total of 5 M gross ft^2 of office and operational space. Through this facility modernization program, the number of buildings would be reduced to 465, totaling approximately 4.9 M gross ft^2. This program would remove 138 buildings accounting for 179,204 gross ft^2 within FY 1998 and FY 1999 at SNL/NM. During FY 2000 through FY 2002, 49 additional buildings, accounting for 108,937 gross ft^2, are potentially scheduled for removal. Over the long term, an additional 29 buildings would be removed with a total of 84,132 gross ft^2. To make up for the loss of office and operational space, seven additional buildings would be built, adding a total of approximately 240,000 gross ft^2.

If implemented, the MESA Complex configuration would result in the decontamination, decommissioning, and demolition of the CSRL. The resulting wastes could include 1 ton of asbestos (1 ton is approximately 2.5 cubic yards), 0.5 ton of PCB ballasts, 0.5 ton of hazardous waste, 0.1 ton of nonhazardous waste, and 2,000 tons of demolition debris. This would occur after MESA became operational (after 2003).

No predictions are made for years beyond 2007.

5.4.10.3 All Other Wastes

All SNL/NM operations also involve four additional waste management activity areas, discussed below.

Biohazardous (Medical) Waste

The total volume of medical waste would generally remain a function of the total number of full-time employees and subcontractors at SNL/NM. In 1997, 2,463 kg of medical waste were disposed of at an approved offsite commercial facility. Under the Expanded Operations Alternative, approximately 4,071 kg of medical waste would be generated. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Nonhazardous Chemical Waste

In 1998, the ER Project will generate approximately 125,112 kg of nonhazardous waste (Table 5.3.10–2). The maximum quantity of nonhazardous waste generated annually at SNL/NM and managed by the HWMF would be 114,576 kg, based on the waste multiplier (see Appendix H) developed for RCRA hazardous waste (Rinchem 1998a). Existing commercial disposal facilities would still have adequate capacities to handle the continued generation of nonhazardous waste, thus no additional impacts would be anticipated.

Municipal Solid Waste

Site-wide solid waste generation trends at SNL/NM would generally remain a function of total building area and the number of full-time and subcontractor employees. This function is based on general build operations activities, such as maintenance and cleaning, and, to a lesser extent, the general office waste created by SNL/NM employees. Despite the projected 10 percent personnel increase, no appreciable onsite impacts to disposal facilities would be anticipated because existing waste handling capabilities are already in place. As existing buildings are replaced, personnel are moved to make more efficient use of the space. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient. However, a significant amount of C&D waste, a special class of solid waste, would potentially be generated under the facility modernization program described above. Quantities of C&D waste associated with the facility modernization program projected to be similar to prior years. This waste is disposed of at KAFB and does not currently create an offsite impact.

Table 5.3.10–3 summarizes construction debris disposal. If implemented, the MESA Complex configuration would become operational after 2003; demolition of the CSRL could result in 2,000 tons (5,000 cubic yards) of additional debris.

Wastewater

Under the Expanded Operations Alternative, increases in process and domestic water use would occur throughout SNL/NM due to varying levels of operation within each facility. SNL/NM would generate approximately 322 M gal of wastewater annually. If MESA becomes operational after 2003, an additional 3.8 M gals of wastewater would be generated. However, SNL/NM entered into an MOU with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997p). The MDL would be the single facility discharging the largest wastewater volume at SNL/NM. Reduction efforts would focus on the MDL to reduce the amount of process wastewater being generated. See Section 5.3.2 for additional discussion of wastewater quantities and capacities.

5.4.11 Noise and Vibration

Projections of the number of impulse noise tests under the Expanded Operations Alternative indicate a 250 percent increase in tests over those of the 1996 baseline 73.2 number and a 184 percent increase above No Action Alternative levels. These test activities originate from facilities located in TA-III and the Coyote Test Field and are remote from other SNL/NM TAs and the site boundary. There would be no increase in the magnitude of explosions during test activities that would result in a larger impulse noise for the Expanded Operations Alternative.

The level of impulse noise activities under the Expanded Operations Alternative would be an average of approximately one impulse noise event per hour for an 8-hour work day and a 261-day work year. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed by those neighborhoods bounding the site. Building damage is sometimes blamed on ground vibrations caused by explosive detonations, whereas the damage is often the result of the traveling pressure waves. The impulse noise levels resemble a dull thud and generally are considered an annoyance because of "startle" effects, including window vibrations. The effects on the public would be minor. Ground vibrations would remain confined to the immediate test area within the ground hazard area.

If implemented, operations under the MESA Complex configuration would have a negligible effect on background noise levels and would not increase the number of impulse noise events. Noise levels would increase temporarily during construction due to the operation of heavy equipment such as air compressors and, cement mixers, and to construction vehicle traffic.

5.4.12 Socioeconomics

Implementation of the Expanded Operations Alternative would result in no appreciable impacts to demographic characteristics, economy, and community services in the ROI, as discussed below. The discussion of impacts is based on a bounding economic analysis based on projections in *SNL/NM Facility Source Documents* (SNL/NM 1998a) and potential indirect increases across all SNL/NM facilities, as discussed in Section 5.2.13.

5.4.12.1 Demographic Characteristics

The Expanded Operations Alternative would not be likely to have any noticeable change in existing demographic characteristics within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would expand gradually at a steady rate through 2008.

5.4.12.2 Economic Base

The Expanded Operations Alternative would not be likely to have a noticeable change in the existing economic base in the ROI (Section 4.14.3). Historically, increases or decreases in operational levels of activities at SNL/NM have been gradual and/or fluctuated about 1 or 2 percent per year (SNL/NM 1997a). Under this alternative, overall expenditures and employment at SNL/NM would expand at a gradual steady rate through 2008.

Table 5.4.12–1 presents an estimate of the Expanded Operations Alternative impacts on the ROI economy from a 10-percent increase in operational levels of activity and associated increases in expenditures, income, and employment, both direct and indirect, at SNL/NM. Operational activities associated with selected facilities are included in the totals presented in the table. If operations at SNL/NM were to increase by 10 percent over current levels, overall economic activity within the ROI would be expected to increase by about 0.8 percent, with slightly smaller increases in income and employment at about 0.7 percent. As presented in Table 5.4.12–1, a 10-percent increase in operational levels of activity at SNL/NM through 2008 would help generate $4.33 B in economic activity out of a total ROI activity of $42.8 B, contribute $1.17 B in income out of a total ROI income level of $13.51 B, and represent 29,123 jobs out of a total of 334,446 jobs within the ROI.

If implemented, the MESA Complex configuration would be constructed adjacent to the existing MDL. Construction would start in FY 2001 and end in FY 2003. Projected construction costs would be $48 M, $110 M, and $94 M in 2001, 2002, and 2003, respectively. Construction of the facility would be likely to employ several hundred short-term workers and probably would result in a small temporary increase in local employment. A substantial portion of the dollars spent for the materials would flow through the wholesale and retail trade sectors of the regional economy. This facility would employ an estimated 500 to 550 workers. Employees working in existing facilities would relocate to MESA, so the hiring of new employees would be unlikely.

Table 5.4.12–1. SNL/NM's Impact on Central New Mexico's Economy if Operations Were to Increase by 10 Percent

ECONOMIC MEASURE	FY 1996[a]			ASSUMING A 10% INCREASE IN OPERATIONS			
	SNL/NM	TOTAL ROI	PERCENT OF ROI	SNL/NM	TOTAL ROI	PERCENT OF ROI	PERCENT CHANGE
ECONOMIC ACTIVITY ($ BILLIONS)							
Direct Expenditures	1.43			1.57			
Indirect & Induced	2.50			2.75			
TOTAL ECONOMIC ACTIVITY	**3.93**	**42.40**	**9.3**	**4.32**	**42.80**	**10.1**	**0.8**
Economic Activity Multiplier: 2.75[b]							
INCOME ($ BILLIONS)							
Net Wages & Salaries	0.48			0.53			
Indirect & Induced	0.58			0.64			
TOTAL INCOME	**1.06**	**13.40**	**7.9**	**1.17**	**13.51**	**8.7**	**0.8**
Income Multiplier: 2.21[b]							
EMPLOYMENT (NUMBER OF EMPLOYEES)							
SNL/NM Employment	7,652			8,417			
Indirect & Induced	18,826			20,706			
TOTAL EMPLOYMENT	**26,478**	**331,800**	**8**	**29,123**	**334,446**	**8.7**	**0.7**
Employment Multiplier: 3.46[b]							

Source: DOE 1997j
FY: fiscal year
ROI: region of influence

[a] Modeled results from DOE 1997j
[b] The use of multipliers in calculating economic impacts in the ROI is explained in Section 4.14.3.

Section 6.4.11 discusses the cumulative impact of the Expanded Operations Alternative within the ROI and the expected growth from other industrial and economic sectors.

5.4.12.3 Housing and Community Services

The Expanded Operations Alternative would not create a noticeable change in existing housing and community services within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would expand at a steady rate through 2008; however, the contributory effects from other industrial and economic sectors within the ROI would be greater than SNL/NM's (Section 6.4.11).

5.4.13 Environmental Justice

In general, SNL/NM operations under the Expanded Operations Alternative would have no known disproportionately high or adverse health or environmental impacts on low-income or minority populations within the ROI. One area of concern is water resources and hydrology. Anticipated water resources adverse impacts would equally affect all communities in the area (see Section 5.4.4). Thus, no disproportionately high and adverse impacts to minority and low-income communities would be anticipated for this resource area.

The DOE does not expect the MESA Complex configuration to create an environmental justice-related impact, based on the MESA-related impacts presented in Section 5.4 and the ROI evaluated for the Expanded Operations Alternative.

Table 5.4.13–1 provides a brief summary of impacts for each resource or topic area under the Expanded Operations Alternative. It also identifies areas where the impacts do not vary from the No Action Alternative. See Section 5.3.13 for an expanded discussion of environmental justice issues by resource area.

Table 5.4.13–1. Summary of Potential Environmental Justice Impacts Under the Expanded Operations Alternative

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBOR-HOODS
Land Use and Visual Resources, Infrastructure, Geology and Soils, Biological and Ecological Resources, Cultural Resources, Waste Generation	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative
Water Resources and Hydrology	SNL/NM groundwater use is projected to account for 12% of local aquifer drawdown.	Adverse effect	Not adverse effect	Not adverse effect
Air Quality Nonradiological Air	Emissions would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Concentrations would be below regulatory standards and human health guidelines. SNL/NM carbon monoxide emissions would account for 6.3% of Bernalillo county carbon monoxide emissions.	Not adverse	Not adverse	Not adverse
Air Quality Radiological Air	MEI 0.51: mrem/yr Collective ROI dose: 15.8 person-rem/yr Average collective ROI dose: $2.16x10^{-2}$mrem/yr	Not adverse	Not adverse	Not adverse
Human Health and Worker Safety	MEI lifetime risk of fatal cancer increases by $2.6x10^{-7}$ Fatal cancers (additional ROI): $7.9x10^{-3}$ Risk of cancer fatality to workforce is $7.6x10^{-3}$	Not adverse	Not adverse	Not adverse
Transportation	Total annual material shipments: 6,303 Total KAFB traffic (daily vehicles): 39,085 Incident-free exposure, truck emissions - annual LCFs: $6.2x10^{2}$ Incident-free exposure, dose - annual LCFs: 0.31	Not adverse	Not adverse	Not adverse

Table 5.4.13–1. Summary of Potential Environmental Justice Impacts Under the Expanded Operations Alternative (concluded)

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBOR-HOODS
Noise and Vibration	Four-fold increase in test activities over 1996 levels, an average of less than one impulse noise event per hour for an 8-hour work day and a 261-day work year. Only a fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed in neighborhoods bounding the site.	Not adverse	Not adverse	Not adverse
Socioeconomics	SNL/NM employees: 8,417 SNL/NM total economic activity: $4.32 B/yr Percent of ROI total economic activity: 10.1%	Not adverse	Not adverse	Not adverse

Source: Original
B. billion
KAFB: Kirtland Air Force Base
LCF: latent cancer fatalities
MEI: maximally exposed individual
mrem: millirem
rem: Roentgen equivalent, man
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
yr. year

5.5 REDUCED OPERATIONS ALTERNATIVE

Under the Reduced Operations Alternative, DOE and interagency programs and activities at SNL/NM would decrease to the minimal operations needed to maintain SNL/NM facilities and equipment in an operational readiness mode. This section describes the impacts that would result from this alternative.

5.5.1 Land Use and Visual Resources

The implementation of the Reduced Operations Alternative would not affect the existing land use patterns or visual resources at SNL/NM facilities on KAFB. Sections 5.5.1.1 and 5.5.1.2 discuss these resource areas in relation to the Reduced Operations Alternative.

5.5.1.1 Land Use

Under the Reduced Operations Alternative, there would be no additional impacts to existing land resources on KAFB. The extent of DOE land and USAF-permitted acreage currently available for use by SNL/NM facilities on KAFB would remain relatively the same. Similarly, operations would remain consistent with industrial/research park uses and would have no foreseeable effect on established land use patterns or requirements. At locations on permitted land where operations would decline or be shut down by the "owning" organization, SNL/NM would continue to hold the sites to conduct periodic safety checks and complete any ER actions (Section 5.3.3.1). Before returning the land to the USAF, SNL/NM would be responsible for conducting any demolition work and restoring the land to its condition when originally acquired (SNL 1997a).

5.5.1.2 Visual Resources

No additional impacts to visual resources would be likely to adversely change the overall appearance of the existing landscape. Efforts initiated by SNL/NM to incorporate and maintain campus-style design would continue. This style contains established principles and design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. The guidance covers building massing, facades, colors, building orientation and entries, traffic circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. These efforts would be consistent with the high concern for scenery due to the numbers of observers and users in the area.

Based on the reduced levels of operation association with this alternative, activities at outdoor testing facilities in the Coyote Test Field and the Withdrawn Area would decline. Some testing activities that produce smoke and dust of variable quantity and duration would take place, but these conditions would be periodic, short-term, and would not change the visual characteristics of the area. Where decommissioning, demolition, or ER work are planned, actions would be taken such as backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its condition when originally acquired.

5.5.2 Infrastructure

As discussed in Section 5.3.2, the infrastructure analysis looked for potential incremental changes to SNL/NM services, utilities, and facilities by alternative. The two areas where incremental changes were identified are site-wide utility demands and four selected infrastructure facilities: the steam plant, RMWMF, HWMF, and TTF. See Section 2.3 for a discussion of how the four facilities were selected for analysis.

With regard to site-wide utility demands, most SNL/NM facilities do not meter utility use. For the Reduced Operations Alternative, the lowest number reported in the No Action Alternative was used as the basis for projecting utility use. Any incremental changes between the base year and the Reduced Operations Alternative projections in utility demands for the selected facilities (see Chapter 2) were taken into account by adjusting site-wide demand accordingly as presented in Table 5.5.2–1. Facility-specific utility data are presented in Chapter 3, Table 3.6–1.

As discussed in Section 5.3.2, analysis of the selected infrastructure facilities relied on the projected throughput and operational capacities as presented in Table 5.5.2–2.

The implementation of the Reduced Operations Alternative would generally lessen the demands on infrastructure (Table 5.5.2–1). Water consumption would decrease approximately 24 M gal per year to 416 M gal per year. SNL/NM would generate approximately 268 M gal of wastewater per year. Annual electrical consumption would decline to 185,000 MWh. Small fluctuations in projected utility consumption rates would occur due to annual changes in weather.

The current infrastructure resources would be capable of accommodating SNL/NM facility requirements under the Reduced Operations Alternative. These levels of

Table 5.5.2–1. Annual[a] SNL/NM Utility Usage and Capacities Under the Reduced Operations Alternative

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	REDUCED OPERATIONS ALTERNATIVE ANNUAL USAGE	SYSTEM CAPACITY	SNL/NM USAGE AS PERCENT OF CAPACITY
WATER USE[b]				
Site-wide demand[c]	440 M gal	417 M gal	2.0 B gal	21
Selected facilities[g]	0 M gal	-1.4 M gal	NA	
TOTAL	**440 M gal**	**416 M gal**	**2.0 B gal**	**21**
WASTEWATER DISCHARGE				
Site-wide demand[c]	280 M gal	265 M gal	850 M gal	31
Selected facilities[g]	0 M gal	3.3 M gal	NA	
TOTAL	**280 M gal**	**268 M gal**	**850 M gal**	**32**
ELECTRICAL USE				
Site-wide demand[c]	197,000 MWh	186,000 MWh	1,095,000[d] MWh	16
Selected facilities[g]	0 MWh	-775 MWh	NA	
TOTAL	**197,000 MWh**	**185,000 MWh**	**1,095,000[d] MWh**	**16**
NATURAL GAS USE				
Site-wide demand[c,e]	475 M ft^3	450 M ft^3	2.3 B ft^3	20
Selected facilities[g,h]	0 M ft^3	-65 M ft^3	NA	
TOTAL	**475 M ft^3**	**385 M ft^3**	**2.3 B ft^3**	**18**
MISCELLANEOUS				
Fuel oil[f,h]	7,000 gal	7,000 gal	Not limited by infrastructure	NA
Propane[h]	383,000 gal	362,000 gal	Not limited by infrastructure	NA

Sources: DOE 1997k; SNL 1997a; SNL/NM 1998a, c; USAF 1998a
B: billion
ft^3: cubic feet
FY: fiscal year
gal: gallon
M: million
MW: megawatt
MWh: megawatt hour
NA: Not applicable
psi: pounds per square inch
[a] Base Year is 1996 or 1997, the most representative of usage. Not necessarily the same as in Chapter 4.
[b] Although not accounted for in the table, SNL/NM expects to reduce water by 30 percent by the year 2004 (see Table 5.3.2–1 for conservation based scenario).
[c] Prorated based on the following M square footage: Base Year = 5.266; FY 2003 = 5.143; FY 2008 = 4.986
[d] Based on 125-MW rating
[e] Estimated based on 60 psi
[f] Fuel oil is used in emergency situations at the Steam Plant and is not dependent upon square footage.
[g] Adjustment for contribution from selected facilities as reported in SNL/NM 1998a
[h] No adjustments were reported in SNL/NM 1998a. Estimate based on 260 M ft^3 (at 14.7 psi) reduction at steam plant converted to 65 M ft^3 at 60 psi

Table 5.5.2–2. Selected (Infrastructure) Facility Annual Throughput[a] and Capacities Under the Reduced Operations Alternative

FACILITY[d]	BASE YEAR 1997	REDUCED OPERATIONS ANNUAL THROUGHPUT	SYSTEM CAPACITY ANNUAL	THROUGHPUT AS PERCENT OF CAPACITY
Steam Plant (steam produced)[e]	544 M lb	362 M lb	3.33 B lb	11
HWMF (waste handled)[e]	203,000 kg	175,000 kg	579,000 kg[c]	30
RMWMF (waste handled)[e]	1.6 M lb	0.8 M lb	2.7 M lb[c]	30
TTF (waste handled)[e]	Minimal	Minimal	7,300 lb/yr[b]	1

Source: SNL/NM 1998a
B: billion
ft^3: cubic feet
HWMF: Hazardous Waste Management Facility
kg: kilogram
lb: pound
M: million
RMWMF: Radioactive and Mixed Waste Management Facility
TTF: Thermal Treatment Facility
yr: year
[a] Throughput means the amount of steam produced or waste handled.
[b] Permit capacity
[c] This is the capacity for single-shift work with current employment level, not permit capacity.
[d] See Section 2.3 for discussion on how these facilities were selected.
[e] See Table 3.6–1, "Infrastructure" category.

support would be compatible with system requirements and less than those under the No Action Alternative. Specific details on these systems are presented in the *1998 Sites Comprehensive Plan* (SNL 1997a). KAFB utility usage is discussed in Section 6.2.

Impacts associated with the four facilities analyzed would be less than those expected under the No Action Alternative. Throughput and capacities are presented in Table 5.5.2–2. As shown in the table, ample capacity exists for the four facilities.

5.5.3 Geology and Soils

The implementation of the Reduced Operations Alternative would result in the continuation or lessening of impacts related to soil contamination and slope stability, as described in Sections 5.5.3.1 and 5.5.3.2, respectively.

5.5.3.1 Soil Contamination

Section 5.3.3 presents the methods used in evaluating soil contamination at SNL/NM. It focuses on near-surface (zero to 1 ft deep) soil contamination at SNL/NM sites, particularly those investigated under the ER Project. The DOE has committed to clean up 162 of 182 ER sites. The remaining 20 sites would be listed as active. Of concern among these active sites are outdoor testing areas where normal operations or accidents could result in the deposition of contaminants on the ground surface.

Under the Reduced Operations Alternative, the frequency of tests would be curtailed such that future soil contamination occurrences requiring cleanup would be unlikely. For example, at the Lurance Canyon Burn site, certification tests would decrease from 12 to 1 per year. Accordingly, the once-in-10-year event (contamination and cleanup of up to 7,000 µg of DU per g of soil over a 1,000-ft^2 area) might be expected to occur once every 120 years.

SNL/NM conducts immediate cleanup actions (SNL/NM 1998a) and periodic site surveys (SNL 1997e) to clean up these sites to levels that meet future land use standards.

5.5.3.2 Slope Stability

Section 5.3.3 presents the relevance of and methods used to evaluate slope stability. Four areas were selected for a detailed, qualitative evaluation: the southern boundary of TA-IV, the Aerial Cable Facility, the Lurance Canyon Burn Site, and the Electro-Explosive Research Facility. Slope failure at these locations would be remote.

Under the Reduced Operations Alternative, no changes in activity types or frequencies would be projected for TA-IV and the Electro-Explosive Research Facility (SNL/NM 1998a). A decrease in testing would be expected at the Aerial Cable Facility and the Lurance Canyon Burn Site (SNL/NM 1998a). No slope destabilizing activities have been identified at the Lurance Canyon Burn Site. Accidental burns of vegetation from hot missile debris could become less frequent at the Aerial Cable Facility, although no evidence of slope instability has been observed from a previous burn. The likelihood of slope failure resulting from SNL/NM activities would continue to be remote under this alternative.

5.5.4 Water Resources and Hydrology

Impacts from the implementation of the Reduced Operations Alternative would not differ substantively from the impacts described in Section 5.3.4 for the No Action Alternative. Impacts to groundwater quality and quantity and surface water quality and quantity are described in Sections 5.5.4.1, 5.5.4.2, 5.5.4.3, and 5.5.4.4, respectively.

5.5.4.1 Groundwater Quality

Section 5.3.4 identifies sources of groundwater contamination and presents modeling of the CWL. All groundwater quality impacts described in Section 5.3.4.1 would be alternative-independent—the Reduced Operations Alternative would not cause any change in the nature or extent of groundwater contamination. Contamination of groundwater would remain an adverse impact as discussed in Section 5.3.4.1. No changes in rate and scope of ER Project remediation activities are projected under the Reduced Operations Alternative.

5.5.4.2 Groundwater Quantity

Using the groundwater quantity analysis described in Section 5.3.4.2 and the projected SNL/NM water use from 1998 to 2008 under the Reduced Operations Alternative, 571 M ft^3 of water would be withdrawn over the 10-year operational period, in comparison to 605 M ft^3 under the No Action Alternative. Both these amounts account for approximately 11 percent of the projected 5,326 M ft^3 of groundwater withdrawal in the KAFB vicinity from 1998 to 2008. The SNL/NM water use for either alternative, therefore, corresponds to 11 percent of this projected withdrawal.

The impacts described in Section 5.3.4.2 would not vary in any significant manner under the Reduced Operations Alternative. Aquifer drawdown would remain an adverse impact.

5.5.4.3 Surface Water Quality

SNL/NM impacts to surface water quality are discussed in the No Action Alternative (Section 5.3.4). This discussion compares results of water quality analyses in Tijeras Arroyo (from samples collected during storm events) near the downstream boundary of KAFB, with NMWQCC stream standards. No constituents in the analyses exceeded these standards. Further, the three major potential contributors to surface water contamination (ER Project sites; permitted storm water discharges from TAs-I, -II, and -IV; and outdoor testing facilities) were evaluated based on potential contaminants and likelihood of migration.

Under the Reduced Operations Alternative, the following two changes could occur in the major potential contributors to surface water contamination:

- A projected 5 percent decrease in staff below current levels (Section 5.5.12) could potentially reduce the quantity of oil and grease runoff from permitted storm water discharges in TAs-I, -II, and -IV. The most recent storm water monitoring shows oil and grease concentrations ranging from 0.60 to 1.4 mg/L (SNL 1997a). Although there are no quantitative NPDES or state limits for oil and grease, these concentrations are near detection limits. A further reduction would have no deleterious effects.
- A reduction in the frequency of outdoor tests could result in a decrease of radioactive materials deposited on the ground surface. To date, surface water sampling has not shown evidence of contamination resulting from tests; reducing the frequency of outdoor tests would further reduce the likelihood of such contamination. Therefore, concentrations of radionuclides at the exit point of Tijeras Arroyo from KAFB would be anticipated to remain substantially the same under the Reduced Operations Alternative.

5.5.4.4 Surface Water Quantity

The method used to estimate the SNL/NM contribution to surface water quantity is described in Section 5.3.4 and in Appendix B. The analysis calculates the quantities of excess surface water runoff from developed areas of SNL/NM, and the discharge of process and sanitary water to Albuquerque's Southside Water Reclamation Plant. Under the No Action Alternative, the estimated total excess surface water contribution to the Rio Grande would be between 40.7 and 41.3 M ft^3 annually. The vast majority of this contribution (40.6 M ft^3) would be from discharge to the water reclamation plant.

Storm Water Runoff

Under the Reduced Operations Alternative, only minor net differences in building and parking lot areas would be likely. These differences would not significantly change the developed (impervious) area of SNL/NM from the 0.72-mi^2 area projected under the No Action Alternative. Therefore, excess storm water runoff would continue at 100,000 to 700,000 ft^3 per year, as estimated under the No Action Alternative (Appendix B).

Discharge to Sanitary Sewer

The estimated annual volume of water to be discharged to the sanitary sewer under the Reduced Operations Alternative would be 35.8 M ft^3 (268 M gal), 13 percent less than under the No Action Alternative (Section 5.3.4). Combined with the excess storm water runoff, the total estimated SNL/NM effect on surface water quantity would be between 35.9 and 36.5 M ft^3 annually. This would represent approximately 0.06 percent of Rio Grande flow at the discharge points. Under the Reduced Operations Alternative, no detrimental effects to the Rio Grande from the quantity of SNL/NM water discharged would be likely.

5.5.5 Biological and Ecological Resources

Impacts to biological and ecological resources resulting from implementation of the Reduced Operations Alternative would be similar to those under the No Action Alternative. There would be slightly decreased levels of noise and activity under this alternative. Impacts to biological and ecological resources would be minimal. Inventory and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to protect the animals, plants, and sensitive species on KAFB.

Outdoor activities would result in a slight decrease in the probability of unintended fires, off-road traffic, noise, small explosive debris, and plumes of smoke. The decreased level of activity would be unlikely to cause the loss of any known species or plant community at KAFB. The area of vegetation disturbed would be decreased, and the effect on the viability of plant communities would be negligible.

Under the Reduced Operations Alternative, there would be no effect to the Federally endangered peregrine falcon, as discussed in Section 5.3.5. It is not anticipated that there would be adverse effects to the viability of populations of any sensitive species.

Potential contaminant loads due to this alternative impacting plants and animals would be expected to be smaller than under the No Action Alternative and continue to be negligible based on annual ecological monitoring data (SNL/NM 1997u). See Section 5.5.3 for a discussion of contaminant loads and geology and soils impacts.

5.5.6 Cultural Resources

Implementation of the Reduced Operations Alternative would have low to negligible impacts to cultural resources due to 1) the absence of cultural resource sites on DOE-administered land, 2) the nature of the cultural resources found in the ROI (see Appendix C), 3) compliance with applicable regulations and established procedures for the protection and conservation of cultural resources located on lands administered by the DOE and on lands administered by other agencies and used by the DOE (see Section 4.8.3.2 and Chapter 7), and 4) the nature of SNL/NM activities near cultural resources. Implementation of the regulations and procedures would make unlikely any adverse impacts resulting from construction, demolition, decontamination, renovation, or ER Project activities.

Under the Reduced Operations Alternative, prehistoric and historic cultural resources could potentially be affected by activities performed at five SNL/NM facilities, although the potential for impact would be low to negligible. These facilities consist of the Aerial Cable Facility, Lurance Canyon Burn Site, Thunder Range, Sled Track Complex, and Terminal Ballistics Complex. The first three facilities are located on land not owned by the DOE. Impacts could potentially result from three activities at these facilities: production of explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires and fire suppression. A decrease in the frequency of these activities under the Reduced Operations Alternative would result in a lower potential for impacts than the No Action Alternative.

Another source of potential impact derives from the restricted access present at KAFB and at individual SNL/NM facilities. Restricted access to areas within the ROI would have positive effects on cultural resources themselves. Under the Reduced Operations Alternative, current security levels that restrict access would be maintained for KAFB in general, but would diminish in frequency for specific SNL/NM facilities during various activities due to the reduced frequency of these activities. This would result in a decreased frequency of added protection at SNL/NM facilities for cultural resources.

5.5.7 Air Quality

The implementation of the Reduced Operations Alternative would result in air quality impacts that would be less than or equal to those estimated for the No Action Alternative (see Section 5.3.7). Section 5.5.7.1 describes nonradiological air quality impacts under the Reduced Operations Alternative, and Section 5.5.7.2 describes radiological impacts.

5.5.7.1 Nonradiological Air Quality

The Reduced Operations Alternative reflects minimum levels of activity required to maintain a facility's assigned capability. In some facilities, this alternative includes activity levels that would represent an increase over the base period activity levels (typically 1991 through 1995). In these cases, the activity levels would be those that, during the baseline period, have not been exercised sufficiently to maintain capability or to satisfy assigned theoretical or experimental research and development product requirements of the DOE.

Criteria Pollutants

The criteria pollutants generated under the Reduced Operations Alternative would be less than or equal to those described for the No Action Alternative. The sources of criteria pollutants would include the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and the 600-kw-capacity generator in Building 870b. The criteria pollutant sources represent SNL/NM infrastructure and are not influenced by mission-specific activity levels. These sources would operate at levels comparable to those projected for the No Action Alternative. Table 5.3.7–1 presents the No Action Alternative criteria pollutant concentrations. Although this alternative reflects the minimum activity levels required to maintain a facility's assigned capability, the requirement for heat and emergency electric power would be likely to remain at the No Action Alternative level.

Mobile Sources

Motor vehicle emissions under the Reduced Operations Alternative would include carbon monoxide emissions from decreased commuter traffic. The estimated commuter traffic would be 97 percent of that under the No Action Alternative, or 13,175 commuter vehicles and 582 on-base vehicles. The carbon monoxide emission factor is determined by the EPA mobile source emission factor model *MOBILE5a*, projected to 2005, or 28.5 g per mi (SNL 1996c). Projected carbon monoxide emissions for SNL/NM under the Reduced Operations Alternative, based on the aforementioned assumptions and modeled emission factor, would be 3,385 tons per year, which is 702 tons per year less than the 1996 baseline. Projected carbon monoxide emissions for Bernalillo county for 2005 would be 206 tons per day, or 75,190 tons per year (AEHD 1998). The contribution of carbon monoxide emissions from vehicles commuting to and from SNL/NM and SNL/NM-operated on-base vehicles in 2005 would be 4.5 percent of the total county highway mobile sources carbon monoxide emissions. These estimates represent the Reduced Operations Alternative contribution of carbon monoxide emissions from mobile sources from SNL/NM.

Total carbon monoxide emissions will, therefore, also be less than those presumed for the No Action Alternative; and similarly, the DOE has concluded that no conformity determination is required for the Reduced Operations Alternative.

Lurance Canyon Burn Site

Lurance Canyon Burn Site emissions criteria and chemical pollutants are bounded by the No Action Alternative emissions. Operations at the Lurance Canyon Burn Site would be at or below the level of operations presented for the No Action Alternative. Table 5.3.7–4 presents the criteria pollutant concentrations estimated at the KAFB site boundary for the No Action Alternative level of activity, representing a test using 1,000 gal of JP-8 fuel. For each of the criteria pollutants (carbon monoxide, nitrogen dioxide, PM_{10}, and sulfur dioxide), for each of the averaging times, the modeled concentrations would be less than 5 percent of the applicable national and New Mexico ambient air quality standards. None of the chemical pollutants from tests performed at the facility would result in modeled concentrations above the OEL/100 guideline used to screen the chemical emissions for further analysis. Tests conducted at the Lurance Canyon Burn Site under the Reduced Operations Alternative would result in criteria and chemical pollutant concentrations less than or equal to those under the No Action Alternative.

Chemical Pollutants
(Noncarcinogenic and Carcinogenic)

The estimated chemical usage under the Reduced Operations Alternative would be less than that under the No Action Alternative, resulting in concentrations less than or equal to those presented in Table 5.3.7–6. The usage of chemicals is based on mission activity levels, which for the Reduced Operations Alternative would be less than those under the No Action Alternative level of activity. The estimates of chemical usage for the Reduced Operations Alternative for 5 of the 12 major chemical users range from a factor of 1.0 to 0.2 times the chemical usage for the base year 1996, and less than under the No Action Alternative usage for each facility.

5.5.7.2 Radiological Air Quality

The SWEIS analysis reviewed the radiological emissions from all SNL/NM facilities. Section 4.9.2 identifies 17 SNL/NM facilities as producing radiological emissions. Based on historic SNL/NM radionuclide emissions data, NESHAP compliance reports, and the FSID (SNL/NM 1998ee), 10 of the 17 SNL/NM facilities were modeled for radiological impacts (Table 5.5.7–1). The ACRR would be operated under one of two configurations: medical isotope production (primarily molybdenum-99 production) or DP. However, for the purpose of conservative analysis, the ACRR was evaluated under simultaneous operation of both configurations. For analysis purposes, based on the review of historical dose evaluations, other facilities that would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI were screened from further consideration in the SWEIS. The modeled releases to the environment would result in a calculated dose to the MEI and the population within 50 mi of TA-V. TA-V was selected as a center for the population within a 50-mi radius, because the majority of radiological emissions would be from TA-V, specifically the HCF, and TA-V is historically addressed for annual SNL/NM NESHAP compliance.

The *CAP88-PC* computer model (DOE 1997e) was used to calculate the doses. Details on the *CAP88-PC* model, radionuclide emissions, model and source parameters, exposures, meteorological data, and population data are presented in Appendix D. Figure 5.3.7–3 shows the locations of the 10 facilities modeled in the SWEIS. Table 5.5.7–1 presents the estimated radiological emissions from the 10 SNL/NM facilities under the Reduced Operations Alternative. The radiological emissions from each facility were estimated based on SNL/NM planned operations and tests projected into the future. Detailed information is available in the FSID (SNL/NM 1998ee). The emission of argon-41 from the ACRR, under the medical isotope production configuration, would be lower than during the base year, 1996, because of the refurbishing operations conducted during 1996. The SPR emissions were estimated to be higher than emissions during the base year. This is due to instituting NESHAP requirements for "confirmatory measurements" of radiological air emissions where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emission factors. These measurements are source-specific to the SPR and ACRR and would not affect the calculations or measurements for other facilities.

Because the general public and USAF personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impact evaluations (see Appendix D.2). Based on NESHAP reports, 16 onsite and 6 offsite additional receptor locations were also evaluated. A total of 38 receptor locations were evaluated for dose impacts. The core receptor locations include schools, hospitals, a museum, and clubs, and were considered for analysis because of potential impacts to children, the sick, and the elderly. The 32 modeled onsite and core receptor locations are shown in Figure 5.3.7–4.

The dose to an individual at each receptor and to the population within 50 mi from the radionuclide emissions from each source was calculated using the *CAP88-PC* model. The receptor receiving the maximum dose was identified as the MEI. The model-calculated dose contributions, including external, inhalation, and ingestion from each of the 10 sources, calculated individually at each receptor location, were combined to determine the overall SNL/NM site-wide normal operations dose to the MEI. Under the Reduced Operations Alternative, the maximum EDE to the MEI from all exposure pathways from all modeled sources was calculated to be 0.020 mrem per year. This MEI having the highest combined dose would be located at the Eubank gate area, offsite of SNL/NM. The EDE contributions from these 10 sources to this combined MEI dose are presented in Table 5.5.7–2. Table 5.5.7–3 presents the doses to 38 onsite, core, and offsite receptor locations. The potential doses for these additional locations would be much lower than the highest

Table 5.5.7–1. Radiological Emissions from Sources at SNL/NM Under the Reduced Operations Alternative

FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	RELEASE (Ci/year)
Annular Core Research Reactor (ACRR, medical isotopes production configuration), Building 6588	V	Argon-41 Tritium	0.24 0.24
Explosive Components Facility (ECF), Building 905	II	Tritium	2.0×10^{-3}
High-Energy Radiation Megavolt Electron Source (HERMES III), Building 970	IV	Nitrogen-13 Oxygen-15	1.0×10^{-4} 1.0×10^{-5}
Hot Cell Facility (HCF), Building 6580	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	0.117 0.3 0.54 0.022 0.33 19.8 0.019 29.0 5.7 48.0 0.18 216.0 10.2 207.0 36.0
Mixed Waste Landfill (MWL)	III	Tritium	0.29
Neutron Generator Facility (NGF), Building 870	I	Tritium	156
Radioactive and Mixed Waste Management Facility (RMWMF), Building 6920	III	Tritium	2.203[b]
Radiographic Integrated Test Stand (RITS), Building 970	IV	Nitrogen-13	0.02
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	2.85

Source: SNL/NM 1998a
Ci/year: Curies per year
DP: Defense Programs
SNL/CA: Sandia National Laboratories/California

[a] Radiological emissions are projections based on planned activities, projects, and programs. Radionuclide releases are not the same as those presented in Chapter 4.
[b] Because SNL/CA tritium-contaminated oil levels handled at RMWMF during the base year were abnormally high, this maximum level of emissions was assumed to be released in any year and, therefore, was constant for all alternatives.

Table 5.5.7–2. Summary of Dose Estimates to SNL/NM Public Under the Reduced Operations Alternative from Radioactive Air Emissions

SOURCE	ANNUAL MEI DOSE, EDE (mrem)	ANNUAL POPULATION DOSE, person-rem
Annular Core Research Reactor (ACRR, medical isotopes production configuration)	7.1×10^{-6}	1.2×10^{-3}
Explosive Components Facility (ECF)	1.9×10^{-8}	4.19×10^{-7}
High-Energy Radiation Megavolt Electron Source (HERMES III)	2.2×10^{-9}	1.7×10^{-8}
Hot Cell Facility (HCF)	2.8×10^{-3}	0.461
Mixed Waste Landfill (MWL)	4.9×10^{-6}	6.16×10^{-4}
Neutron Generator Facility (NGF)	1.7×10^{-2}	0.322
Radioactive and Mixed Waste Management Facility (RMWMF)	1.9×10^{-5}	3.24×10^{-3}
Radiographic Integrated Test Stand (RITS)	4.5×10^{-7}	3.4×10^{-6}
Sandia Pulsed Reactor (SPR)	3.1×10^{-5}	7.6×10^{-3}
TOTAL MEI DOSE	$\mathbf{2.0\times10^{-2}}$	-
50-MILE POPULATION COLLECTIVE DOSE	-	**0.80**

Sources: DOE 1997e, SNL/NM 1998a
DP: Defense Programs
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem

Note: Although the Annular Core Research Reactor is expected to be operated under DP configuration intermittently, for this analysis, it was assumed to be operated continuously in conjunction with molybdenum-99 production. Its contribution to the total dose would not be appreciable.

Table 5.5.7–3. Summary of Dose Estimates From Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Reduced Operations Alternative

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
ONSITE AND NEAR-SITE RECEPTORS	
Albuquerque International Sunport (Bldg. 1064)	3.6×10^{-3}
Albuquerque International Sunport (Bldg. 760)	5.4×10^{-3}
Building 20706	7.8×10^{-3}
Building 24499	7.5×10^{-3}
Child Development Center-East	5.1×10^{-3}
Child Development Center-West	2.6×10^{-3}
Civil Engineering Research Facility (Bldg. 5701)	1.4×10^{-3}
Coronado Club	5.7×10^{-3}
Coyote Canyon Control Center	1.4×10^{-3}
Golf Course Clubhouse	7.9×10^{-3}
Golf Course Maintenance Area	5.5×10^{-3}
Kirtland Elementary School	2.5×10^{-3}
KAFB Firestation #4 (Bldg. 9002)	1.9×10^{-3}
KAFB Landfill	5.0×10^{-3}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	1.6×10^{-2}
Loop Housing	8.4×10^{-3}
Lovelace Hospital	2.8×10^{-3}
Lovelace Respiratory Research Institute	1.4×10^{-3}
Manzano Offices (Fire Station)	3.8×10^{-3}
Maxwell Housing	2.2×10^{-3}
National Atomic Museum	9.0×10^{-3}
Pershing Park Housing	4.9×10^{-3}
Riding Stables	6.8×10^{-3}
Sandia Base Elementary	4.1×10^{-3}
Sandia Federal Credit Union	1.4×10^{-2}
Shandiin Day Care Center	6.3×10^{-3}
Technical Onsite Inspection Facility	6.8×10^{-3}
Veterans Affairs Medical Center	4.0×10^{-3}
Wherry Elementary School	4.5×10^{-3}

Table 5.5.7–3. Summary of Dose Estimates From Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Reduced Operations Alternative (concluded)

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
Zia Park Housing	5.8×10^{-2}
OFFSITE RECEPTORS	
Albuquerque City Offices	1.5×10^{-2}
East Resident	1.1×10^{-2}
Eubank Gate Area (Bldg. 8895)	2.0×10^{-2}
Four Hills Subdivision	1.0×10^{-2}
Isleta Gaming Palace	1.1×10^{-2}
Northeast Resident	1.2×10^{-2}
Seismic Center (USGS)	1.1×10^{-2}
Tijeras Arroyo (West)	1.5×10^{-2}

Sources: DOE 1997e, SNL/NM 1998a
EDE: effective dose equivalent
mrem: millirem
USGS: U.S. Geological Survey

combined MEI dose. Under the Reduced Operations Alternative, the total collective dose to the population of 732,523 within a 50-mi radius of TA-V was calculated to be 0.80 person-rem per year. The contributions from all of the 10 modeled sources to the overall SNL/NM site-wide normal operations collective dose to the population within 50 mi are also presented in Table 5.5.7–2. The average dose to an individual in the population within 50 mi of TA-V (collective dose divided by the total population) would be 1.1×10^{-3} mrem per year.

The calculated total MEI dose of 0.020 mrem per year (see Table 5.5.7–2) would be much lower than the regulatory limit of 10 mrem per year to an MEI from SNL/NM site-wide total airborne releases of radiological materials (40 CFR Part 61). This dose would be small compared to an individual background radiation dose of 360 mrem per year (see Figure 4.10–2). The calculated collective dose from SNL/NM operations to the population within 50 mi of TA-V would be 0.80 person-rem per year, which would be much lower than the collective dose from background radiation. Based on this individual radiation dose, the population within 50 mi of TA-V would receive 263,700 person-rem per year.

5.5.8 Human Health and Worker Safety

The implementation of the Reduced Operations Alternative would result in human health and worker safety impacts for normal and accident conditions, as detailed in the following sections.

5.5.8.1 Normal Operations

This section provides information on public health and worker health and safety under the Reduced Operations Alternative. It assesses the potential human health effects associated with routine releases of radioactive and nonradioactive hazardous material from normal SNL/NM operations. For detailed discussions of analytical methods and results along with terminology, definitions, and descriptions, see Appendix E.

Health risk analyses are presented for potential exposures at specific receptor locations and for the potential maximum exposures to radiation and chemical air releases. For a description of receptor locations, exposure scenarios, and environmental pathways selected for assessing human health impacts, see Section 5.3.8.

Chemical Air Release Pathways

Under the Reduced Operations Alternative, chemical use would be less than the quantities anticipated under the No Action Alternative. Therefore, the exposure to receptors would also decrease. Potential exposure concentrations of chemicals under the Reduced Operations Alternative are estimated and shown in Appendix E, Table E.3–4. The chemical assessment process, described in Section 5.3.8 for chemical air release pathways, identified seven COCs under the Reduced Operations Alternative. Several of the COCs are common among the three facilities. These COCs are associated with SNL/NM operations in Buildings 878 (AMPL), 897 (IMRL), and 870 (NGF).

The health risk and corresponding potential for adverse health effects from airborne exposures to chemicals is a range of values. Several receptor locations, individual exposure scenarios, and a hypothetical worst-case exposure scenario were used to represent this range. Adult, child, residential, and visitor risk assessments were calculated. Table 5.5.8–1 lists the human health impacts from the estimated exposures to chemical air releases from SNL/NM facility operations. These potential health risks would be low and no adverse health effects would occur at these risk levels. Assessing the hypothetical worst-case exposure scenario for chemicals establishes the upper limit (bounding value) to health risk. Under the Reduced Operations Alternative, the upper bound value for health risk from noncarcinogenic chemicals would be HIs of less than 1; from carcinogenic chemicals, the ELCRs would be less than 10^{-6} (see Table E.6–5).

Radiation Air Release Pathways

Under the Reduced Operations Alternative, air releases of radionuclides would be lower than those projected under the No Action Alternative. Section 5.5.7 identifies these lower doses to the MEI and the population within the ROI. Radiological health effects would also be lower under the Reduced Operations Alternative. The greatest dose resulting from the SNL/NM yearly air release of radionuclides would occur offsite at the Eubank gate and would increase the lifetime risk of fatal cancer to the MEI by $1.0x10^{-8}$. This means that the likelihood of fatal cancer to the MEI from a 1-year dose from SNL/NM normal operations would be less than 1 chance in 100 M. The annual collective dose to the population due to these releases would increase the annual number of fatal cancers in the entire population within the ROI by $4.0x10^{-4}$. Therefore, no additional LCFs would be likely to occur in the ROI due to SNL/NM radiological air releases.

To estimate a range in the potential for human health effects, radiation doses at specific receptor locations such as schools, hospitals, and daycare centers in the SNL/NM vicinity were calculated. These doses are identified in Table 5.5.7–3. Radiological health risks associated with the doses to receptors at several of these locations are presented in Table 5.5.8–2. The risk from radiation at these receptor locations would be much lower than the highest risk determined for the MEI receptor offsite at the Eubank gate.

Receptors in the SNL/NM vicinity would also have the potential to be exposed to radionuclides by way of the indirect air pathway of ingesting food that contains radionuclides. *CAP88-PC* integrates doses from this pathway in the collective dose estimation for the population within the ROI, but does not integrate it to the dose evaluation for the potential onsite MEI receptor. The estimated percentage of the population dose from ingesting potentially contaminated food would be 18 percent (0.101 person-rem of the 0.80 person-rem collective population dose) which means it would also account for approximately 18 percent of the health risk value. When the same percent contribution is assumed, the potential onsite MEI's lifetime risk of fatal cancer from a 1-year dose would be increased by $1.0x10^{-9}$ (18 percent) under the Reduced Operations Alternative. Overall, the cancer risk to the MEI from radiation would remain less than 1 chance in 100 M.

Nonfatal Cancers and Genetic Disorders

Radiation exposures can cause nonfatal cancers and genetic disorders. The NCRP has adopted risk estimators developed by the ICRP for the public assessing these health effects from radiation (ICRP 1991). Under the Reduced Operations Alternative, SNL/NM's maximum annual dose to the MEI would increase the lifetime risk of nonfatal cancers and genetic disorders by $1.6x10^{-9}$ and $2.1x10^{-9}$, respectively, which would be less than 1 chance in 475 M. The SNL/NM annual collective dose to the ROI population would increase the number of nonfatal cancers and genetic disorders by $8.0x10^{-5}$ and $1.0x10^{-4}$, respectively. This means that no additional nonfatal cancers or genetic disorders would be likely to occur in the ROI population from SNL/NM radiological air releases.

Transportation

The potential human health risks and accident fatalities for transporting various radiological materials for SNL/NM operations are discussed in Section 5.5.9. The radiological dose to the population along the route within the ROI was estimated by assuming 10 percent of the total travel distance would occur within the ROI. Therefore, 10 percent of the total radiological dose (off link and on link) calculated for all radiological materials transport would be considered as an additional human health impact to the population along the route within the ROI (see Appendix G). This percentage of the annual collective dose to the population along the route due to transportation activities would increase the ROI number of LCFs by $2.0x10^{-4}$. Adding this to the number of LCFs associated

Table 5.5.8–1. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the Reduced Operations Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
RESIDENTIAL SCENARIOS			
Four Hills Subdivision[a]	Adult	<0.01/<0.01	$1.8 \times 10^{-11}/1.1 \times 10^{-11}$
	Child	<0.01/<0.01	$7.4 \times 10^{-12}/7.4 \times 10^{-12}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.7 \times 10^{-10}/1.7 \times 10^{-12}$
	Child	<0.01/<0.01	$1.2 \times 10^{-10}/1.3 \times 10^{-12}$
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$3.6 \times 10^{-10}/3.8 \times 10^{-12}$
	Child	<0.01/<0.01	$2.5 \times 10^{-10}/2.9 \times 10^{-12}$
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$3.4 \times 10^{-10}/3.9 \times 10^{-12}$
Child Development Center-West	Child	<0.01/<0.01	$6.7 \times 10^{-11}/7.6 \times 10^{-13}$
Coronado Club	Adult	<0.01/<0.01	$5.9 \times 10^{-10}/6.0 \times 10^{-12}$
	Child	<0.01/<0.01	$4.1 \times 10^{-10}/4.6 \times 10^{-12}$
Golf Course (Clubhouse)	Adult	<0.01/<0.01	$1.9 \times 10^{-11}/1.9 \times 10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$5.5 \times 10^{-11}/6.2 \times 10^{-13}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)[b]	Adult	<0.01/<0.01	$1.8 \times 10^{-10}/1.8 \times 10^{-12}$
Lovelace Hospital	Adult	<0.01/<0.01	$1.6 \times 10^{-10}/1.7 \times 10^{-12}$
	Child	<0.01/<0.01	$1.1 \times 10^{-10}/1.3 \times 10^{-12}$
National Atomic Museum	Adult	<0.01/<0.01	$9.9 \times 10^{-10}/1.0 \times 10^{-11}$
	Child	<0.01/<0.01	$6.9 \times 10^{-10}/7.8 \times 10^{-12}$
Riding Stables	Adult	<0.01/<0.01	$9.7 \times 10^{-11}/1.0 \times 10^{-12}$
Sandia Base Elementary School	Child	<0.01/<0.01	$4.7 \times 10^{-10}/5.3 \times 10^{-12}$
Shandiin Day Care Center	Child	<0.01/<0.01	$3.7 \times 10^{-10}/4.2 \times 10^{-12}$
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$1.6 \times 10^{-10}/1.6 \times 10^{-12}$
Wherry Elementary School	Child	<0.01/<0.01	$2.5 \times 10^{-10}/2.8 \times 10^{-12}$

Source: SmartRISK 1996
AEI: average exposed individual
RME: reasonable maximum exposed
[a] Four Hills Subdivision receptor location impacts were based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions.
[b] This receptor location was analyzed using a worker scenario, as discussed in Appendix E.5.
Note: See Section 5.3.8 for a discussion of selection of receptor locations.

Table 5.5.8–2. Human Health Impacts in the SNL/NM Vicinity from Radiological Air Emissions Under the Reduced Operations Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	$2.6x10^{-9}$
Child Development Center-West	$1.3x10^{-9}$
Coronado Club	$2.9x10^{-9}$
Four Hills Subdivision	$5.0x10^{-9}$
Golf Course (Clubhouse)	$4.0x10^{-9}$
Kirtland Elementary School	$1.3x10^{-9}$
KAFB Housing (Zia Park Housing)	$2.9x10^{-9}$
Kirtland Underground Munitions & Maintenance Storage Complex (KUMMSC)[a]	$8.0x10^{-9}$
Lovelace Hospital	$1.4x10^{-9}$
National Atomic Museum	$4.5x10^{-9}$
Riding Stables	$3.4x10^{-9}$
Sandia Base Elementary School	$2.1x10^{-9}$
Shandiin Day Care Center	$3.2x10^{-9}$
Isleta Gaming Palace	$5.5x10^{-9}$
Veterans Affairs Medical Center	$2.0x10^{-9}$
Wherry Elementary School	$2.3x10^{-9}$

Sources: DOE 1997e, SNL/NM 1998a
MEI, maximally exposed individual

[a] The radiological MEI location for normal operations.
Note. Calculations were completed using *CAP88-PC*.

with the annual collective population dose from routine air releases would change the risk to $6.0x10^{-4}$. In other words, no additional LCFs in the ROI population would likely occur from SNL/NM radiological material transportation activities.

Composite Cancer Risk

The increase in lifetime cancer risk due to SNL/NM normal operations is associated with both the small amounts of radionuclides and small amounts of carcinogenic chemicals emitted into the air. The composite cancer risk associated with the Reduced Operations Alternative would be lower than that calculated for either the No Action or Expanded Operations Alternatives. Under those alternatives, the composite cancer risk values calculated would all be within the EPA risk range established for the protection of human health of 10^{-6} to 10^{-4} (40 CFR Part 300). This would be a risk of less than 1 chance in 1 M. The SNL/NM potential contribution to an individual's lifetime cancer risk is very low considering that in the U.S., men have a 1-in-2 lifetime risk and women have a 1-in-3 lifetime risk of developing cancer. One out of every four deaths in the U.S. is from cancer (ACS 1997).

Worker Health and Safety

Under the Reduced Operations Alternative, the worker safety assessment shows impacts would be less than those under the No Action Alternative. Worker health consequences would be the same as those presented in Section 4.10 for the period 1992 through 1996. Tables and figures in Section 4.10 show that for the entire SNL/NM worker population, zero fatalities per year, an average of 47 mrem per year radiation dose (TEDE) to radiation-badged workers, approximately 287 nonfatal injuries and illnesses per year, and 1 or 2 confirmed chemical exposures occurred annually from 1992 through 1996.

Routine air emissions evaluated for potential exposures to specific receptors in the SNL/NM vicinity have the potential to impact noninvolved workers at SNL/NM. A noninvolved worker is not exposed to chemical or radiological work related activities but is potentially exposed because they work at SNL/NM in the vicinity of facility releases. Potential exposures to airborne radiation were identified using the KUMMSC receptor location. Potential exposures to airborne chemicals were identified using a receptor location at the center of TA-I, near SNL/NM's chemical facility sources. Based on an exposure scenario for a worker, health risks from chemicals to the noninvolved worker would be below a HI of 1 and less than 10^{-6} for an ELCR (see Appendix E, Table E.6–5).

The average annual individual worker dose, annual maximum worker dose, and annual workforce collective dose for the radiation workers under the Reduced Operations Alternative are identified in Table 5.5.8–3. Health risks from the annual average individual and annual maximum worker doses would be expected to remain constant for all alternatives (based on the REMS database dose information for 1996). The annual collective dose to the radiation worker population at SNL/NM would be lower than under the No Action Alternative. This would equate to a lower risk of fatal cancer to the radiation worker population under the Reduced Operations Alternative.

Table 5.5.8–3. Radiation Doses (TEDE)[a] and Health Impacts to Workers from SNL/NM Operations Under the Reduced Operations Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY FROM A 1-YEAR DOSE
Annual Average Individual Worker Dose	47[b] (mrem/yr)	$1.9x10^{-5}$
Annual Maximum Worker Dose	845[b] (mrem/yr)	$3.4x10^{-4}$
RADIATION WORKER DOSE RATES	**RADIATION DOSE**	**NUMBER OF LCFs**
Annual Workforce Collective Dose	10 (person-rem/year)	$4.0x10^{-3}$

Source: SNL/NM 1997k

mrem/yr: millirems per year

TEDE: total effective dose equivalent

[a] Average measured TEDE means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.

[b] Annual average individual and annual maximum worker doses would be expected to remain consistent with the base year, 1996 (see Section 4.10).

Note: Because not all badged workers are radiation workers, "radiation workers" means those badges with greater than 10 mrem above background measurements used in the calculations.

Nonfatal Cancers and Genetic Disorders

The SNL/NM maximum annual dose to the radiation worker population would increase the number of nonfatal cancers and genetic disorders by $8.0x10^{-4}$, based on the ICRP dose-to-risk conversion factor for workers of 80 health effects per 1 M person-rem for both effects. In other words, no additional nonfatal cancers or genetic disorders would be likely to occur in the SNL/NM radiation worker population due to operations. The annual average and annual maximum workers dose and associated potential health impacts would remain consistent with 1996 values.

Nonionizing Radiation

Routine high-voltage impacts to SNL/NM and the public would not occur.

5.5.8.2 Accidents

This section describes, under the Reduced Operations Alternative, the potential impacts to workers and the public for accidents involving the release of radioactive and/or chemical materials, explosions, and other hazards. Additional details on the accident analyses and impacts are presented in Appendix F.

Site-Wide Earthquake

An earthquake in the Albuquerque, New Mexico, area has the potential for human injury and building damage throughout the local region. Due to differences in structural design, SNL/NM buildings and structures vary in their capabilities to withstand earthquake forces. Any magnitude earthquake has the potential to cause injury to workers in and around buildings and damage to structures from the physical forces and effects of the earthquake. Additional injury to workers and the public would be possible from explosions and from exposure to chemical and radioactive materials that could be released from buildings and storage containers. Facilities in TA-I are the predominant source of chemical materials that could be released during an earthquake. Facilities in TA-V are the predominant source of radioactive materials that could be released. The ECF in TA-II is the predominant source of explosive materials. Lesser quantities of radioactive materials in TAs-I and -II could also be released and cause exposures to workers and the public.

The UBC specifies different levels of seismic design depending on the location and proposed use of a facility or structure. For office buildings and other nonhazardous use of buildings, the UBC specifies an acceleration of 0.17 *g* for the Albuquerque area. This level seismic design would apply to most buildings in TA-I. For those facilities that would contain radioactive materials, the UBC specifies an acceleration level of 0.22. In the event of an earthquake (UBC, 0.17 *g*), various buildings in TA-I could be affected and various chemicals could be released (see Appendix F, Table F.7–7). Larger magnitude earthquakes could cause more serious impacts. The only dominant chemical that changes among the alternatives is arsine, and it is not released in the earthquake at 0.17 *g* and lesser accelerations. Therefore, failure of facilities at lesser accelerations would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged. The shape and direction of the chemical plumes would depend upon local meteorological conditions and physical structures. The plumes shown on Figure 5.5.8–1 are positioned to reflect the predominant wind direction during daylight hours. The daylight period was chosen to maximize the number of people potentially affected onsite, because more people are working onsite during the daytime than during nighttime periods. The circled area represents the potential area that could be affected by other wind directions. For wind blowing toward the north-northeast, there would be up to 423 people exposed to chemical concentrations above ERPG-2. Existing and known mitigation features designed to limit the release of chemicals from storage containers, rooms, and buildings would limit or reduce plume size, concentration levels, and exposures. Emergency procedures and sheltering would also minimize exposures to workers and the public.

Nuclear facilities in TAs-I, -II, and -V could also be damaged during an earthquake. The frequency of an earthquake (0.17 *g*) that could cause the release of radioactive materials from TAs-I and -II facilities is 1.0×10^{-3} per year, or 1 chance in 1,000 per year. The frequency of an earthquake (0.22 *g*) that could cause the release of radioactive materials from TAs-I (NG-1), -II (ECF-1), and -V facilities is 7.0×10^{-4} per year, or 1 chance in 1,500 per year. The consequences are shown in Table 5.5.8–4. If a 0.22-*g* earthquake was to occur, there would be an estimated 6.4×10^{-2} additional LCFs in the total population within 50 mi of the site, associated with the HC-1 accident scenario. The MEI and noninvolved worker would have an increased probability of LCF of 6.9x10^{-}[illegible] and 3.0x10^{-}[illegible], respectively, associated with the HC-1 accident scenario. The risks for these receptors can be estimated by multiplying these consequence values by the probability (frequency) of earthquake. If a stronger earthquake was to occur, larger releases of radioactive materials would be possible and could cause greater impacts.

A severe earthquake could also cause damage to other SNL/NM facilities and result in environmental impacts. For example, the large quantities of oil stored in external tanks and in accelerator buildings in TA-IV could potentially be spilled and cause impacts to the ecosystem and water resources. Underground natural gas lines could break and ignite causing brush and forest fires that could further damage facilities and persons in the vicinity. Hydrogen storage tanks in TA-I could be damaged, causing hydrogen combustion or explosion and potential injury to persons in the vicinity. Explosives in the ECF in TA-II and smaller quantities in other facilities could also be accidentally detonated during an earthquake with potential injury to persons in the vicinity. Occupants of all facilities would be at risk of injury as a result of the earthquake forces and building damage.

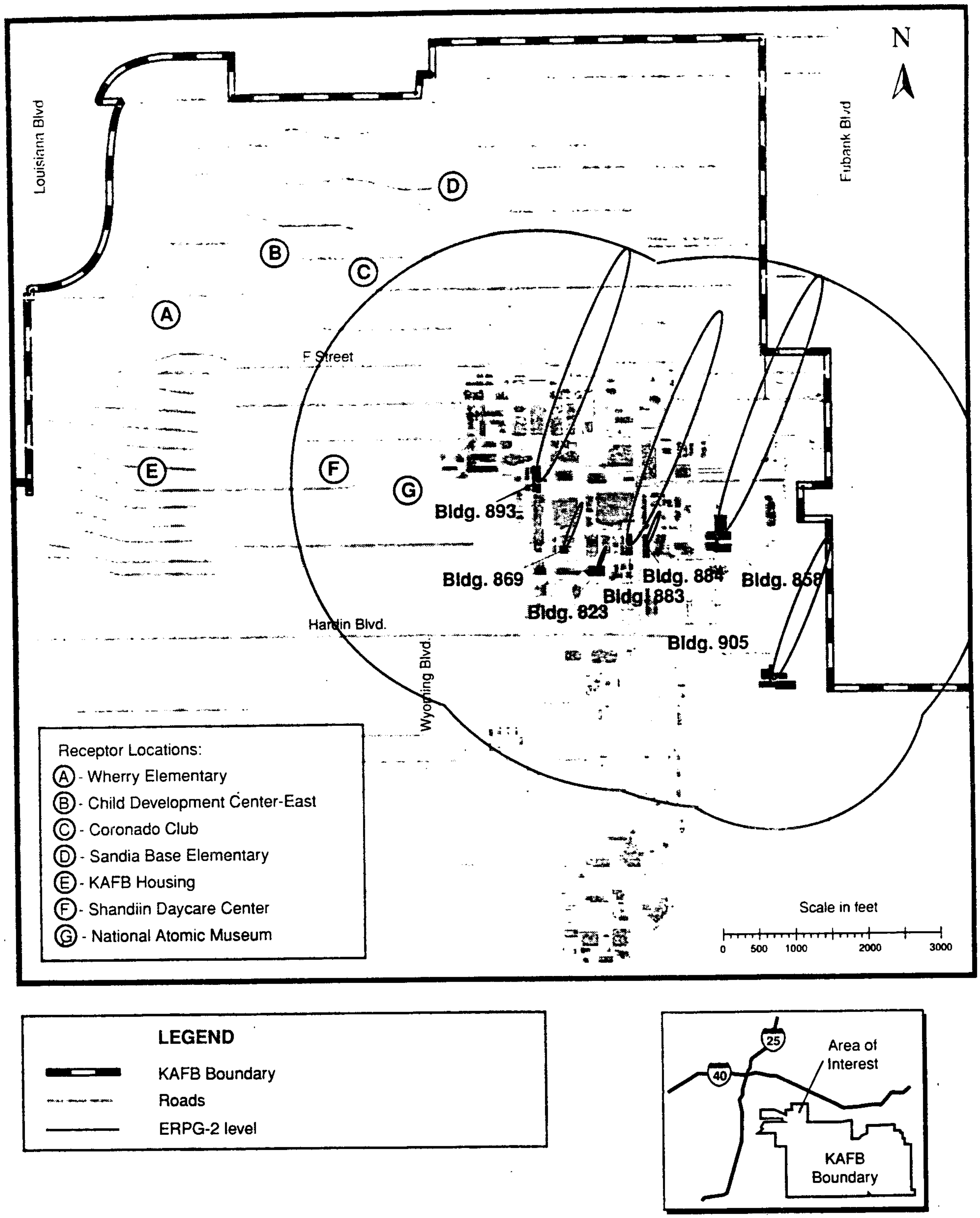
Facility Hazards

Some of the facilities at SNL/NM could contain occupational hazards with the potential to endanger the health and safety of involved workers near an accident. Some of these facilities also contain hazardous materials that, in case of an accident, could endanger the health and safety of people within the immediate vicinity and beyond. These people include noninvolved workers, members of the military assigned to KAFB, and a member of the public located within the KAFB boundary and offsite. Offsite consequences were determined to a 50-mi radius around the affected facility.

operational procedures would be implemented to maintain operations within the authorization basis.

Explosion Accidents

Explosive materials are stored, handled, transported, and used at some SNL/NM facilities. Administrative controls and facility design would help prevent an explosion accident and limit the impacts to personnel, if an accident was to occur. The ECF, for example, contains large quantities of explosives for use in its testing programs. Hydrogen trailers are another large source of



Source: Original
Note: see Appendix F.7, Figure F.7–1

Figure 5.5.8–1. Areas Above Emergency Response Planning Guideline 2 from a Site-Wide Earthquake Under the Reduced Operations Alternative

The circled areas represent locations that could be above ERPG-2, depending upon wind direction.

Table 5.5.8–4. Site-Wide Earthquake Radiological Impacts Under the Reduced Operations Alternative

ACCIDENT ID[a]	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES WITHIN 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
			MAXIMALLY EXPOSED INDIVIDUAL[b]	NONINVOLVED WORKER[c]
TECHNICAL AREA -I				
NG-1	7.0×10^{-4}	5.1×10^{-5}	1.4×10^{-9}	3.2×10^{-6}
TECHNICAL AREA -II				
ECF-1	7.0×10^{-4}	3.0×10^{-6}	1.5×10^{-10}	1.9×10^{-7}
TECHNICAL AREA -V				
AM-2	7.0×10^{-4}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
HC-1	7.0×10^{-4}	6.4×10^{-2}	6.9×10^{-6}	3.0×10^{-2}
SP-1	7.0×10^{-4}	9.2×10^{-3}	5.8×10^{-7}	2.7×10^{-4}

Source: Original (See also Appendix F, Tables F.7–4 and F.7–5)

[a] Facility Accident Descriptors:
Neutron Generator Facility: NG-1
Explosive Component Facility: ECF-1
Annular Core Research Reactor-Medical Isotope Production: AM-2
Hot Cell Facility: HC-1
Sandia Pulsed Reactor: SP-1

[b] The maximally exposed individual would be located at the Golf Course and the consequences can be added.

[c] Because the noninvolved worker is located 100 meters from the release point, the location varies relative to each technical area. Therefore, the consequences to the noninvolved worker can only be added for a given technical area.

Note: The only earthquake radiological accident that changes among alternatives is AR-5, which contributes only 3.9 person-rem to the 150 person-rem population dose. Therefore, failure of facilities at lesser acceleations than 0.22 *g* would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged.

explosive material. There would be approximately five hydrogen trailers parked near facilities or routinely transported to facilities from remote locations.

In the Draft SWEIS, the largest quantity of hydrogen with the highest potential for consequences to both SNL/NM workers and facilities is a set of horizontally mounted cylinders, with a storage capacity of approximately 90,000 SCF, located approximatley east of the CSRL, Building 893, in TA-I. An explosion at the hydrogen storage cylinders near the CSRL was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion were to occur in the relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 61 ft of an explosion could be seriously injured and would have a 50-percent chance of survival. Involved workers out to a distance of 126 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance.

Based on additional information gathered since the Draft SWEIS was published, the Final SWEIS bounding facility explosion would be in a cryogenic tank with a storage capacity of approximately 493,000 SCF, located northwest of MDL, Building 858, in TA-I. An explosion at the cryogenic tank was selected for detailed analysis to estimate the bounding impacts of an explosion accident.

If a hydrogen explosion were to occur in the relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 101 ft of an explosion could be seriously injured and would have a 50-percent chance of survivial. Involved workers out to a distance of 210 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance, as shown in Table 5.5.8–5.

The actual number of persons in the vicinity of the accident depends upon many factors and the actual number of potential fatalities is uncertain. Factors include the time of day (start of work day, lunchtime, after hours), the actual location of the people (amount of shielding between the hydrogen tank and the person), and the actual spread of the pressure waves in a very complex arrangement of buildings, alleys, and walkways.

Table 5.5.8–5. Impacts of an Explosion Accident Under the Reduced Operations Alternative

P_r (psi)	PHYSICAL EFFECTS	DISTANCE (ft)	
		472-lb TNT	2203-lb TNT
50	50% survival rate for pressures in excess of 50 psi	61	101
10	50% rate of eardrum rupture and total destruction of buildings for pressures in excess of 10 psi	126	210
2.0	Pressures in excess of 2-3 psi will cause concrete or cinder block walls to shatter.	370	617
1.0	Pressures in excess of 1 psi will cause a house to be demolished.	657	1,096

Source: Original, DOE 1992b (See also Appendix F, Table F.4–1)
ft: feet
lbm: pound mass
psi: pounds per square inch
TNT: trinitrotoluene

This bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen, stored in a tank outside the MDL building, caused by human errors (such as mishandling activities) or equipment failures (such as a pipe joint failure) and the presence of an ignition source (such as a spark) near the location of release. Because multiple failures would have to occur for an uncontrolled release of hydrogen to lead to an explosion, this accident scenario would be extremely unlikely (that is, between $1x10^{-6}$ and $1x10^{-4}$ per year).

The human organs most vulnerable to shock explosions are the ears and lungs because they contain air or other gases. The damage would be done at the gas-tissue interface, where flaking and tearing could occur. Both the ear and the lung responses would be dependent not only on the overpressure, but also on impulse and body orientation. The shorter the pulse width, the higher the pressure the body could tolerate. An overpressure of approximately 50 psi would result in a 50 percent fatality rate; approximately 10 psi would result in eardrum rupture. These overpressure estimates are based on a square pressure wave with a pulse duration greater than 10 msec, and their effects could vary depending on body orientation to the pressure wave.

Structural damage produced by air blasts would depend on the type of structural material. An overpressure on the order of 1 psi would cause partial demolition of houses (rendering them uninhabitable). An overpressure of 2 to 3 psi would shatter unreinforced concrete or cinder block walls shattering; An overpressure of 10 psi would probably cause total destruction of buildings.

Radiological Accidents

The largest quantities of radioactive materials at risk for radiological accidents are located in TA-V. The Manzano Waste Storage Facilities, and TAs-I, -II, and -IV also contain radioactive material, but in smaller amounts. The nuclear facilities in TA-V include the ACRR, SPR, HCF and GIF. The NGIF is under construction in TA-V. The planned primary use of the ACRR is medical isotope production (primarily molybdenum-99). The HCF has been reconfigured for medical isotope production, and the accidents analyzed reflect this mode of operation. Accidents have also been analyzed for storage of radioactive materials in the HCF not associated with molybdenum-99 production.

The most serious radiological accident impacts associated with SNL/NM facilities under the Reduced Operations Alternative are shown in Table 5.5.8–6. The table lists a set of accidents and their consequences in terms of an increased probability of an LCF for an exposed individual and an increased number of LCFs for the offsite population. Other radiological accidents could also occur at these facilities, but their impacts would be within the envelope of the selected set of accidents.

The accident at a single facility with the highest consequences to the public would be a fire in Room 108 at the HCF in TA-V (HS-2). If this accident was to occur, there would be $7.9x10^{-2}$ additional LCFs in the offsite population within 50 mi of the site. There would be an increased probability of an LCF for an MEI and a noninvolved worker of $6.6x10^{-6}$ and $7.4x10^{-6}$, respectively. The estimated frequency of occurrence for this accident would be $2.0x10^{-7}$ per year, or less than 1 chance in 5,000,000 per year. Involved workers run the

Table 5.5.8–6. Potential Impacts of Radiological Facility Accidents Under the Reduced Operations Alternative

FACILITY	ACCIDENT ID[a]	SCENARIO	FREQUENCY PER YEAR	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Annular Core Research Reactor-medical isotopes production configuration	***AM-1***	Airplane crash - collapse of bridge crane	$6.3x10^{-6}$	$2.0x10^{3}$	$2.4x10^{7}$	$7.4x10^{5}$
	AM-3	Rupture of waterlogged fuel element	$1.0x10^{-2}$ to $1.0x10^{4}$	$4.9x10^{4}$	$5.4x10^{-8}$	$3.8x10^{6}$
	AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{6}$	$3.9x10^{-4}$	$4.3x10^{-8}$	$3.0x10^{6}$
	AM-5	Fuel handling accident - irradiated element	$1.0x10^{4}$ to $1.0x10^{-6}$	$4.9x10^{-3}$	$6.1x10^{7}$	$7.6x10^{5}$
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3x10^{6}$	$1.6x10^{-6}$	$1.0x10^{-10}$	$4.9x10^{8}$
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0x10^{-6}$	$3.9x10^{-4}$	$4.9x10^{8}$	$1.4x10^{5}$
Hot Cell Facility-medical isotopes production	***HM-1***	Operator error - molybdenum-99 target processing	$1.0x10^{1}$ to $1.0x10^{2}$	$3.8x10^{-5}$	$3.3x10^{9}$	$1.6x10^{7}$
	HM-2	Operator error - iodine-125 target processing	$1.0x10^{-1}$ to $1.0x10^{2}$	$1.6x10^{-6}$	$1.0x10^{10}$	$4.2x10^{9}$
	HM-4	Fire in glovebox	$1.0x10^{2}$ to $1.0x10^{-4}$	$2.6x10^{3}$	$2.4x10^{7}$	$2.3x10^{6}$
Hot Cell Facility-Room 108 Storage	***HS-1***	Fire in room 108, average inventories	$3.3x10^{5}$	$2.1x10^{3}$	$1.8x10^{7}$	$2.0x10^{7}$

Table 5.5.8–6. Potential Impacts of Radiological Facility Accidents Under the Reduced Operations Alternative (concluded)

FACILITY	ACCIDENT ID[a]	SCENARIO	FREQUENCY PER YEAR	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Hot Cell Facility-Room 108 Storage (continued)	***HS-2***	Fire in room 108, maximum inventories	2.0×10^{7}	7.9×10^{2}	6.6×10^{6}	7.4×10^{6}
Sandia Pulsed Reactor	***S3M-2***	Control-element misadjustment before insert	1.0×10^{4} to 1.0×10^{6}	1.2×10^{3}	1.5×10^{7}	2.5×10^{4}
	S3M-3	Failure of a fissionable experiment	1.0×10^{4} to 1.0×10^{6}	7.9×10^{3}	8.4×10^{7}	3.8×10^{3}
	SS-1	Airplane crash into North Vault storage vault	6.3×10^{6}	9.2×10^{3}	5.8×10^{7}	5.5×10^{4}

Source: Original
ACRR: Annular Core Research Reactor
SPR: Sandia Pulsed Reactor
TA: technical area
[a] TA-V Facility Accident Descriptors:
ACRR - Medical Isotope Production: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell - Medical Isotope Production: HM-1, HM-2, HM-4
Hot Cell - Room 108 Storage: HS-1, HS-2
SPR: S3M-2, S3M-3, SS-1

highest risk of injury or fatality in case of many radiological accidents discussed in this section, as well as the many others that could occur. Although there are protective measures and administrative controls to protect involved workers, they are usually in the immediate vicinity of the accidents where they could be exposed to radioactivity. Accident scenarios for the Reduced Operations Alternative are described in Section 5.3.8.2.

The impacts of accidents have also been analyzed for other receptors located on the KAFB site. The impacts to all other receptors would be less than for the MEI. Details on the impacts to the core receptors are provided in Appendix F.2.

Chemical Accidents

Many SNL/NM facilities store and use a variety of hazardous chemicals. For the chemical with the highest RHI in a building, a catastrophic accident and total release of the building inventory was postulated as the bounding event and estimates were made of the chemical's concentrations at various distances from the accident. The results are shown in Table 5.5.8–7. "Building inventory values are shown for the source term release to reflect the variability and uncertainty in the actual amount of the chemical that could be present at the time of an accident. Similarly, estimates are shown for the range of distances within which the ERPG-2 would be exceeded. The ERPG-2 is an accepted guideline for public exposure (see Appendix F.3 for the description of the various ERPG levels).

In the event of a severe chemical accident in TA-I, involved workers, noninvolved workers, KAFB personnel, onsite residents, and onsite and offsite members of the public would be at risk of being exposed to chemical concentrations in excess of ERPG-2 levels. The number of individuals at risk is shown in Table 5.5.8–8. The actual number exposed would depend on the time of day, location of people, wind conditions, and other factors.

As shown in Table 5.5.8–7, the dominant chemical accident would be a catastrophic release of arsine from Building 893 in TA-I. If the building inventory of 65 lb of arsine was released, individuals within a distance of 6,891 ft from the point of release would receive exposures that exceed the ERPG-2. Figure 5.5.8–2 illustrates the KAFB locations that would be affected by chemical accident scenarios involving the release of arsine or chlorine from Buildings 893 and 858, respectively.

The plumes on the figure correspond to the areas within which the ERPG-2 would be exceeded. Some individuals within the ERPG-2 plume, close to the release point, could experience or develop irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. For any release, the seriousness of any exposure would generally decrease for distances further from the point of release.

In case of an aircraft crash or earthquake involving buildings with various chemical inventories, multiple chemicals would be released and could mix and interact. Although the impacts of mixed chemicals could be greater than individual chemicals, their behavior, dispersion, and health effects can be complex and have therefore, not been considered quantitatively. An earthquake could also cause the release of like chemicals from multiple buildings and lead to increased concentration where individual plumes overlap. The potential and impacts for overlapping plumes are discussed in Appendix F.3.

Other Accidents

Other types of potential accidents have been identified whose impacts are not measured in terms of LCFs or chemical concentrations. These could cause serious injury or fatality for humans or impacts to the nonhuman environment such as the ecology, historical sites, or sensitive cultural sites.

- *Brush Fires*—Small fires are expected and planned for during outdoor testing that involves propellants and explosives. The potential exists for brush and forest fires when hot test debris or projectiles come in contact with combustible elements in the environment. One such incident was reported in 1993 in TA-III when a rocket motor detonated during a sled track impact test and resulted in a 40-ac brush fire. Another accident occurred at the Aerial Cable Facility in the Coyote Test Field, which resulted in a fire that swept up the side of a mountain before being extinguished by SNL/NM workers. Many others have also occurred that were contained in the immediate vicinity of the test area. Measures would be taken to prevent fires and, should a fire occur, the effects would be reduced by activating fire fighting facilities in the test area (DOE 1995a, SNL/NM 1993d, SNL/NM 1998i).
- *Natural Phenomena*—Naturally occurring events such as tornadoes, lightning, floods, and heavy snow, as documented in existing SNL/NM safety documentation, were considered for their potential to

Table 5.5.8–7. Potential Impacts of Chemical Accidents Under the Reduced Operations Alternative

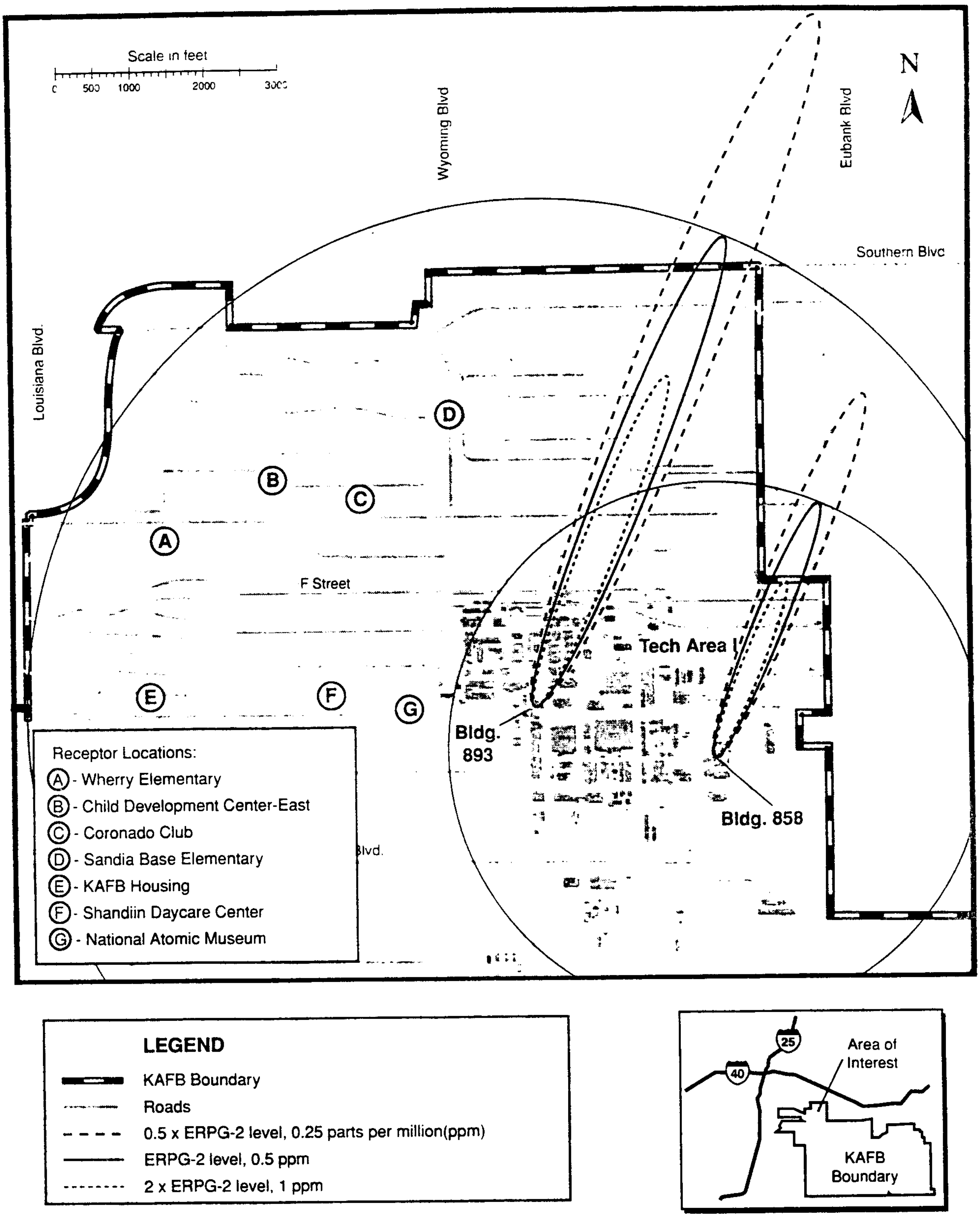
BUILDING	CHEMICAL	BUILDING INVENTORY SOURCE TERM (lb)	ERPG-2 LEVEL OF CONCERN (ppm)	EXCEEDANCE DISTANCE (ft)	FREQUENCY[a] (PER YEAR)
823	Nitrous oxide	32.17	125	351	1.0×10^{3} to 1.0×10^{4}
858	Chlorine	106.4	3	3,726	1.0×10^{3} to 9.7×10^{5}
869	Nitric acid	18.6	15	666	1.0×10^{3} to 1.0×10^{4}
878	Nitrous oxide	50	125	426	1.0×10^{3} to 3.2×10^{5}
880	Hydrofluoric acid	2	20	NR	1.0×10^{3} to 1.0×10^{4}
883	Phosphine	6.8	0.5	3,357	1.0×10^{3} to 1.0×10^{4}
884	Hydrofluoric acid	10	20	504	1.0×10^{3} to 1.0×10^{4}
888	Fluorine	0.07	1	NR	1.0×10^{3} to 1.0×10^{4}
893	Arsine	65	0.5	6,891	1.0×10^{3} to 1.0×10^{4}
897	Chlorine	4.4	3	699	1.0×10^{3} to 6.6×10^{5}
905	Thionyl chloride	101.1	5	2,067	1.0×10^{3} to 9.0×10^{5}

Source: Original (See also Appendix F, Tables F.3–4 and F.5–2)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pounds
NR: Not reported; the model did not provide a plume footprint due to near-field unreliability. No population estimates are available.
ppm: parts per million
TA: technical area
[a]Frequency ranges from 1.0×10^{3} for an earthquake in TA-I to 1.0×10^{4} for an aircraft crash into a generic building in TA-I, or a lower number based on an aircraft crash described in Appendix F.5.
823 Systems Research and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Tandem Van der Graaf Generator
888 Lightening Simulation Facility Laboratory
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Component Facility

Table 5.5.8–8. Impacts of Chemical Accidents on Individuals Within KAFB

BUILDING	CHEMICAL NAME	RELEASE (lb)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)	NUMBER OF PEOPLE WITHIN ERPG-2
823	Nitrous oxide	32.17	351	2
858	Chlorine	106.41	3,726	141
869	Nitric acid	18.6	666	6
878	Nitrous oxide	50	438	3
880	Hydrofluoric acid	2	NR	NR
883	Phosphine	6.8	3,357	100
884	Hydrofluoric acid	10	504	2
888	Fluorine	0.07	NR	NR
893	Arsine	65	6,891	409
897	Chlorine	4.4	699	5
905	Thionyl chloride	101.1	2,067	55

Source: Original [See also Appendix F, Table F.3–6]
ALOHA: Areal Locations of Hazardous Atmospheres (model)
ERPG: Emergency Response Planning Guideline
NR: Not reported, the model did not provide a plume footprint due to near-field unreliability estimates
ft: feet
lb: pound
823 Systems Research and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Tandem Van der Graaf Generator
888 Lightning Simulation Facility Laboratory
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility



Source: Original
Note: see Appendix F.3, Table F.3–4

Figure 5.5.8–2. Areas above Emergency Response Planning Guideline 2 from Accidental Releases of Arsine (Building 893) and Chlorine (Building 858)

The circled areas represent locations that could be above ERPG-2, depending on wind direction, for an accidental release of arsine (Building 893) or chlorine (Building 858) under the Reduced Operations Alternative.

initiate the accidental release of radioactive, chemical, and other hazardous materials that affect workers and the public. Any of these events, should they occur, could also lead to serious injury or fatality because of the physical and destructive forces associated with the events. The risks of such events to workers and the public would be equivalent to everyday risks from naturally occurring events to the general public wherever they work and reside.

- *Spills and Leaks*—The potential would exist throughout SNL/NM for the accidental spill of radioactive, chemical, or other hazardous materials. The effects of such spills on workers and the public through airborne pathways were considered earlier in this section. The impacts from pathways other than airborne would normally be bounded by exposure from airborne pathways. Any spill of a hazardous substance would have the potential for impacts to the nonhuman elements of the environment. A spill could make its way into surface and groundwater systems, affecting water quality and aquatic life. Spills of flammable substance could cause fires that damage plant and animal life and other land resources. There have been spills of hazardous substances at the SNL/NM site that had the potential to affect the nonhuman elements of the environment. In 1994, over 100 gal of oil were spilled at the Centrifuge Complex in TA-III when a hydraulic pump failed during a centrifuge test causing a potential impact to the nonhuman elements of the environment. In addition, in 1994, a small spill of transformer oil occurred from an oil storage tank in TA-IV when a gasket failed and, at the Coyote Test Field, a leaking underground storage tank containing ethylene glycol was discovered.
- *Radiological and Chemical Contamination*—Some accidents analyzed in this section and others, that were considered but not analyzed, could potentially affect the nonhuman elements of the environment. Any accidentally released chemicals would result in concentrations that would typically decrease with increasing distance from the point of release. While chemical concentrations would diminish over distance to a point where a human hazard would no be longer present, the concentrations could still affect other elements of the environment such as the ecology, water quality, and cultural resources. Radiological releases could also affect nonhuman elements of the environment. After an accident, SNL/NM, through their spill and pollution control and radiological emergency response plans, would be required to assess the potential for ground contamination; if contamination exceeds guidance levels, plans would be developed for remediation.
- *Industrial*—Besides radioactive and chemical materials and explosives, many SNL/NM facilities conduct operations and use materials and equipment that could also be potentially hazardous to workers. These hazards are typically referred to as normal industrial hazards, not unlike similar hazards that workers are exposed to throughout the nation, and include working with electricity, climbing ladders, welding, and driving forklifts. All operations and activities at SNL/NM facilities, as well as all DOE facilities, would be subject to administrative procedures and safety features designed to prevent accidents and mitigate their consequences should they occur.

5.5.9 Transportation

Under the Reduced Operations Alternative, transportation impacts were assessed for each of three ROIs: KAFB; major Albuquerque roadways; and major roadways between Albuquerque and specific waste disposal facilities, vendors, and other DOE facilities. This analysis involved estimating the number of trips made by SNL/NM-associated vehicles under normal operations in each of these transportation corridors. Transportation evaluators and activity multipliers are discussed in Section 5.3.9, Appendix A, and Appendix G.

5.5.9.1 Transportation of Material and Wastes

The number of material shipments received by SNL/NM is generally proportional to total SNL/NM material consumption. According to facility projections, material consumption under the Reduced Operations Alternative is projected to decrease by 54 percent from current levels. Thus, total material shipments would also decrease, although not necessarily for all types of material.

Radioactive and explosive material shipments are often delivered through government carriers, unless the quantities and activities being transported are low enough to meet the Federal guidelines and restrictions in place for authorized commercial transporters. Government carriers operate on an as-needed basis, thus the general decrease in material inventory under the Reduced Operations Alternative would result in a similar decrease in these kinds of shipments.

Due to their shipment method, there would be very little impact to the number of chemical shipments that are made to SNL/NM. JIT chemicals, which are ordered infrequently and in small quantities, are usually shipped to SNL/NM by way of commercial carriers such as Federal Express and UPS. These carriers make daily shipments to SNL/NM to deliver packages other than chemicals, and a slight decrease in the volume of chemicals they handle per shipment would not likely decrease their frequency. Similarly, major chemical vendors who deliver their own material, rather than use a commercial carrier, also generally make daily shipments to SNL/NM. Therefore, any slight decrease in the volume of material that major vendors ship per load would not have an impact on the frequency of those shipments. Thus, chemical shipments would remain at approximately the same level regardless of the fluctuations in material consumption.

Considering the above factors, overall material transportation due to normal operations would increase by 24 percent over current levels. This increase would be due to shipment requirements of the medical isotopes production project. The anticipated changes in annual and daily material shipments for each material category are presented in Table 5.5.9–1. The analysis assumed that SNL/NM has 250 work days per calendar year.

Waste Transportation

The amount of waste shipped from SNL/NM to disposal facilities correlates directly to SNL/NM waste generation levels. Overall offsite waste shipments would increase by 291 percent. Of this increase, 285 percent is considered to be waste currently disposed of at the KAFB landfill. This leaves a real projected increase of 6 percent under the Reduced Operations Alternative. The total anticipated changes in waste shipments during all operations for each type of waste are presented in Table 5.5.9–2 and Appendix G, Table G.3–3.

Specials Projects

Two special project wastes, ER Project and legacy, were addressed separately due to their one-time operation/project status and in order to avoid skewing the SNL/NM normal operations impact. Legacy wastes would be anticipated to account for an additional 18 shipments of LLW, 3 shipments of LLMW, and 2 shipments of TRU/MTRU wastes over the 10-year time frame (see Figures 4.12–1, 4.12–2, and 4.12–3). In 1998 through 2000, the ER Project could account for up to an additional 312 offsite shipments of LLW, 101 offsite shipments of LLMW, 2 offsite shipments of RCRA waste, 5 offsite shipments of TSCA waste, and 75 shipments of nonhazardous waste. Both of these special projects have been included within the total facility risks.

Offsite Receipts and Shipments of Material and Waste

The bounding case for this analysis assumed that each material and waste shipment is composed of two trips: one to and one from SNL/NM. Thus, the total number of trips made by material and waste transporters under this alternative would be 10,374 (total shipments x 2). Assuming that the year is comprised of 250 work days, the average work day traffic within KAFB contributed by these carriers would be 41 trips. This is small compared to 26,349 trips of SNL/NM vehicles entering and exiting KAFB under this alternative (SNL 1996a, SNL/NM 1998a). Therefore, the overall traffic impacts on KAFB from SNL/NM material and waste shipments under the Reduced Operations Alternative would be minimal.

Shipments of Material and Waste in the Albuquerque Area

The total SNL/NM placarded material and waste shipment traffic under this alternative would comprise only 1.2 percent, or 41 shipments per day, of the total placarded truck traffic (1,767) entering the greater Albuquerque area. Although a 43-percent increase in SNL/NM placarded material and waste truck traffic would be expected, this increase would represent the inclusion of waste currently managed at KAFB landfill and new shipments from the MIPP. ER Project and legacy waste are addressed separately under special projects. Thus, the impacts under the Reduced Operations Alternative would be insignificant.

Shipments of Material and Waste Outside of Albuquerque

All material and waste transported to and from SNL/NM from outside of Albuquerque must enter and depart the city by way of Interstate 25 or Interstate 40. Table 5.5.9–3 presents the impacts to those corridors from material and waste shipments under the Reduced Operations Alternative. The specific remote facility locations are listed in Section 4.11. Daily SNL/NM shipment figures were derived for comparison purposes by dividing the annual waste and material shipment totals in Tables 5.5.9–1 and 5.5.9–2 by the approximately 250 work days in a calendar year.

Based on this analysis, overall SNL/NM material and waste shipments would be expected to increase in frequency by 43 percent under this alternative. Furthermore, the reduced SNL/NM truck traffic would only comprise less than 0.013 percent of all traffic

Table 5.5.9–1. SNL/NM Annual Material Shipments Under the Reduced Operations Alternative

MATERIAL TYPE		BASE YEAR[a] ANNUAL SHIPMENTS	REDUCED OPERATIONS ANNUAL SHIPMENTS
Radioactive		305	140
Radioactive (medical isotopes production)	*Receiving*	0	2
	Shipping	0	1,140
Chemical		2,750	2,750
Explosive		303	138
TOTAL		**3,358**	**4,170**

Sources: SNL/NM 1997b, 1998a

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Table 5.5.9–2. Annual Waste Shipments Under the Reduced Operations Alternative

WASTE TYPE	BASE YEAR SHIPMENTS	REDUCED OPERATIONS SHIPMENTS
LLW[c] (1996)	4	8
LLMW (1996)	1	3
Hazardous (RCRA+TSCA) (1997)	102	95
Recyclable (Hazardous and Nonhazardous)[a,b] (1997)	86	8
Solid (Municipal, Construction, and Demolition)[b] (1997)	51	650

Sources: Rinchem 1998a; SNL/NM 1998a, 1998y, n.d. (d)
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Excludes decontamination and decommissioning
[b] Recyclable and solid wastes currently handled by the KAFB landfill could be shipped offsite in the future, contributing an additional 741 shipments.

Table 5.5.9–3. 24-Hour Placarded Material and Waste Traffic Counts Under the Reduced Operations Alternative

ROUTE (ALL TRAFFIC)[a]	BASE YEAR[b]	REDUCED OPERATIONS
I-25 North (52,400)	230	268
I-25 South (18,000)	94	110
I-40 West (16,400)	621	725
I-40 East (54,200)	569	664
TOTAL (141,000)	**1,514**	**1,767**
SNL/NM[c]	**14.5**	**20.7**

Sources: Scientific Services 1995; SNL/NM 1997b, 1998a
I: Interstate
[a] Total vehicle count for all types of vehicles entering and departing Albuquerque
[b] The base year varies depending on information provided in the Facilities and Safety Information Document (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] SNL/NM placarded trucks

(165,000 vehicles per day), including all types of vehicles, projected to be entering and departing Albuquerque by way of interstates. For the base year (1996 or 1997), waste leaving Albuquerque represented 35 percent of the total shipments, with an additional 20 percent going to Rio Rancho. Because most materials are supplied through the JIT vendors, origination points are generally not known. However, most vendors use local suppliers; therefore, in the base year, 82 percent of material was assumed to be provided locally, with the remaining 18 percent coming from outside Albuquerque. Thus, the impact to this ROI from the Reduced Operations Alternative would be insignificant.

5.5.9.2 Other Transportation (Traffic)

Overall vehicular traffic impacts under the Reduced Operations Alternative were assessed by projecting the total number of SNL/NM commuter vehicles that would be traveling to and from SNL/NM. The term commuter includes all vehicles operated by SNL/NM employees, contractors, and visitors; DOE employees; and additional traffic, such as delivery vehicles.

Traffic on KAFB

Table 5.5.9–4 presents general anticipated traffic impacts at KAFB under the Reduced Operations Alternative. The number of SNL/NM commuter vehicles traveling to and from the site each work day was conservatively assumed to decrease at the same rate as the SNL/NM work force levels (see Section 5.5.12). Based on this analysis, overall KAFB traffic would decrease by 1 percent under this alternative.

Table 5.5.9–5 shows projected 24-hour KAFB vehicular flow for each of the three main gates under the Reduced Operations Alternative. It was assumed that the Carlisle and Truman gates would be used primarily by KAFB

Table 5.5.9–4. KAFB Daily Traffic Projections Under the Reduced Operations Alternative

COMPONENT	BASE YEAR[a]			REDUCED OPERATIONS			CHANGE (%)
	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	
SNL/NM Commuters	36	13,582	27,164	35	13,174	26349	-3
KAFB Commuters	64	24,145	48,290	65	24,145	48,290	0
TOTAL KAFB COMMUTER TRAFFIC	**100**	**37,727**	**75,453**	**100**	**37,319**	**74,639**	**-1**
SNL/NM Waste & Material Transporters	0.04	14.5	29	0.06	20.7	41	+43[b]

Sources: SNL/NM 1997a, 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] This increase represents inclusion of waste currently managed at the KAFB landfill and new shipments from the medical isotopes production project.

Table 5.5.9–5. Total KAFB Gate Traffic Under the Reduced Operations Alternative

GATE	BASE YEAR[a]			REDUCED OPERATIONS ALTERNATIVE			% CHANGE GATE TOTAL
	24-HOUR SNL/NM[b]	24-HOUR TOTAL[c]	PEAK HOUR[d]	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	
Wyoming	7,141	19,835	1,941	6,927	19,621	1,922	-1
Eubank	5,324	14,788	2,683	5,164	14,626	2,656	-1
Gibson	8,108	22,523	1,571	7,865	22,280	1,555	-1

Sources: USAF 1995e; SNL/NM 1997a, 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] SNL/NM commuter and transporter trips per day equals 36 percent of total KAFB trips per day

[c] Total KAFB trips per day

[d] Total KAFB trips per hour, 1996 traffic counts

personnel and not by SNL/NM employees. For the bounding case for this analysis, it was assumed that the SNL/NM contribution to total KAFB flow at each gate would fluctuate by the same factor as the total fluctuation in SNL/NM traffic under the Reduced Operations Alternative. Based on this analysis, the daily KAFB gate traffic would decrease by 1 percent under the Reduced Operations Alternative. This minimal change would not have an appreciable impact on the level of service at the gates.

Traffic in the Albuquerque Area

To determine the traffic impacts in the Albuquerque traffic corridor, roadways most likely to be affected by SNL/NM traffic were selected for analysis. The bounding case used the projected SNL/NM traffic contributions from Table 5.5.9–5 to approximate the SNL/NM component of the total traffic count for each roadway. For worst-case impacts, the SNL/NM traffic component was assumed to be equivalent to the total SNL/NM traffic at the nearest gate. In actuality, a significant percentage of traffic would likely diffuse onto other nearby roads, which would greatly reduce the magnitude of the SNL/NM component. The projected impacts to these roadways under the Reduced Operations Alternative, according to the bounding case factors, are presented in Table 5.5.9–6.

Based on this analysis, there would be a 3 percent overall average decrease in the SNL/NM traffic component on these roadways under the Reduced Operations Alternative. There would also be a 0.8 percent decrease in the total vehicular traffic.

Traffic Outside of Albuquerque

The additional local SNL/NM traffic under the Reduced Operations Alternative would have minimal impacts on transportation routes between Albuquerque and other DOE facilities, vendors, and disposal facilities (see Section 4.11 for a list of these facilities). In a worst-case assessment, the SNL/NM component represents an average 19 percent of the total traffic count (144,000 vehicles per day) on major roadways entering and departing Albuquerque in the base year (MRGCOG 1997b). Under the Reduced Operations Alternative, the SNL/NM component would decrease to 16 percent of total vehicular traffic due to the increase in Albuquerque population and commuters. This assumes that all SNL/NM traffic would actually enter and depart Albuquerque by way of the interstates every day, although a significant portion of SNL/NM traffic would more likely diffuse onto other roadways or remain in Albuquerque.

5.5.9.3 Transportation Risks Associated with Normal Operations

Incident-Free Exposure

The representative conservative cases for this analysis used the distances traveled by SNL/NM waste and material carriers, as listed in Table 5.3.9–7. These distances were based on the average distance traveled by trucks in route to other facilities under all alternatives.

Truck emissions impacts are a function of the number of truck shipments to and from SNL/NM. The bounding case for truck emissions impact analysis assumed that the greatest risk is when these shipments are transported through urban areas, such as the Albuquerque transportation corridor, because these areas are most susceptible to emissions related problems. To evaluate the actual risk associated with SNL/NM truck shipments, the most common origins and destinations of all shipments of concern were compiled to determine the urban distance each material or waste would be transported (Section 4.11). Table 5.5.9–7 presents projected truck emissions impacts resulting from the Reduced Operations Alternative.

The radiological impact of exposure to incident-free routine transportation of radioactive materials was analyzed using *RADTRAN 4* (SNL 1992a), as described in Appendix G. Routes and population densities were modeled using *HIGHWAY* (Johnson et al. 1993). Results of these calculations are presented in Table 5.5.9–8.

This table shows that the LCFs due to annual shipments of radioactive material and wastes under the Reduced Operations Alternative would decrease appreciably although the magnitude is small.

In the absence of an accident that compromises package integrity, no incident-free chemical or explosive exposure would be foreseen to affect the public, workers, or vehicle transport crews under this alternative.

5.5.9.4 Transportation Risks Associated with Accidents

General Accidents

The bounding case for general vehicular traffic impacts under the Reduced Operations Alternative assumed that the percent decrease in accidents would

Table 5.5.9–6. Albuquerque Daily Traffic Counts Under the Reduced Operations Alternative

ROADWAY		BASE YEAR[a]		REDUCED OPERATIONS		% CHANGE
		DAILY[b]	PEAK[c]	DAILY	PEAK	DAILY
Gibson west at Louisiana	*TOTAL*	15,671	2,066	15,428	2,034	-1.6
	SNL/NM	8,108	1,069	7,865	1,037	-3
	% SNL/NM	52		51		-2
Wyoming south of Lomas	*TOTAL*	37,639	2,293	37,853	2,280	-0.6
	SNL/NM	7,141	435	6,927	423	-3
	% SNL/NM	19		18.6		-2
Eubank south of Copper	*TOTAL*	14,572	1,852	14,732	1,832	-1.1
	SNL/NM	5,324	677	5,164	657	-3
	% SNL/NM	37		36		-3
Interstate 25 at Gibson[d]	*TOTAL*	91,000		91,243		-0.3
	SNL/NM	8,108		7,865		-3
	% SNL/NM	8.9		8.6		-3
Interstate 40 at Eubank[d]	*TOTAL*	90,300		90,460		-0.2
	SNL/NM	5324		5,164		-3
	% SNL/NM	5.9		5.7		-3
Wyoming north of KAFB gate	*TOTAL*	20,272	1,749	20,486	1,731	-1.0
	SNL/NM	7,141	612	6,927	594	-3
	% SNL/NM	35		34		-3

Sources: MRGCOG 1997b, 1997c; SNL/NM 1997b, 1998a; UNM 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Vehicles per day, *1996 Traffic Flows for the Greater Albuquerque Area*

[c] Vehicles per hour, *1996–1998 Traffic Counts*

[d] Peak hour counts for this intersection are not available

Table 5.5.9–7. Reduced Operations Alternative Incident-Free Exposure: Truck Emissions

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[b]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS							
RAD Materials	$1.0x10^{-7}$	73.0	$1.5x10^{-5}$	305	140	$4.6x10^{-3}$	$2.1x10^{-3}$
Explosives	$1.0x10^{-7}$	48.0	$9.6x10^{-6}$	303	138	$2.9x10^{-3}$	$1.3x10^{-3}$
Chemicals	$1.0x10^{-7}$	8.0	$1.6x10^{-6}$	2,750	2,750	$4.4x10^{-3}$	$4.4x10^{-3}$
LLW	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	4	8	$2.6x10^{-5}$	$5.3x10^{-5}$
Medical Isotopes Production (receipts)	$1.0x10^{-7}$	NA	NA	0	2	NA	$3.5x10^{-4}$
Medical Isotopes Production (shipments)				0	1,140		
LLMW (shipments)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	1	3	$8.1x10^{-6}$	$2.4x10^{-5}$
LLMW (receipts)	$1.0x10^{-7}$	35.6	$7.1x10^{-6}$	0	1	$7.1x10^{-6}$	$7.1x10^{-6}$
Hazardous Waste	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	64	58	$4.2x10^{-4}$	$3.8x10^{-4}$
Recyclable Hazardous to California	$1.0x10^{-7}$	23.0	$4.6x10^{-6}$	2	2	$9.2x10^{-6}$	$9.2x10^{-6}$
Recyclable Hazardous to New Mexico	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	6	6	$7.8x10^{-6}$	$7.8x10^{-6}$
Solid Waste	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	51	51	$1.0x10^{-4}$	$1.0x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	1	1	$6.6x10^{-6}$	$6.6x10^{-6}$
D&D Hazardous Waste TSCA-Asbestos	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	14	14	$2.8x10^{-5}$	$2.8x10^{-5}$
Biohazardous Waste	$1.0x10^{-7}$	24.0	$4.8x10^{-6}$	1	1	$4.8x10^{-6}$	$4.8x10^{-6}$
Recyclable D&D Hazardous Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	22	22	$2.9x10^{-5}$	$2.9x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	78	78	$1.0x10^{-4}$	$1.0x10^{-4}$
Nonhazardous Landscaping Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	142	NA	$2.8x10^{-4}$

Table 5.5.9–7. Reduced Operations Alternative Incident-Free Exposure: Truck Emissions (concluded)

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[b]	REDUCED OPERATIONS	BASE YEAR[b]	REDUCED OPERATIONS
Construction and Demolition Solid Waste	1.0×10^{-7}	10	2.0×10^{-6}	NA	599	NA	1.2×10^{-3}
RCRA Hazardous Waste (Receipt)	1.0×10^{-7}	3	6.0×10^{-7}	12	25	7.2×10^{-6}	1.5×10^{-5}
LLW (D&D)	1.0×10^{-7}	33	6.6×10^{-6}	4	4	2.6×10^{-5}	2.6×10^{-5}
TOTAL[c]						**1.33×10^{-2}**	**1.1×10^{-2}**
SPECIAL PROJECT OPERATIONS							
TRU/MTRU	1.0×10^{-7}	8.4	1.7×10^{-6}	0	2	0	3.4×10^{-6}
TRU/MTRU (legacy)	1.0×10^{-7}	8.4	1.7×10^{-6}	0	2	0	3.4×10^{-6}
LLW (legacy)	1.0×10^{-7}	33	6.6×10^{-6}	0	56	0	3.7×10^{-4}
LLMW (legacy)	1.0×10^{-7}	40.6	8.1×10^{-6}	0	8	0	6.5×10^{-5}
LLW (ER)	1.0×10^{-7}	33	6.6×10^{-6}	0	136	0	9.0×10^{-4}
LLMW (ER)	1.0×10^{-7}	40.6	8.1×10^{-6}	0	5	0	4.1×10^{-5}
Hazardous Waste (ER)	1.0×10^{-7}	33	6.6×10^{-6}	0	113	0	7.5×10^{-4}
Nonhazardous Solid Waste (ER)	1.0×10^{-7}	10	2.0×10^{-6}	0	9	0	1.8×10^{-5}
TOTAL[c]						**0**	**2.1×10^{-3}**

Sources: DOE 1996h; SNL 1992a; SNL/NM 1982, 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
km: kilometer
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] LCFs per km of urban travel
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated total LCFs

Table 5.5.9–8. Doses to Crew and Public Under the Reduced Operations Alternative

CARGO	ANNUAL DOSE/TRUCK CREW (person-rem)		ANNUAL DOSE/GENERAL PUBLIC (person-rem)		ANNUAL LCFs	
	BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[a]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS						
RAD Materials[b]	9.8	4.5	82.4	37.8	4.5×10^{-2}	2.1×10^{-2}
LLW	0.21	0.41	0.6	1.2	3.8×10^{-4}	7.6×10^{-4}
LLMW[c]	1.6×10^{-4}	5.9×10^{-4}	1.6×10^{-3}	6.4×10^{-3}	8.6×10^{-7}	3.4×10^{-6}
Medical Isotopes Production	0	0.92	0	2.7	0	1.7×10^{-3}
LLW (D&D)	0.21	0.21	0.60	0.60	3.8×10^{-4}	3.8×10^{-4}
TOTAL[d]					$\mathbf{4.6 \times 10^{-2}}$	$\mathbf{2.4 \times 10^{-2}}$
SPECIAL PROJECT OPERATIONS						
TRU/MTRU[e]	0	3.2×10^{-3}	0	1.8×10^{-2}	0	1.0×10^{-5}
TRU/MTRU[e] *(Legacy)*	0	3.2×10^{-3}	0	1.8×10^{-2}	0	1.0×10^{-5}
LLW (Legacy + ER)	0	10.0	0	28.8	0	1.8×10^{-2}
LLMW[f] *(Legacy + ER)*	0	2.1×10^{-3}	0	2.1×10^{-2}	0	1.1×10^{-5}
TOTAL[d]					**0**	$\mathbf{1.8 \times 10^{-2}}$

Sources: DOE 1996h, SNL 1992a, SNL/NM 1997b, 1998a
Ci: Curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RAD: radiological
rem: roentgen equivalent, man
TRU: transuranic

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consisted of 100 kg of depleted uranium
[c] 1996 shipment of 7.2410^{6} Ci of Sodium-24; Transport Index (TI)= 0.1
[d] Lifetime estimated total LCFs
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index (TI)= 1.0

be equal to the percent decrease in SNL/NM traffic. Therefore, SNL/NM traffic accidents would decrease by 3 percent under this alternative.

Hazardous Material Waste-Related Accidents

The SNL/NM material and waste shipments projected in Table 5.5.9–1 and Table 5.5.9–2 were used in conjunction with traffic fatality statistics (SNL 1986) to project the truck accident fatality incidence rate that would be expected under the Reduced Operations Alternative. The details are presented in Appendix G. These impacts are presented in Table 5.5.9–9. Based on this analysis, accident fatalities due to SNL/NM truck transportation would decrease from 0.22 to 0.18 under this alternative.

Radiological Transportation Accidents

The annual risk to population due to transportation accidents that could involve radiological releases resulting from the Reduced Operations Alternative are presented in Table 5.5.9–10. This analysis indicates that under normal routine operations, LCFs would decrease from 1.2×10^{-3} to 5.5×10^{-4} incidents due to the worst-case radiological transportation accident under the Reduced Operations Alternative. In addition, 5×10^{-5} LCFs would result from legacy and ER Project waste shipments. For more information see Appendix G.

Risks due to radiological, chemical and explosives accidents are evaluated in detail in Appendix F. The bounding transportation accident analysis involves explosion of a tractor-trailer containing 40,000 ft^3 of hydrogen. Based on the results presented in Appendix F, Table F.4–1, the hydrogen explosion would result in structural damage to buildings up to a distance of 91 m from the truck. Fatalities would result up to a distance of 15 to 18 m from the truck, while eardrum ruptures would occur up to a distance of 36 m from the truck.

Table 5.5.9–9. Truck Transportation Traffic Fatalities Under the Reduced Operations Alternative

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS			
RAD Materials	3.5×10^{-4}	0.11	4.9×10^{-2}
Explosives	2.9×10^{-4}	8.8×10^{-2}	4.0×10^{-2}
Chemicals	2.1×10^{-6}	5.8×10^{-3}	5.8×10^{-3}
LLW	2.2×10^{-4}	8.8×10^{-4}	1.8×10^{-3}
Medical Isotopes Production	NA	NA	7.7×10^{-4}
LLMW (shipments)	3.0×10^{-4}	3.0×10^{-4}	9.0×10^{-5}
LLMW (receipts)	2.1×10^{-4}	0	2.1×10^{-4}
Hazardous Waste	2.2×10^{-4}	1.4×10^{-2}	1.3×10^{-2}
Recyclable Hazardous to California	1.5×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
Recyclable Hazardous to New Mexico	1.6×10^{-7}	9.6×10^{-6}	9.6×10^{-6}
Solid Waste	2.6×10^{-6}	1.3×10^{-5}	1.3×10^{-4}
D&D Hazardous Waste TSCA-PCBs	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
D&D Hazardous Waste TSCA-Asbestos	2.2×10^{-5}	3.1×10^{-4}	3.1×10^{-4}
Biohazardous Waste	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}
Recyclable D&D Hazardous Waste	1.6×10^{-6}	3.5×10^{-5}	3.5×10^{-5}
Recyclable Nonhazardous Solid Waste	1.6×10^{-6}	1.2×10^{-4}	1.2×10^{-4}
Nonhazardous Landscaping Waste	2.6×10^{-6}	NA	3.7×10^{-4}
Construction and Demolition Solid Waste	2.6×10^{-6}	NA	1.6×10^{-3}
RCRA Hazardous Waste (receipt)	6.7×10^{-7}	8.0×10^{-6}	1.7×10^{-5}
Low-level waste (D&D)	2.2×10^{-6}	8.8×10^{-4}	8.8×10^{-4}
TOTAL[b]		**0.22**	**0.11**
SPECIAL PROJECT OPERATIONS			
TRU/MTRU	1.9×10^{-5}	0	3.8×10^{-5}
TRU/MTRU (Legacy)	1.9×10^{-5}	0	3.8×10^{-5}
LLW (Legacy)	2.2×10^{-4}	0	1.2×10^{-2}

Table 5.5.9–9. Truck Transportation Traffic Fatalities Under the Reduced Operations Alternative (concluded)

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	REDUCED OPERATIONS
LLMW (Legacy)	3.0×10^{-4}	0	2.4×10^{-3}
LLW (ER)	2.2×10^{-4}	0	3.0×10^{2}
LLMW (ER)	3.0×10^{-4}	0	1.5×10^{3}
Hazardous Waste (ER)	2.2×10^{-4}	0	2.5x10[illegible]
Nonhazardous Solid Waste(ER)	2.6×10^{-6}	0	2.3×10^{-5}
TOTAL[b]		0	7.1×10^{-2}

Sources: SNL 1986, 1992a; SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Lifetime estimated total fatalities from annual shipments and total special project shipments

Table 5.5.9–10. Risks to Population Due to Transportation Radiological Accident, Maximum Annual Radiological Accident Risk for Highway Shipments

CARGO	ANNUAL DOSE RISKS TO POPULATION PERSON-REM		LCFs	
	BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[a]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS				
Radioactive Material[b]	2.3	1.1	1.2×10^{-3}	5.5×10^{-4}
LLW	2.3×10^{-3}	4.6×10^{-3}	1.2×10^{-6}	2.3×10^{-6}
LLMW[c]	4.6×10^{-11}	1.7×10^{-10}	2.3×10^{-14} 1.7×10^{-8}	8.5×10^{-14}
Medical Isotopes Production	0	1.9×10^{-3}	0	9.6×10^{-7}
LLW (D&D)	2.3×10^{-3}	2.3×10^{-3}	1.2×10^{-6}	1.2×10^{-6}
TOTAL[d]			**1.2×10^{-3}**	**5.5×10^{-4}**
SPECIAL PROJECT OPERATIONS				
TRU/MTRU[e]	0	3.4×10^{-6}	0	3.4×10^{-9}
TRU/MTRU[e] *(Legacy)*	0	6.8×10^{-6}	0	3.4×10^{-9}
LLW (Legacy + ER)	0	0.11	0	5.5×10^{-5}
LLMW[d] *(Legacy + ER)*	0	4.4×10^{-4}	0	2.2×10^{-7}
TOTAL[d]			**0**	**5.5×10^{-5}**

Sources: DOE 1996h; SNL 1992a; SNL/NM 1997b, 1998a
Ci: Curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium-24; Transport Index (TI) = 0.1
[d] Lifetime estimated total LCFs
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index (TI) = 1.0

5.5.10 Waste Generation

Implementation of the Reduced Operations Alternative would not result in any major changes in the types of waste streams generated onsite. Except for new operations, waste generation levels at SNL/NM would remain constant or decrease slightly, consistent with slight decreases in laboratory operations. These lower waste volumes would be enhanced by the waste minimization and pollution prevention programs, which project a 33-percent overall decrease in total waste disposal needs by FY 2000. Waste projections used for analysis do not take credit for potential waste minimization techniques that have not yet been implemented. Regardless, the decreased generation activities would not exceed current existing waste management disposal capacities.

For projection purposes, the baseline waste generation data were considered to be constant for existing facilities with no major increases or decreases in the amount of wastes generated. Operations waste are considered to be derived from mission-related work. Nonoperations waste are generated from special programs. New operations are discussed separately in order to show the maximum likely existing operational increases. Waste generation levels for special operations waste, such as for the ER Project, are derived separately from the representative facilities' projections under special projects. However, the amount of waste generated is anticipated to reflect proportionally increases or decreases in SNL/NM activity levels over the next 10 years, with the exception of waste to be generated by new programs. The waste quantities projected, listed in Table 5.5.10–1, represent a site-wide aggregate of quantities for each type of waste stream from existing selected facilities. As appropriate, the balance of operations (not selected facilities or special projects) waste generated is discussed within the individual waste sections. Units shown for each waste type are based on how industrial facilities charge commercial clients for disposal of these wastes.

5.5.10.1 Radioactive Wastes

Only three types of radioactive waste, LLW, LLMW, and MTRU waste, would potentially be generated under the Reduced Operations Alternative. SNL/NM would not generate any high-level waste or TRU waste. Projections for waste generation at selected facilities from new and existing operations are presented in Appendix H.

Existing Operations

Under the Reduced Operations Alternative, SNL/NM anticipates a maximum 20 percent decrease in the generation of LLW from existing operations over the next 10 years. LLW generated by SNL/NM is and will continue to be transported offsite to appropriate DOE-approved disposal facilities, such as the NTS. LLMW generation would decrease by 13 percent for existing operations through 2008. Under the *Resource Conservation and Recovery Act Part B, Permit Application for Hazardous Waste Management Units* (SNL/NM 1996a), some treatment of the hazardous component of LLMW could be performed at SNL/NM (Table 4.12–2). LLMW for which no onsite treatment is available would be shipped offsite for treatment and disposal. SNL/NM also projects no TRU waste would be generated annually. The existing TRU/MTRU wastes stored onsite, as well as all future TRU/MTRU wastes, are anticipated to be transferred to LANL for certification, as indicated in the Waste Management Programmatic Environmental Impact Statement (DOE 1997i) ROD (DOE 1998n), prior to disposal at the WIPP. Projected MTRU waste generated would decrease to 0.23 m^3 annually. Existing SNL/NM operations would use less than 1 percent (0.17 percent) annually of the available radioactive waste storage capacity.

New Operations

SNL/NM anticipates a maximum of 10.8 m^3 of LLW would be generated from new operations annually over the next 10 years. The majority of this increase would be primarily due to the full implementation of medical isotopes production operations in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for over 47 percent of the total projected LLW in the Reduced Operations Alternative. However, due to the nature of the waste, it would be managed at the generation facility to minimize worker exposure until disposal offsite. LLMW generation from all new onsite sources would be a maximum of 0.14 m^3 annually through 2008.

SNL/NM does not expect to generate TRU or MTRU wastes from new operations. Approximately 42 kg of spent fuel would be generated over the 10-year period. Spent fuel is further discussed in Appendix A as a material resource.

Balance of Operations

The waste level for the balance of operations was determined for each type of radioactive waste

Table 5.5.10–1. Total Waste Generation for Facilities Under the Reduced Operations Alternative

ALL WASTE		UNIT	BASE YEAR[a]	REDUCED ALTERNATIVE
RADIOACTIVE WASTE				
Low-Level Waste (500 kg/m³)	Existing Operations	m³(kg)	16(8,000)	18(9,000)
	New Operations	m³(kg)	4(2,000)	11(5,500)
	SNL/NM Balance of Operations	m³(kg)	74(37,000)	74(37,000)
	SNL/NM Total LLW	m³(kg)	94(47,000)	102(51,000)
	Percent change		0.0%	8.8%
Low-Level Mixed Waste (550 kg/m³)	Existing Operations	m³(kg)	3.85(2,120)	3.36(1,850)
	New Operations	m³(kg)	0.20(110)	0.14(80)
	SNL/NM Balance of Operations	m³(kg)	0.28(150)	0.28(150)
	SNL/NM Total LLMW	m³(kg)	4.33(2,380)	3.79(2,080)
	Percent change		0.0%	-12.6%
TRU Waste (310 kg/m³)	Existing Operations	m³(kg)	-	-
	New Operations	m³(kg)	-	-
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total TRU	m³(kg)	-	-
MTRU Waste (76 kg/m³)	Existing Operations	m³(kg)	0.45(34)	0.23(26)
	New Operations	m³(kg)	-	-
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total MTRU	m³(kg)	0.45(34)	0.23(26)
	Percent change		0.0%	-50.0%
RADIOACTIVE WASTE TOTAL[c]	**Existing Operations**	**m³(kg)**	**20.34 (10,154)**	**21.55 (10,876)**
	New Operations	**m³(kg)**	**4.62(2,110)**	**10.96 (5,580)**
	SNL/NM Balance of Operations	**m³(kg)**	**73.92 (37,150)**	**73.92 (37,150)**
	SNL/NM Total Radioactive Waste	**m³(kg)**	**98.88 (49,414)**	**106.42 (53,606)**
	Percent change		**0.0%**	**7.6%**

Table 5.5.10–1. Total Waste Generation for Facilities Under the Reduced Operations Alternative (concluded)

ALL WASTE	UNIT	BASE YEAR[a]	REDUCED ALTERNATIVE
RCRA HAZARDOUS WASTE			
Existing Operations	kg	16,187	15,176
New Operations	kg	398	598
SNL/NM Balance of Operations	kg	39,267	37,349
SNL/NM Total RCRA Hazardous	kg m^3	55,852 44.3	53,123 42.1
Percent change		0.0%	-4.9%
SOLID WASTE			
SNL/NM Total Solid Waste[b]	m^3(kg)	0.6M (2,022)	0.6M (1,955)
Percent change		0.0%	-3.3%
WASTEWATER			
Existing Operations	M gal	49	51
New Operations	M gal	0	3
SNL/NM Balance of Operations	M gal	231	214
SNL/NM Total Wastewater	M gal	280	268
Percent change		0.0%	-4.3%

Sources: SNL/NM 1997b, 1998a, 1998c, 1998i
kg: kilogram
LLMW: low-level mixed waste
LLW: low-level waste
M: million
M gal: million gallons
m^3: cubic meter
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate
[b] Individual breakdowns of solid waste for existing, new, and balance of operations are unavailable because of tracking methods.
[c] Numbers are rounded and may differ from calculated values.
Note: Densities shown are found in Table H.3–1.

(Table 5.5.10–1). Only LLW and LLMW would be affected. Balance of operations at SNL/NM would account for an additional 73.6 m^3 per year of LLW. These same operations would account for an additional 0.28 m^3 of LLMW per year. The overall operations impacts for this alternative would increase by 9 percent for LLW and would decrease by 13 percent for LLMW.

Current Capacity

Previously generated radioactive wastes (legacy waste) occupy approximately 494 m^3 of the available 11,866 m^3 of total radioactive waste storage capacity at the RMWMF and its associated storage areas. This represents approximately 4.2 percent of the total available capacity. Therefore, there is sufficient capacity to accommodate the anticipated decrease in radioactive wastes generated.

Special Projects

Projections indicate the ER Project, a special project beyond the scope of normal operations, will actually be the single largest waste generator at SNL/NM in 1998. The ER Project will produce approximately 2,862 m^3 of LLW and 221 m^3 of LLMW, primarily contaminated soil and debris, prior to the end of the project (Table 5.3.10–2). Actual cleanup is now expected to be completed between FY2003 and FY2005 depending on budget availability, with ER Project wastes disposed of. Prior to disposal, ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

5.5.10.2 Hazardous Waste

Existing Operations

As shown on Table 5.5.10–1, under the Reduced Operations Alternative, SNL/NM anticipates a decrease in the generation of RCRA hazardous waste from 16,187 kg in the base year to 15,176 kg per year. Projections are shown in Appendix H. Projected RCRA hazardous waste generation is presented in Figure 4.12–4.

No appreciable change in the generation of explosive waste would occur. Therefore, the TTF, with a treatment capacity of 9.1 kg of waste per burn, would continue to accommodate those wastes, as discussed in the No Action Alternative. The majority of explosive waste would be disposed of at SNL/NM or through KAFB.

New Operations

SNL/NM anticipates annual generation of a maximum of approximately 600 kg of hazardous waste by new operations over the next 10 years. The increase would be primarily due to the full implementation of medical isotopes production operations associated with the MIPP in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for less than 2 percent (1.2 percent) of the total projected hazardous waste in 2003 and 2008.

New SNL/NM operations would use less than 1 percent (0.2 percent) annually of the available hazardous waste storage capacity at SNL/NM. This is considered to be a minimal impact.

Balance of Operations

It was assumed that the RCRA hazardous waste levels for the balance of operations at SNL/NM would decrease by the same proportion as RCRA wastes for selected facilities, because facilities represent the overall plant. Consequently, multipliers were used to project RCRA hazardous waste levels under all three alternatives. In the base year, the selected facilities will generate 16,187 kg out of a total of 55,852 kg of all operational RCRA waste. The remainder, 39,267 kg, is the balance of operations RCRA hazardous waste. For the Reduced Operations Alternative, the maximum projected balance of operations amount would be 37,349 kg.

Current Capacity

Under the Reduced Operations Alternative, the total volume of hazardous waste generated at SNL/NM requiring offsite disposal at licensed/approved facilities, would not exceed the existing 286.5 m^3 of storage and handling capacities at the HWMF and its associated storage buildings. The outside nonpermitted bermed storage area for nonhazardous waste was not included in the onsite storage capacity calculations. Hazardous waste is routinely shipped out on a monthly basis to various offsite disposal facilities by SNL/NM. Projections indicate that a maximum of 15.4 percent of the existing hazardous waste capacity would be used. Therefore, a minimum of six years capacity exists for the hazardous waste based on the highest level of generation. Most, if not all, waste would be shipped in less than 1 year to meet regulatory requirements. Based on these projections and continued operations at selected facilities under the Reduced Operations Alternative, the hazardous waste generation impacts would continue to be minimal.

Special Projects

During field remediation, the ER Project, likely the single largest waste generator at SNL/NM in 1998, would produce an additional 26 M kg of hazardous waste by 2002 (Table 5.3.10–2). Final disposal would be accomplished by 2004. ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

D&D operations would continue (as outlined in Section 2.3.5). This program would directly impact the quantity of TSCA hazardous waste requiring disposal. Under this modernization program, SNL/NM would continue to generate TSCA hazardous waste, primarily PCBs and asbestos that are removed from transformers and buildings. Since the main PCB relamping and transformer removal is now completed, quantities of TSCA waste have dropped to approximately 122,000 kg per year and should remain at that level (Figures 4.12–5 and 4.12–6).

The total volume of TSCA waste would eventually decrease as the targeted facilities are removed. Currently, SNL/NM has 674 buildings providing a total of 5 M gross ft^2 of office and operational space. Through this facility modernization program, the number of buildings would be reduced to 465 buildings totaling approximately 4.9 M gross ft^2. This program would remove 138 buildings accounting for 179,204 gross ft^2 within FY 1998 and FY 1999 at SNL/NM. During FY 2000 through FY 2002, 49 additional buildings accounting for 108,937 gross ft^2 are potentially scheduled for removal. Over the long term, an additional

29 buildings would be removed with a total of 84,132 gross ft². To make up for the loss of office and operational space, seven additional buildings would be built, adding approximately 240,000 gross ft². No predictions are made for years beyond 2007.

5.5.10.3 All Other Wastes

All SNL/NM operations also involve four additional waste management activity areas, discussed below.

Biohazardous (Medical) Waste

The total volume of medical waste would generally remain a function of the total number of full-time employees and subcontractors located at SNL/NM. Under the Reduced Operations Alternative, approximately 2,423 kg of medical waste would be generated. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Nonhazardous Chemical Waste

The maximum quantity of nonhazardous waste generated annually at SNL/NM and managed by the HWMF under the Reduced Operations Alternative would be 65,934 kg, based on the waste multiplier (see Appendix A) developed for RCRA waste (Rinchem 1998a). Existing commercial disposal facilities would have adequate capacities to handle the continued generation of nonhazardous waste; thus, no additional impacts would be anticipated.

Municipal Solid Waste

Site-wide solid waste generation trends at SNL/NM would generally remain a function of total building area and the number of full-time and subcontractor employees. This function is based on general build operations activities, such as maintenance and cleaning, and, to a lesser extent, the general office waste created by SNL/NM employees. Over the 10-year time frame, a decrease of 2.2 percent would be anticipated. Despite the projected 3 percent personnel decrease, no appreciable onsite impacts to disposal facilities would be anticipated because existing waste handling capabilities are already in place. As existing buildings are replaced, personnel would be moved to make more efficient use of the space. No additional offsite impacts would occur, since offsite disposal capacity would continue to be sufficient. However, a significant amount of C&D waste, a special class of solid waste, would potentially be generated under the facility modernization program described above. Quantities of C&D waste associated with the facility modernization program were projected to be similar to prior years. This waste would be disposed of at KAFB and would not create an offsite impact. Table 5.3.10-3 summarizes construction debris disposal.

Wastewater

SNL/NM would generate approximately 268 M gal of wastewater annually. However, SNL/NM entered into an MOU with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997p). The MDL would be the single facility discharging the largest volume of wastewater at SNL/NM. Reduction efforts would focus on the MDL in order to reduce the amount of process wastewater being generated. See Section 5.3.2 for additional discussion of wastewater quantities and capacities.

5.5.11 Noise and Vibration

Implementation of the Reduced Operations Alternative could include activity levels at some facilities that would increase over the 1996 baseline activity levels. In these cases, the activity levels would be those that were not exercised sufficiently during the baseline period to maintain the capability or to satisfy testing requirements of the DOE.

The frequency of impulse noise events under the Reduced Operations Alternative is projected to be 65 percent less than the 1996 baseline level of activity and approximately 75 percent less than the 2008 No Action Alternative level for all test activities combined. This level of activity would result in an average of approximately 1.5 impulse noise tests per day, compared to an average of 5.5 impulse noise tests per day under the 2008 No Action Alternative. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed by the neighborhoods bounding the site. These impulse noise levels resemble a dull thud and generally are considered an annoyance because of "startle" effects, including window vibrations. The effects on the public would be minor.

5.5.12 Socioeconomics

The implementation of the Reduced Operations Alternative would result in no noticeable changes in the socioeconomic categories discussed in the following sections. Environmental impacts to demographic characteristics, economy, and community services in the ROI under the Reduced Operations Alternative are discussed below. The discussion of impacts is based on a bounding economic analysis.

5.5.12.1 Demographic Characteristics

The Reduced Operations Alternative would not likely generate a noticeable change in the existing demographic characteristics within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would decrease gradually and then remain constant through 2008.

5.5.12.2 Economic Base

The Reduced Operations Alternative would not be likely to result in a noticeable economic change in the existing economic base within the ROI (Section 4.14.3).

Table 5.5.12–1 presents an estimate of the Reduced Operations Alternative impacts on the ROI economy from a 3-percent decrease in operational levels of activity and associated decreases in expenditures, income, and employment, both direct and indirect, at SNL/NM. Minimal operational activities associated with selected facilities are included in the totals presented in the table. If operations at SNL/NM were to decrease by 3 percent over current levels, overall economic activity and income within the ROI would be expected to decrease by about

Table 5.5.12–1. SNL/NM's Impact on Central New Mexico's Economy if Operations Were to Decrease by 3 Percent

ECONOMIC MEASURE	FY 1996[a]			ASSUMING A 3-PERCENT DECREASE IN OPERATIONS			
	SNL/NM	TOTAL ROI	PERCENT OF ROI	SNL/NM	TOTAL ROI	PERCENT OF ROI	PERCENT CHANGE
ECONOMIC ACTIVITY ($ BILLIONS)							
Direct Expenditures	1.43			1.39			
Indirect & Induced	2.50	42.4	9.3	2.43	42.28	9.0	-0.3
Total Economic Activity	3.93			3.81			
Economic Activity Multiplier: 2.75[b]							
INCOME ($ BILLIONS)							
Net Wages & Salaries	0.48			0.47			
Indirect & Induced	0.58	13.4	8.0	0.56	13.37	7.7	-0.3
Total Income	1.07			1.03			
Income Multiplier: 2.21[b]							
EMPLOYMENT (NUMBER OF EMPLOYEES)							
SNL/NM Employment	7,652			7,422			
Indirect & Induced	18,826	331,800	8.0	18,259	331,004	7.6	-0.4
Total Employment	26,478			25,682			
Employment Multiplier: 3.46[b]							

Source: DOE 1997j
ROI: region of influence
FY: fiscal year

[a] Modeled results from DOE 1997j
[b] The use of multipliers in calculating economic impacts in the ROI is explained in Section 4.14.3.

0.3 percent. As presented in Table 5.5.12–1, a 3-percent decrease in operational levels of activity at SNL/NM through 2008 would result in a decrease from $42.4 B to $42.28 B, amounting to a $120-M total reduction in economic activity (an average loss of $12 M per year). Total income would decrease from $1.07 B to $1.03 B, amounting to a $40-M reduction in total income (an average loss of $4 M per year). Total employment would decrease from 331,800 to 331,004, amounting to a reduction of 796 total jobs (an average loss of 80 jobs per year) in the ROI. By 2008, contributory effects from other industrial and economic sectors within the ROI would reduce or mask some of SNL/NM's effect on the ROI economy (Section 6.4.12).

5.5.12.3 Housing and Community Services

The Reduced Operations Alternative would not be likely to have a noticeable impact on existing housing and community services within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would decrease gradually and then remain constant through 2008. Contributory effects from other industrial and economic sectors within the ROI would reduce or mask the SNL/NM proportional impact.

5.5.13 Environmental Justice

In general, SNL/NM operations under the Reduced Operations Alternative would have no known disproportionately high or adverse health or environmental impacts on minority or low-income populations within the ROI. One area of concern is water resources and hydrology. Anticipated water resources adverse impacts would equally affect all communities in the area (see Section 5.5.4). Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated for this resource area.

Table 5.5.13–1 provides a brief summary of environmental justice impacts on each resource or topic area under the Reduced Operations Alternative. It also identifies areas where the impacts do not vary from the No Action Alternative. See Section 5.3.13 for an expanded discussion of environmental justice issues by resource area.

Table 5.5.13–1. Summary of Potential Environmental Justice Impacts Under the Reduced Operations Alternative

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBOR-HOODS
Land Use and Visual Resources, Infrastructure, Geology and Soils, Water Resources and Hydrology[a], Biological and Ecological Resources, Cultural Resources, and Waste Generation	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative
Air Quality–Nonradiological Air	Emissions would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Concentrations would be below regulatory standards and human health guidelines. SNL/NM carbon monoxide emissions would be 5.6% of Bernalillo County carbon monoxide emissions.	Not adverse	Not adverse	Not adverse
Air Quality–Radiological Air	MEI: 0.020 mrem/yr Collective ROI dose: 0.80 person-rem/yr Average collective dose in ROI: 1.1×10^{3} mrem/yr	Not adverse	Not adverse	Not adverse
Human Health and Worker Safety	MEI lifetime risk of fatal cancer would increase by 8.0×10^{9} Fatal cancers (additional ROI): 4.0×10^{4} Risk of cancer fatality to workforce is 4.0×10^{3}	Not adverse	Not adverse	Not adverse
Transportation	Total annual material shipments: 4,170 Total KAFB traffic (daily vehicles): 37,319 Incident-free exposure, truck emissions - annual LCFs: 1.1×10^{2} Incident-free exposure, dose - annual LCFs: 2.4×10^{2}	Not adverse	Not adverse	Not adverse

Table 5.5.13–1. Summary of Potential Environmental Justice Impacts Under the Reduced Operations Alternative (concluded)

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBOR-HOODS
Noise and Vibration	Test activities would be 85% less than the 1996 level, an average of approximately 1.5 impulse noise tests per week. Only a fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed in neighborhoods bounding the site.	Not adverse	Not adverse	Not adverse
Socioeconomics	SNL/NM employees: 7,422 SNL/NM total economic activity: $3.81 B/yr Percent of ROI total economic activity: 9%	Not adverse	Not adverse	Not adverse

Source: Original
B: billion
LCFs: latent cancer fatalities
MEI: maximally exposed individual
mrem: millirem
ROI: region of influence
TCPs: traditional cultural properties
yr: year
[a] Groundwater withdrawal was considered adverse; however, the effects are not disproportionately high and adverse to low-income and minority neighborhoods.

5.6 MITIGATION MEASURES

The regulations promulgated by the CEQ to implement the procedural provisions of NEPA (42 U.S.C. § 4321) require that an EIS include a discussion of appropriate mitigation measures (40 CFR §1502.14[f] and 16[h]). The term "mitigation" includes the following (40 CFR §1508.20):

- avoiding an impact by not taking an action or parts of an action;
- minimizing impacts by limiting the degree or magnitude of an action and its implementation;
- rectifying an impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact by preservation and maintenance operations during the life of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

This section describes mitigation measures by resource area, along with descriptions and key proactive initiatives. These mitigation measures and proactive initiatives address the range of potential impacts of continuing to operate SNL/NM.

SNL/NM operates under existing programs and controls, including regulations, policies, contractual requirements, and administrative procedures, to mitigate impacts. The existing programs and controls are too numerous to list completely. Examples include the Fire Protection Program, Pollution Prevention and Waste Minimization Programs, Water and Energy Conservation Programs, and a Natural Resource Management Plan.

In large part, these programs and controls effectively reduce the need for additional mitigation measures in a majority of resource areas evaluated in the SWEIS. Also, as presented in Chapter 5, the majority of resource area impacts would not pose substantial harm to the environment or the public, and thus mitigation measures would not be required or anticipated. However, several resource areas, including cultural resources and environmental justice, present potential mitigation measures.

The description of these potential mitigation measures does not constitute a commitment to undertake any of them. Any such commitments would be reflected in the ROD following the Final SWEIS, with a more detailed description and implementation plan in a Mitigation Action Plan published following the ROD.

5.6.1 Resource-Specific Mitigation Measures

Resource-specific mitigation measures are discussed below.

5.6.2 Land Use and Visual Resources

No land use or visual resources impacts are anticipated that would require specific mitigation measures. Because land use on KAFB is influenced by a variety of landowners, permit arrangements, and withdrawal agreements, future land use is a complex issue. As a proactive means of developing future use options for properties owned by the DOE or permitted for its use on KAFB, SNL/NM is participating in a Future Use Options Logistics and Support Working Group with the DOE as the lead. Additional members of this group include other DOE affiliates (such as the Lovelace Respiratory Research Institute, Nonproliferation and National Security Institute (NNSI), TSD, KAFB, USFS, NMED, and EPA). Public involvement is encouraged through the DOE/SNL Citizens Advisory Board, which has been instrumental in providing interim recommendations on future land use options. These recommendations recognize the high probability of continued Federal use of KAFB and propose, for future use planning and cleanup level determination, reasonable land use classifications based on residential, recreational, and industrial use (SNL 1997a, Keystone 1995).

Improving the visual quality of SNL/NM is currently accomplished through incorporating Campus Design Guidelines. These guidelines contain a set of principles and detailed design guidance for the physical development and redevelopment of SNL/NM sites. They include guidance for building massing, facades, color palettes, building orientation and entries, circulation corridors, standardized signage, and landscaping, including low-water use plant selections. All new and modified facilities will be brought into compliance with these guidelines over time. They have been endorsed by senior management of SNL/NM and are administered through the Corporate Projects Department, the Sites Planning Department, and the Campus Development Committee (SNL 1997a). Where decommissioning, demolition, or environmental restoration are planned, actions will be taken to restore the area to its approximate natural condition by backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth (SNL/NM 1997a).

5.6.3 Infrastructure

SNL/NM site infrastructure resources are capable of accommodating any of the alternatives with regular maintenance, repair, and upgrades. No mitigation measures would be anticipated.

5.6.4 Geology and Soils

Of the two analyses (slope stability and soil contamination) conducted for the Geology and Soils resource area, negligible environmental impacts were noted. Therefore, no mitigation measures would be required. Slope stability has not been an issue at SNL/NM because of the location of major facilities on relatively level ground and the stable bedrock-dominated mountainous areas. For soil contamination, this finding assumes SNL/NM's continued compliance with applicable regulations regarding the management and disposal of waste. Mitigation measures for potential releases of hazardous or radioactive materials at outdoor testing areas would be part of future operations (SNL 1997e).

5.6.5 Water Resources and Hydrology

Groundwater contamination exists at the CWL as a result of prior waste disposal activities. Groundwater contamination also exists in an area beneath TAs-I and -II, although contamination may not be of SNL/NM origin (see discussion in Section 5.3.4.1). At the Lurance Canyon Burn Site, nitrates exceeding the MCL have been detected in groundwater, but may be naturally occurring. Investigations or cleanup are underway at all of these sites, and further actions will be coordinated with the NMED.

The groundwater quantity analysis established SNL/NM's current and future contribution to local aquifer drawdown to be approximately 11 percent. To mitigate impacts to groundwater supplies, SNL/NM has announced a plan to cut water usage by 30 percent (SNL/NM 1997a). However, the effectiveness of any SNL/NM conservation initiative in reducing aquifer drawdown must be evaluated in the context of SNL/NM's portion of aquifer usage, determined to be approximately 1 percent (see Chapter 6). Accordingly, significant water conservation by SNL/NM will have a limited effect on regional aquifer drawdown.

5.6.6 Biological and Ecological Resources

Surveys for the presence or absence of threatened and endangered species and sensitive species, as well as for migratory bird nests, would be conducted at sites prior to commencing activities that could result in ground disturbance or destruction. If any of these species are encountered at a site, avoidance measures would be implemented. Such measures could include scheduling the activities outside of the breeding season and transplanting populations to another location. Migratory bird nests and birds occupying those nests, which could be affected by the activity, would be removed in accordance with the *Migratory Bird Treaty Act* (MBTA) (16 U.S.C. §703) permit from the USFWS. These thirteen species of birds would include, for example, the western burrowing owl and the gray vireo (see Section 4.7).

5.6.7 Cultural Resources

The likelihood for future discovery or identification of previously unrecorded archaeological sites or TCPs in the ROI is high. At present, there are no identified archaeological sites or TCPs on DOE-administered land within the ROI. If resources were discovered as a consequence of ongoing consultations, the stipulations outlined in the *National Historic Preservation Act* (NHPA) (16 U.S.C. §470 as amended) and its regulations (36 CFR Part 800) would be followed. Activities in the immediate vicinity of the discovery would cease until the significance and disposition of the resource could be determined in consultation with the New Mexico SHPO, Native American tribes with cultural affiliation, and the Advisory Council on Historic Preservation. The inadvertent discovery of Native American human remains or funerary objects (associated or unassociated) would require adherence to the *Native American Graves Protection and Repatriation Act* (NAGPRA) (25 U.S.C. §3001). The activity leading to the discovery would stop and would be delayed for 30 days after certification that notification to the agency or tribes had been received. Protection of the individual or objects *in situ* or while curated would be initiated and continue until disposition of the individual or objects is completed. A notice of the discovery would be sent to the Native American tribes with the closest known cultural affiliation, and direction would be requested for treatment and disposition of the items. For land that is permitted to the DOE by another agency, the stipulations in the permits governing the management and treatment of cultural resources would determine which agency is responsible for each of the steps identified above.

The additional security that is enforced at selected facilities during certain activities would increase protection of archaeological sites and TCPs from inadvertent and intentional damage. Although no specific TCPs have been identified within the ROI, if any are identified on DOE-administered land in the future, access to these sites could become an issue. If TCPs are identified and access is desired, the DOE would consult with the appropriate Native American tribe to develop an agreement and procedure for access to the specific TCP. For lands permitted to the DOE by the USAF or USFS, such agreements would potentially involve multiple Federal agencies. Any agreement would have to take into account the additional security enforced by that particular SNL/NM facility.

5.6.8 Air Quality

5.6.8.1 Nonradiological Air Quality

Mitigation measures to control the emissions of chemical and criteria pollutants would not be required under the alternatives. The health impacts associated with the atmospheric release of chemicals were evaluated in Sections 5.3.8.1, 5.4.8.1, and 5.5.8.1. No health effects were identified.

At this time, SNL/NM has a voluntary program for traffic minimization. The city of Albuquerque provides bus routes that nearly span the city boundaries. Several bus routes include KAFB to provide access to SNL/NM. However, the most significant efforts in car-pooling are exercised by individuals who live in outlying cross-town areas or in Belen or Los Lunas. The SNL/NM van or car pool coordinator provides assistance to potential participants. Both the DOE and SNL/NM allow employees to work on a 9-day work schedule (rather than 10 days) over 2 weeks, thus reducing SNL/NM and DOE commuter traffic as much as 10 percent.

SNL/NM actively promotes alternative transportation for employees to commute to work. Current alternatives include walking, bicycling, riding in a van pool, riding in a car pool, and riding the city bus. SNL/NM encourages its employes to reduce the number of cars coming to the base to provide improved air quality, less traffic congestion, reduced travel time, and fewer parking problems. SNL/NM workforce bicyclists commuted approximately 345,000 miles during the Winter Pollution Advisory Periods the last 3 years, avoiding the production of about 15,600 pounds of carbon monoxide pollution. Employees have used 844-RIDE to learn more about van pools, car pools, and city bus service, or to obtain a city bike path map.

From a national perspective, the *Sandia National Laboratories Institutional Plan* (SNL/NM 1997b) briefly describes energy resource R&D projects, as noted in Section 2.1.2. In 1997, SNL/NM undertook 218 R&D projects using DOE-focused technologies and unique SNL/NM science and engineering capabilities. Nearly 16 percent of the projects had applications that were energy resources-related. For example, Sandia's Combustion Research Facility collaborates with industry on its combustion project and concentrates on reducing noxious emissions and developing improved technologies for internal combustion engines. In addition, SNL/NM has a cooperative R&D agreement with the U.S. Advanced Battery Consortium for development of electric vehicle battery technologies. Sandia scientists and engineers are also developing new materials fuel processing catalysts and improved manufacturing processing for batteries, fuel cells, and supercapacitors.

5.6.8.2 Radiological Air Quality

Under each alternative, the calculated radiological annual dose due to air emissions from SNL/NM operations to the MEI and total population within 50 mi of SNL/NM would be minimal and not expected to have any adverse impacts. Therefore, no mitigation measures would be required.

5.6.9 Human Health and Worker Safety

5.6.9.1 Normal Operations

Adverse human health effects are not expected under any of the alternatives. Therefore, no mitigation measures would be necessary to protect human health.

5.6.9.2 Accidents

DOE operations at SNL/NM are conducted in strict accordance with DOE orders, laws, and regulatory requirements to minimize the chances of an accidental release of chemical and radiological materials. Measures can be taken to prevent accidents and, in the event of an accident, to eliminate, lessen, or compensate for potential impacts. For example, engineered safety features and administrative controls are designed to prevent accidents from occurring or stop the progression of the accident. Other measures taken following an accident would minimize impacts to workers, the public, and the environment. For example, air filtration systems, room and building barriers, and air locks that contain releases of hazardous materials, dikes for controlling spills, fire-fighting equipment, evacuating workers and/or the public, restricting the consumption of contaminated food and water, cleaning up contaminated areas, and restricting public access to contaminated areas are existing means to mitigate the adverse effects of accidents. Specific measures for preventing and mitigating accident impacts depend on the accident scenarios, facility locations, and other factors. For this reason, additional existing mitigation measures and their effects are discussed in the context of specific accidents, where applicable, in Appendix F.

Emergency Preparedness and Emergency Plan

SNL/NM has prepared and maintains an Emergency Plan (SNL/NM 1993e) in accordance with DOE requirements. The plan uses inputs from the HA process, SARs, site development plans, and other documents to establish the basic requirements for emergency response. The plan establishes an Emergency Response Organization that is responsible for minimizing the effect of an emergency incident on people, property, and the environment. SNL/NM maintains a working relationship with offsite authorities. The goal is to share information that might be needed during an event, establish response interfaces, maintain rapport, and share resources when requested for event mitigation. The city of Albuquerque, county of Bernalillo, state of New Mexico, KAFB, U.S. Department of Agriculture, USFS, and the DOE have established roles and responsibilities for emergency response. These include the notification processes for each of the response groups and mutual aid in the event of an emergency. SNL/NM, upon request from the DOE, would respond with technical support to transportation accidents involving radiological and hazardous materials. No emergency response roles are identified between SNL/NM and tribal organizations.

5.6.10 Transportation

5.6.10.1 Normal Operations

The transportation of many different materials and waste streams from SNL/NM operations and projects results in a continuous need for proper packaging, labeling, and manifesting. General transportation requirements are anticipated to decrease in 2003 and 2008, based on full implementation of waste minimization/pollution prevention projects. To minimize the impact to the environment, SNL/NM, whenever possible, would transport full shipments of waste materials offsite for treatment and disposal within the programmatic goals and schedules. Using the JIT procurement system would minimize the quantities of materials transported (for example, more packages, smaller quantities) by using specific chemical providers, thereby reducing the number of trips.

Special projects such as the ER Project and shipments of legacy wastes would, in the short-term, increase total transportation requirements for radioactive and hazardous waste. Mitigation measures for the different wastes are discussed in Section 5.6.11.

5.6.11 Waste Generation

5.6.11.1 Waste Generation

No impacts from waste generation would be anticipated. Therefore, no specific mitigation measures would be required. However, the generation of the many different waste streams from SNL/NM operations and projects poses a continuous need for the proper packaging, labeling, manifesting, transportation, storage, and ultimate disposal of the waste. General waste trends are anticipated to decrease in quantity for 2003 and 2008 based on full implementation of waste minimization/ pollution prevention projects. All waste management is considered to be part of the general infrastructure of SNL/NM and has been identified as such in facility documents.

Radioactive Wastes

As part of the effort to minimize the total quantity of radioactive wastes that are generated at SNL/NM facilities, all wastes originating from a Radioactive Materials Management Area (RMMA) must be identified prior to pickup and disposal. A RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material, or an area that is exposed to beams or other sources of particles (neutron, proton, and so on) capable of causing activation. Managers of all facilities must document the location of any RMMAs. Procedures to minimize the generation of radioactive wastes are developed with the Generator Interface and Pollution Prevention Department, Health Protection Department, and the Radiation Protection Operation Department.

The ER Project has been the largest single contributor of LLW and LLMW. Based on current program objectives, the ER Project will be completed around 2004, depending on funding of cleanup projects and NMED approval. Once sites are cleaned up, significant reductions in total waste volumes generated are anticipated. Procedures for this project are detailed in the EA for the ER Project (DOE 1996c). ER Project waste generation would be minimized through a detailed sampling analysis. Site-specific restoration details would be negotiated and approved by the DOE and the NMED program to determine contamination of waste materials from ER sites.

Hazardous Waste

Under the DOE and the NMED, RCRA hazardous waste would be closely managed with annual audits to determine SNL/NM's level of compliance. RCRA hazardous waste operations at SNL/NM are covered under a SNL/NM permit. The largest single contributor of RCRA hazardous waste would be the ER Project. Based on current program objectives, the ER Project will be completed around 2004, depending on funding of cleanup projects and state of NMED approval. Once sites are cleaned up, significant reductions in the total waste volumes being generated would be anticipated. Procedures for this project are detailed in the EA for the ER Project (DOE 1996c). Site-specific restoration details would be negotiated and approved by the DOE and the NMED. In order to more effectively handle and treat hazardous waste generated by this program a CAMU has been constructed. This will minimize the amount of waste generated and pollution generated through packaging and transportation operations. Waste generation would be minimized through a detailed sampling analysis program to determine contamination of waste materials from ER sites and treatment requirements.

As TSCA hazardous wastes (PCBs and asbestos) are removed from existing facilities, the total volume of this type of waste material would decrease. Proper sampling and management of TSCA wastes would reduce overall quantities generated at SNL/NM.

Biohazardous Medical Waste

The total volume of biohazardous waste would remain a function of the total number of full-time employees and subcontractors located at SNL/NM. Proper management of biohazardous wastes would reduce overall quantities and the combined cost for disposal of this waste to SNL/NM.

Wastewater

Measures are currently being implemented that will reduce the total process water used, this will directly reduce the wastewater being generated. SNL/NM entered into a MOU with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997a). The MDL accounts for approximately 90 percent of all process wastewater generated by SNL/NM. Recycling efforts would focus on the MDL in order to reduce the amount of process wastewater being generated. If all of the planned water conservation projects are implemented, 63 to 205 M gal of the current 440 M gal of the water used per year at SNL/NM would be saved. Section 5.3.2 discusses wastewater quantities and capacities. Specific MDL projects are presented below:

MDL Reverse Osmosis Efficiency Improvements

Many MDL operations require high-purity water. Incoming water from KAFB is processed through a water treatment facility that includes the following unit processes: carbon adsorption, reverse osmosis, vacuum degassing, and ion exchange. The production of ultra-pure water before water conservation required 128 M gal of water per year.

The water treatment system of the MDL was modified in 1996 to meet a 30-percent reduction goal. Specifically, the following changes were implemented: new stainless-steel control valves were installed for precise control of water flow; a new manifold was added to the reverse osmosis pump, converting it to a more efficient two-stage pump; high-surface-area reverse osmosis membranes were added; and the existing PVC piping was replaced with industrial, water-production piping.

These modifications cost $107,113 and resulted in an annual reduction of 38 M gal in water use. Annual water and sewer discharge savings were $100,000. The improved reverse osmosis system also reduced the operation hours, saving an additional $22,000.

MDL Water Recycling Project

The MDL Water Recycling Project is funded by SEMATECH, the U.S. semiconductor industry consortium. The project's objective is to document a case history of introducing water recycling into a semiconductor laboratory such as MDL. Water recycling, which could reduce water consumption by 70 percent to 80 percent, has met industry resistance from operational personnel because of the serious risk of product line shutdowns from system contaminants being introduced into the recycle loop.

Project researchers are developing near real-time sensors for detecting organic spikes or excursions in a water recycle loop. Upstream detection will prevent the introduction of contaminants, effectively eliminating the risks associated with recycling spent rinse water. Installation of the common drain system and the collection tanks at MDL is completed. Sensor development and testing continue.

Process Water Reclamation for Cooling Towers at the MDL

Design for this project is complete and the system has been scheduled for construction. The plan for this project is to take some of the process wastewater at the MDL and pump it to an adjacent cooling tower, resulting in a savings of approximately 12 M gal of water per year. The estimated annual cost savings is $25,000. Several technical issues have been addressed, including a chemical analysis of the process wastewater and a corresponding change to the chemical treatment program for the cooling tower.

Water Reduction Project for Cooling Towers

Sandia has 23 cooling tower systems serving 42 chillers. The estimated makeup water for blowdown, evaporation, and drift results in the use of approximately 110 M gal of water per year. The proposed project would change the chemical treatment program and provide instrumentation in the operation of the cooling tower system to reduce water consumption by maximizing the system performance. Approximately 20 M gal of water per year would be saved.

5.6.11.2 Waste Minimization/ Pollution Prevention Program

The Waste Minimization/Pollution Prevention Program is a central element of the SNL/NM Environment Safety and Health management strategy, and day-to-day operations. The program was developed to change the corporate culture, including pollution prevention practices, into everyday activities and tasks. As a result, reducing or eliminating the generation of waste has become an integral part of the philosophy and operations at SNL/NM. SNL/NM developed a formal program plan that provides programmatic guidance, specifying strategies, activities, and methods that are to be employed to reduce the quantity and toxicity of waste and pollutants, to conserve energy and resources, and to encourage the purchase of products with recycled content.

SNL/NM also employs a comprehensive waste minimization program to reduce the quantity of chemical and radioactive wastes generated onsite. The key components of this program are identified in the *SNL/NM Pollution Prevention Plan* (SNL/NM 1997p). These include having senior SNL/NM management committed to the plan, identifying quantitative source reduction and recycling goals, performing Pollution Prevention Opportunity Assessments, and incorporating pollution prevention designs and training into new facilities or processes.

Another aspect of the SNL/NM environmental management strategy includes the implementation of a comprehensive recycling program to reduce the amount of waste generated onsite. Annual projections for recycled waste are presented in Figures 5.3.10–1, 5.3.10–2, and 5.3.10–3. Actual waste trends are shown for RCRA hazardous, TSCA PCB, and TSCA asbestos wastes in Figures 5.3.10–4, 5.3.10–5, and 5.3.10–6. SNL/NM has identified an overall goal to reduce the generation of radioactive and hazardous wastes onsite by 50 percent from the 1993 level, and to reduce the annual generation of sanitary waste by 33 percent.

5.6.12 Noise and Vibration

No impacts would be anticipated; therefore, no specific mitigation measures would be required. However, the existing Weather Watch Program is used by KAFB meteorologists to help engineers select a time for testing when atmospheric conditions are most favorable for deadening sound. These conditions exist during cloudless days with unstable air as opposed to meteorological conditions that favor noise propagation such as when it is overcast or there is an inversion (DOE 1997e).

5.6.13 Socioeconomics

No mitigation measures would be required.

5.6.14 Environmental Justice

In general, no mitigation measures would be required. If access to traditional cultural sites becomes an issue, the DOE would consult with the respective Native American tribe to develop an agreement and procedure for access to specific sites. Any agreement would have to take into account the additional security enforced by that particular SNL/NM facility.

5.7 UNAVOIDABLE ADVERSE EFFECTS

Under any of the three alternatives, SNL/NM operations would require the use of large quantities of groundwater, approximately 400 to 500 M gal per year. Analysis shows that the regional demands on the Albuquerque-Belen Basin aquifer would continue to exceed recharge. SNL/NM's portion of water use in Albuquerque would be less than 2 percent (400 M gal per year, compared to 35 B gal per year). Although SNL/NM could use waste avoidance measures and has committed to a 30-percent reduction by 2004, water use would be unavoidable.

Other areas where effects would be small but unavoidable include human health, worker safety, transportation, and waste generation.

During normal operations at SNL/NM, a minimal amount of radioactive material and activation products would be released to the environment. However, any radiation dose received by a member of the public from emissions from SNL/NM would be too small to distinguish from naturally occurring background radiation. During normal operations, even with a strong as-low-as-reasonably-achievable (ALARA) program and engineering and administrative controls, some radiological exposures to workers would be expected.

In addition, because hazardous and toxic chemicals would be routinely handled at SNL/NM facilities, worker exposure to these chemicals would be unavoidable. However, no onsite chemical concentrations would exceed the Occupational Exposure Limit (OEL) guidelines. Analysis has shown that chemical pollutant emissions would be of minimal consequence and would not pose a danger to the public. For details on the human health and worker safety impacts, see Sections 5.3.8.1, 5.4.8.1, and 5.5.8.1, and Appendix E.

Under any alternative, many different materials and waste streams would be transported at SNL/NM, and such transport would have unavoidable adverse consequences. Transporting materials along public routes would impose unavoidable effects on the environment, which include health effects from radioactive materials and truck emissions.

SNL/NM operations would generate a variety of wastes (including radioactive, biohazardous, solid, liquid, gas, and sanitary) as an unavoidable result of normal operations. Although SNL/NM uses pollution prevention and waste avoidance measures, generation of chemical and radioactive wastes would be unavoidable. SNL/NM would continue to further reduce hazards and potential exposures through the continued success of pollution prevention and waste avoidance measures. Details regarding waste generation impacts are presented in Sections 5.3.10, 5.4.10, and 5.5.10 for each alternative. Appendix H contains expanded information on SNL/NM operations regarding waste generation.

5.8 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The implementation of any of the alternatives would cause some adverse impacts to the environment and permanently commit some resources to specific SNL/NM activities. The alternatives for SNL/NM would require the short-term use of resources (for example, fuel, electricity, water, material, land, expertise, and labor) to reach the long-term goal of achieving DOE's missions in national security, energy resources, environmental quality, and science and technology.

5.9 IRREVERSIBLE AND IRRETRIEVABLE EFFECTS

Operations at SNL/NM under any of the three alternatives would require an irreversible and irretrievable commitment of resources. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. For example, as a landfill receives waste, the primary impact is a limit on waste capacity. The secondary impact is a limit on future land use options. An irretrievable commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations. This section discusses four major resources–water, land, material, and energy–that are committed irreversibly or irretrievably under the three alternatives.

5.9.1 Water

All SNL/NM water needs are met by groundwater. Regional demand on the Albuquerque-Belen Basin aquifer continues to exceed recharge. Therefore, large portions of the water resources that support SNL/NM operations represent expenditure of a nonrenewable resource. The maximum consumption of water under the three alternatives would be 463 M gal per year (No Action Alternative, Section 5.3.2), 495 M gal per year (Expanded Operations Alternative, Section 5.4.2), and 416 M gal per year (Reduced Operations Alternative, Section 5.5.2). Under the Expanded Operations Alternative, MESA would be expected to consume an additional 3.8 M gal per year.

5.9.2 Land

SNL/NM has in the past used onsite landfills for chemical and radioactive waste disposal of SNL/NM-generated wastes. These sites and other ER Project sites are essentially unavailable for use for other purposes due to a variety of factors. These include construction-related criteria involving soil compacting, regulatory restrictions, and compatibility issues related to DOE missions. The total acreage removed from future or unrestricted use is yet-to-be-determined, because some sites (for example, the CWL) would require continued monitoring, limited access, limited use, and potentially require other future corrective actions for an extended period of time.

5.9.3 Material

Resources irreversibly and irretrievably committed during the 10-year period of the SWEIS, associated with the operation of SNL/NM in support of DOE missions and programs include construction, maintenance, and operational support materials. Consumption of these widely available materials would not be expected to result in critical shortages. Appendix A contains information related to the types and quantities of materials used, stored, and shipped to support SNL/NM operations.

5.9.4 Energy

The irretrievable commitment of resources during construction and operation of the facilities would include nonrenewable fuels to generate heat and power. Energy would be expended in the form of electricity and natural gas. The maximum consumption of electricity, 198,000 MWh per year, would occur under the Expanded Operations Alternative. Corresponding natural gas consumption would be at 475 M ft^3 per year (see Section 5.4.2). Under the Expanded Operations Alternative, MESA would be expected to contribute an additional 6,000 MWh and 6 M ft^3 of natural gas consumption annually.

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CHAPTER 6

Cumulative Effects Analysis

The Council on Environmental Quality regulations implementing the *National Environmental Policy Act* (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 Code of Federal Regulations [CFR] §1508.7). The regulations further explain that "cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." The cumulative effects analysis presented in this Site-Wide Environmental Impact Statement (SWEIS) is based on the incremental actions in the region and the operations at Sandia National Laboratories/New Mexico (SNL/NM), as detailed in Chapter 5.

Based upon examination of the potential environmental effects of direct and indirect actions, coupled with other agency and U.S. Department of Energy (DOE) actions in the region and private actions, the DOE determined the following resource areas were likely to have a potential for cumulative effects and needed to be analyzed in detail: land use, infrastructure, water resources and hydrology, soils, biological and ecological resources, cultural resources, air quality, human health and worker safety, waste generation, transportation, noise and vibration, socioeconomics, and environmental justice. This chapter provides a detailed description of seven additional DOE facilities that are not included in the impact analysis presented in Chapter 5, a brief overview of U.S. Department of Defense (DoD) activities at Kirtland Air Force Base (KAFB), and the cumulative effects on resource areas of the activities at facilities selected for study in this SWEIS.

6.1 METHODS OF ANALYSIS

The DOE assessed cumulative effects by combining the potential effects of the Expanded Operations Alternative with the effects of other past, present, and reasonably foreseeable activities in the regions of influence (ROIs). The Expanded Operations Alternative with the Microsystems and Engineering Sciences and Applications (MESA) Complex configuration was chosen to assess and present a bounding scenario of potential cumulative effects, with the exception of air quality chemicals. This approach allowed a conservative analysis or a maximum estimation of cumulative impacts. This chapter notes any differences in impacts from the other alternatives if they would cause variation in the analysis. The extent of the regions of influence (ROIs) varies widely from one resource area to another. The ROIs used in the cumulative effects analysis are the same as those presented in Chapter 4.

6.2 DOE FACILITIES/DoD ACTIVITIES

This section describes seven additional DOE facilities and their activities and operations. These include the DOE Albuquerque Operations Office (AL), Energy Training Complex (ETC), Transportation Safeguards Division (TSD), Nonproliferation and National Security Institute (NNSI), Ross Aviation, Inc. (Ross), Lovelace Respiratory Research Institute (formerly the Inhalation Toxicology Research Institute), and Federal Manufacturing & Technology/New Mexico (FM&T/NM) (also known as AlliedSignal) (Figure 6.2–1). The operations of these facilities and any contribution to impacts to specific resource areas are summarized in the sections that follow (Sections 6.2.1 through 6.2.7). Table 6.2–1 lists various parameters related to the operation of the additional DOE facilities.

In general, activities at the seven additional DOE facilities are similar to the activities described in Chapters 2 and 3. The potential impacts to resources described in Chapter 5 are largely representative of the type of impacts resulting from these seven DOE facilities. These seven facilities were not included in Chapter 5 because they are not SNL/NM's activities. Routine operations of these facilities involve maintenance support services, ongoing custodial services, security services, and training services. None of these activities pose any major threat or harm to the environment, and the potential for environmental impacts is low. Standard safety procedures, environmental safeguards, and hazardous waste and materials management are conducted at the facilities in accordance with applicable U.S. Department of Transportation (DOT), DoD, DOE, and U.S.

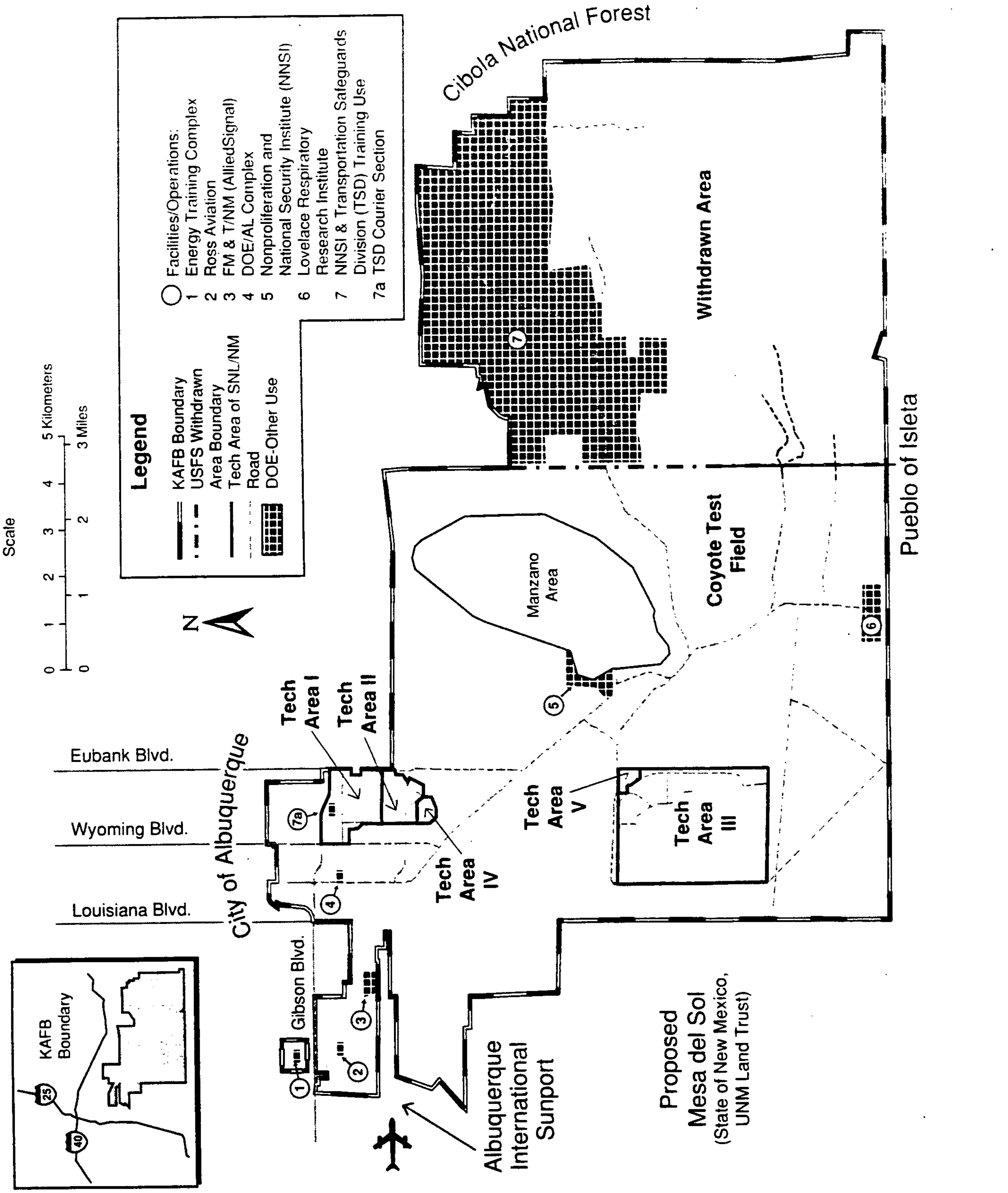

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Figure 6.2–1. Additional DOE Facilities at KAFB

Other DOE operations, not related to SNL/NM, are located at KAFB.

Table 6.2–1. Summary of Parameters and Activities of Additional DOE Facilities at KAFB

PARAMETER	ALBUQUERQUE OPERATIONS OFFICE	ENERGY TRAINING CENTER	TRANSPORTATION SAFEGUARDS DIVISION	NNSI	ROSS AVIATION	LOVELACE RESPIRATORY RESEARCH INSTITUTE	FM&T/NM
FTEs	840	20	80	130	70	225	282
Utilities	Electric power from PNM; water from city; steam from SNL/NM sources; natural gas provided through KAFB; some diesel fuel storage for emergency generators	Electric power from PNM; water from city	Electric power from KAFB; water from KAFB and city	Electric power from KAFB; water from KAFB and city	Electric power from KAFB; water from KAFB and city	Electric power from KAFB; water from KAFB and city	Electric power from KAFB; water from KAFB and city
Wastes[a]	Wastes managed through SNL/NM and KAFB	Wastes managed through KAFB	Wastes managed through SNL/NM and KAFB	Wastes managed through SNL/NM and KAFB	Wastes managed by Ross	Wastes managed through SNL/NM and KAFB	Wastes managed through SNL/NM and KAFB
Special Materials	None	None	Classified materials and explosives	Weapons, ordnance, oil, gasoline, paint, cleaning compounds, insecticides	Jet fuel, batteries, and some handling of radioactive materials	Radioactive materials	Paint, fuel, cleaning compounds, oil, pyrotechnic, and ammunition material

Sources: DOE 1998f, SNL/NM 1997j
FM&T/NM: Federal Manufacturing & Technology/New Mexico
FTE: full-time equivalent
KAFB: Kirtland Air Force Base
LLW: low-level waste
NNSI: Nonproliferation and National Security Institute
PNM: Public Service Company of New Mexico
TA: technical area
TRU: transuranic
[a] Waste volumes are accounted for in total volumes by waste category as managed by SNL/NM and KAFB (see balance of operations totals in Tables H 3-2 and H 3-8). Site-wide municipal solid waste is covered in Table H 3-14. Individual facility waste generation rates by waste category were not reported (DOE 1998f) but are believed to be small due to the nature and scope of operations conducted at these facilities.

Environmental Protection Agency (EPA) requirements. Similarly, Section 6.2.8 describes DoD activities at KAFB, including operations and environmental quality.

6.2.1 Albuquerque Operations Office

The DOE implements many of its mission lines and programs through assignments to field organizations. Since the establishment of the Atomic Energy Commission in 1946, AL's primary assignment has been the field management of the nation's nuclear weapons stockpile. AL performs this mission for Defense Programs (DP) and its customer, the DoD's Strategic Command. Other missions are restoring the environment and ensuring a strong scientific and technology base. AL uses Federal resources to accomplish mission objectives and to oversee the contractors who manage and operate major facilities located throughout the country. These facilities include research and engineering laboratories, nuclear weapons production plants, and environmental management sites.

The site is located on land owned by the Federal government. The main AL site is located on KAFB. Some DOE buildings are on property owned by the DOE, although many are on property owned by the U.S. Air Force (USAF) and permitted to the DOE. Two USAF buildings are also adjacent to DOE buildings. The AL complex occupies approximately 6 ac of DOE-owned land and 6.7 ac of land under a use permit from the USAF. Additionally, DOE owns an 86 ac parcel of vacant land located along the west side of Eubank Boulevard just outside the northern boundary of KAFB (see Section 4.3).

Facilities and Operations

The main AL site includes 40 buildings, of which 30 are bounded by a security fence. Buildings on the main site include five three-story office buildings, several portable trailers used as temporary office space, eight one-story buildings, an interconnect, one maintenance shop, a shipping and receiving building, a wellness center/snack bar, and a child development center. Most activities at AL are administrative in nature. Hazards are typical of an office environment that might result in falls on stairways, minor cuts or abrasions, back strains, and the like.

As of April 1998, approximately 840 personnel were located in this complex. Approximately 100 other DOE employees were located within SNL/NM Technical Area (TA)-I, in the AL Kirtland Area Office (KAO), and in a number of smaller offices associated with activities described below.

6.2.2 Energy Training Center

AL operates the ETC, located approximately 3 mi west of the main AL site previously described. The ETC consists of approximately 10 ac of land permitted to the DOE by the USAF. The facility is an historic complex registered with the New Mexico Historical Society. It was originally constructed in 1936 as the Sandia School, a group of buildings housing an all-girls school. Since that time, it has served during World War II as the location for an Army and USAF convalescent hospital, the first location of the New Mexico Institute of Mining & Technology, the location for some of Sandia Laboratories' first physicists, the offices of the Atomic Energy Commission, and the KAFB West Officers' Club. The facility has recently undergone major interior renovations to support DOE's technical training program functions, while maintaining its historical character.

The ETC has the capacity for multifaceted training and development and for large conferences and meetings. The ETC's operations are funded solely by the DOE; however, the Department shares the facilities with SNL/NM contractors; other Federal, state, and local agencies; and the local community, thereby generating ongoing cost savings for the Federal government, its laboratories, and its customers. The site includes eight buildings, with a gross building area of 53,996 ft^2, and an adjacent parking lot. The ETC contains 15 training and meeting rooms accommodating up to 700 attendees, an auditorium with a 300-seat capacity, and a computer training room. The ETC also has a customer service complex, offering a variety of support services to accommodate training and meeting needs. Hazards existing at the ETC are those typical of an office building.

6.2.3 Transportation Safeguards Division

Established in 1975, the DOE's TSD provides for safe and secure movement and continual surveillance and accountability of government-owned special nuclear material, nuclear weapons, and weapon components throughout the U.S., by way of DOE-owned and -operated tractor trailers. There are three TSD facilities located in different areas of KAFB: the Albuquerque Courier Section, the Training Center and Annex, and the TSD Administrative Offices and Secure Communications Center (SECOM). These facilities are described below. SNL/NM manages and disposes of all hazardous waste generated by TSD. A description of the transport activity for weapon components and radioactive materials may be found in the *Stockpile Stewardship and Management*

[SSM] *Programmatic Environmental Impact Statement* [PEIS] (DOE 1996a) and the *Final Environmental Impact Statement* [EIS] *for Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons* (DOE 1996k).

Albuquerque Courier Section

The TSD Albuquerque Courier Section is located in a fenced area within SNL/NM's TA-I. The facility consists of eight administrative buildings; one vehicle maintenance facility (VMF); a Mobile Electronic Maintenance Facility (MEMF); and a safe, secure transport (SST) parking area in support of TSD's operations. The buildings on the site are prefabricated metal buildings, approximately 30 ft by 60 ft, located on approximately 3 ac of land.

TSD's Albuquerque Courier Section has approximately 80 employees including both Federal and contractor personnel. Activities are mainly administrative in nature, but also include special agent trip preparation and vehicle maintenance. There is an armory located in one of the buildings. Limited amounts of Class 1.3 and 1.4 munitions are stored separately from the firearms for immediate protective force response. The MEMF functions primarily as an electronics equipment testing, maintenance, and repair facility for TSD vehicles. The VMF, which is adjacent to the Albuquerque Courier Section, is operated by SNL/NM to perform routine maintenance on the SSTs and escort vans. Most of TSD's functions are administrative or standard vehicle maintenance, and the associated hazards are typical of those activities.

Training Center and Annex

TSD's Training Center and Annex consist of 11 administrative buildings, 1 armory, 8 storage bunkers, and an SST parking area in support of the TSD's operations. The Training Center and Annex are located in Coyote Canyon on approximately 619 ac of property leased from the USAF. The buildings are prefabricated metal, approximately 30 ft by 60 ft. There is an armory located in one of the buildings. DoD-approved and -licensed bunkers for housing munitions are located across the road from the Annex.

TSD's Training Center and Annex operations are performed by approximately 40 contractor personnel. Activities include administrative functions, special agent classroom training, engagement simulation system equipment storage, and firearm maintenance and storage. The Training Center and Annex are used for training, development, and logistical support. Similar to TSD's Albuquerque Courier Section, most of the Training Center and Annex activities consist of office and classroom training and the typical hazards are those associated with such activities. As mentioned, munitions are stored onsite, but are not used in this area.

Administrative Office and Secure Communications Center

The administrative offices of TSD are encompassed in the description of the main AL office site. SECOM is also located within this area. There are 15 TSD personnel who operate the equipment that continuously tracks the DOE's SST vehicles over the road, 24 hours a day, 7 days a week. SECOM provides management of nuclear material shipments, reliable communications, emergency response, and remote command and control of five relay stations. Backup tracking systems, including a voice system and a digital vehicle monitoring system, are also available for use in case the primary SECOM tracking system should fail. Hazards existing at TSD administrative offices are those typical of an office setting.

6.2.4 Nonproliferation and National Security Institute

In May 1984, the Secretary of Energy authorized the establishment of the Central Training Academy (CTA), which is located on land owned by the USAF and permitted to the DOE. The CTA, now known as the NNSI, is composed of two facilities, the campus and the live-fire range. The campus is located in the foothills and canyons of the Manzanita Mountains on KAFB. The live-fire range is located in Coyote Canyon on 85 ac approximately 6 mi east of the campus. The land and buildings for both facilities are administered by KAFB, and the buildings occupy approximately 41 ac. The live-fire range is on U.S. Forest Service (USFS) land that has been withdrawn to the USAF and subsequently permitted to the DOE. Safety zones associated with the live-fire range also extend into the DOE portion of the Withdrawn Area.

The NNSI provides the effective and efficient training and professional development of safeguards security personnel throughout the DOE who are, or may become, involved in security training and program management for safeguards and security training at all DOE facilities. The NNSI provides training in various security disciplines such as tactical response, supervisor and instructor certification, advanced weaponry, threat analysis, material control and accountability, and safety officer certification. SNL/NM manages and disposes of small quantities of hazardous waste generated at the live-fire range.

Facilities and Operations

The NNSI campus consists of eight permanent buildings, used under a 15-year permit from the USAF, and several portable buildings. Under the terms of the permit, the USAF is responsible for all subsurface utilities and facilities such as sewer, water, fuel, telephone, and power lines.

There are five firearms ranges, including two pistol ranges, two rifle ranges, and a research and development (R&D) range. There are a number of support facilities for range operations such as a range administration building with a paramedic facility, three range control towers, a small tactical simulator tower, a tactical training facility, an armory, a machine shop, classroom space, a small ammunition bunker, and a structure used for weapons cleaning. Small quantities of chemicals, including paint, adhesives, fertilizer, oil, gasoline, cleaning compounds, and insecticides, are used and stored at these facilities.

Most of the campus activities are those associated with an educational facility or office environment and the typical hazards are those associated with such activities. Live-fire range instruction includes basic firearms instructor training, armorer training, rappelling, tactical movement with firearms, and safety officer range instruction. Activities at the NNSI firing range could involve hazards of types and magnitudes that are not as common. Because training at the live-fire range involves live ammunition, the possibility of a traumatic accident exists. Although these activities present certain risks, existing safety procedures reduce these risks. Overall, the risks are considered low. A paramedic is on duty during all potentially hazardous training courses and has advanced life support and emergency first aid equipment and trauma supplies on hand.

The NNSI has an Interdependent Support Agreement with KAFB to provide fire protection and other support activities. The risk of fire at the campus is consistent with that of any business or educational facility. Most of the buildings within the NNSI campus have fire detection systems in place. The risk of fire in the administrative area of the live-fire range is also low. In the range areas, the most likely fire-related incident is one wherein diversionary devices are used during training. The fire potential has been recognized, and safe operating procedures require that diversionary devices be used only in designated areas. Organizations using pyrotechnic devices are required to provide their own fire watch and means of extinguishing fires. Very limited amounts of flammable liquids are maintained at the NNSI. Gasoline is stored in one 500-gal aboveground tank or in approved 5-gal safety cans and secured in National Fire Protection Association-approved flammable storage cabinets.

The live-fire range munitions storage area is inside a fenced enclosure east of the administration area. Aboveground storage containers are used for storage of small arms ammunition and diversionary devices. Munitions are stored in accordance with safe operating procedures, the DOE *Explosive Safety Manual* (DOE M 440.1-1), and the DOE *Firearms Safety Technical Standard* (DOE-STD-1091-96), which consider risks, quantities, distances, compatibility, and procedural requirements. Regular inspections are conducted to ensure compliance with storage and transportation requirements.

6.2.5 Ross Aviation, Inc.

Ross is the air transportation support services contractor for TSD. Ross has been involved in both operating and maintaining large transport-category and small multi-engine aircraft in support of DOE operations for over two decades. Ross operates from facilities and land owned by the 377th Air Base Wing, KAFB, and permitted to the DOE. The Ross site is located on KAFB and covers approximately 11.4 ac. Ross's facilities and operations on KAFB are described below. A description of the transportation of weapon components and radioactive materials may be found in the SSM PEIS (DOE 1996a) and the Pantex EIS (DOE 1996k).

Facilities and Operations

The facilities consist of the main 42,412-ft^2 aircraft hangar, two guard buildings, a portable modular building, a hazardous materials storage area, a parking lot, and a 3,200-ft^2 maintenance support facility, which houses various workshops. The aircraft that Ross operates in support of the DOE air service contract are government-owned.

Ross transports cargo to and from DOE production plants, national laboratories, test sites, and military facilities and provides special passenger and cargo flights on demand. Ross operates from facilities located on

KAFB land, permitted to the DOE by the USAF, adjacent to the Albuquerque International Sunport. Ross operates and maintains a fleet of seven aircraft that include the deHavilland DHC-6, Beechcraft B-200, Lear 35A, and Douglas DC-9 aircraft. The DHC-6 aircraft are used for research-related activities. The size and mix of the fleet are adjusted in response to DOE mission line requirements. Loading and unloading of radioactive materials at the Albuquerque location are frequently conducted on the south side of the runway at KAFB. On rare occasions, shipments are loaded at the Ross facility.

Ross maintains a Federal Aviation Administration-approved repair station at this site and is certified to perform maintenance on each of the DOE's aircraft. All maintenance, except DC-9 major maintenance, is performed at Ross's facilities in the city of Albuquerque. The DC-9 major maintenance is performed under contract by Air Canada at their maintenance center located in Montreal, Canada.

There is no permanent or bulk storage of gasoline or jet fuel on the site. Jet fuel is purchased on an as-needed basis from the USAF and is kept in two 5,000-gal-capacity tank trucks until dispensed. Ross operates and maintains the fuel trucks within the DOT requirements. During routine aircraft maintenance, some spent jet fuel and oil are generated and are recycled by a local contractor. Ross Aviation generates hazardous wastes in quantities less than 1,000 kg per month, and is, therefore, considered a small-quantity generator of hazardous wastes under the *Resource Conservation and Recovery Act* (RCRA) (42 United States Code [U.S.C.] §6901). Solid waste from the site is transported to the city of Albuquerque landfill by a commercial service provider under contract to the DOE. Cardboard and paper are recycled through the KAFB recycling program.

6.2.6 Lovelace Respiratory Research Institute

The Lovelace Respiratory Research Institute is located on land owned by the Federal government; administered by the U.S. Department of the Interior, Bureau of Land Management (BLM); and withdrawn for use by the USAF at KAFB. AL maintains a permit from the USAF for use of the land, which is renewed every five years. The primary permit includes the main site, a water line from SNL/NM TA-III, an elevated water tank site, and a high-voltage power transmission line. The site covers approximately 144 ac.

The buildings and most major equipment at the Lovelace Respiratory Research Institute are owned by the DOE. The facility was formerly a single-program laboratory under the DOE's Office of Energy Research and was operated for the DOE by the Lovelace Biomedical and Environment Research Institute, Inc. (LBERI), under a cost-reimbursable, no-fee management and operating (M&O) contract between DOE, LBERI, and The Lovelace Institute, LBERI's corporate parent. The M&O contract terminated in September 1996. On October 1, 1996, the DOE leased the buildings and equipment to LBERI for a period of five years, for operation of a private biomedical research institute now known as the Lovelace Respiratory Research Institute. The DOE has continued to fund work by LBERI under a five-year cooperative agreement that began in October 1996. The DOE, as the landlord, continues to be responsible for major maintenance at the facility. LBERI conducts private work at the facility funded through various grants, contracts, and philanthropic contributions. Use of the facility by LBERI must be within the scope of the DOE lease arrangement and the conditions of the USAF permit to DOE.

The initial research program at Lovelace Respiratory Research Institute focused on the human health consequences associated with the inhalation of airborne radioactive fission products. In the late 1960s and early 1970s, the research program expanded to include research on the transuranic (TRU) alpha-emitting radionuclides. In the mid-1970s, the research program was broadened further to examine the potential health effects of airborne chemicals released from energy use and energy production sources such as coal combustion and gasification, solar collectors, and light-duty diesel engines. Since 1980, the program focus has shifted to include more basic research, with an emphasis on understanding the fundamental biological response of the respiratory tract to inhaled materials.

Site Description

The Lovelace Respiratory Research Institute complex is located approximately 10 mi south of the city of Albuquerque on KAFB. The main site covers approximately 144 ac, of which approximately 40 ac are developed. In addition to the main site, 9 ac are associated with water pumping, storage, and distribution, and electrical power distribution. The site is on a high, semi-arid alluvial fan, surrounded by KAFB to the north, east, and west, and by the Pueblo of Isleta to the south.

Facilities and Operations

Most of the Lovelace Respiratory Research Institute's research operations and facilities are concentrated within a 20-ac area, with the remaining acreage used for roads, storage, buffer area, environmental monitoring, and utilities. Total building square footage is approximately 290,000 ft^2. Approximately 50 percent of the space is devoted to bench-scale laboratory operations. Facilities for animal housing occupy about 25 percent of the space. Warehouse storage; engineering and maintenance shops; environment, safety, and health facilities; and waste storage buildings comprise the remainder of the space. The site includes unique facilities for conducting long-term inhalation toxicology studies using laboratory animals under carefully controlled conditions. These facilities are designed with specialized air handling systems, are isolated from other laboratories, and may be used for research on radioactive or potentially carcinogenic materials. The scale of the work is best portrayed by the fact that materials under investigation are used in concentrations to which people are, or may be, typically exposed, and that about half of the work involves materials that are common air pollutants.

There are three main categories of operations at the facility. About 5 to 10 percent of laboratory operations is devoted to work with aerosols. Characterization of aerosols is conducted for purposes such as designing atmospheric pollutant detectors, identifying the effectiveness of respirator filters, and developing effective medication delivery carriers for inhaler devices. Aerosols are prepared for use in animal exposure tests for determination of effects from inhalation of various chemicals and nuclear materials.

Much of the work (approximately 40 percent) includes conducting exposure studies using test aerosols with laboratory animals, primarily rodents. Work is typically conducted with microgram to milligram quantities of materials and is carried out within enclosures for health protection measures and to treat air exhaust. Examples of this type of research include

- determining radiation dose and injury to critical lung cells following exposure to radon, *in vivo* and *in vitro;*
- characterizing xenobiotic-metabolizing enzymes produced from exposure to cigarette smoke in the respiratory tract of rodents;
- determining the relationship between airway dimensions and airflow following exposure to various energy-related aerosols; and
- conducting histopathological examination of lung tissue collected from uranium miners.

An additional 15 to 20 percent may be described as analytical chemistry operations. Work in this category is typically related to characterizing the biochemical mechanisms of respiratory disease. Examples of this type of research include

- testing the metabolic action of benzene and its metabolites in the liver and bone marrow of rodents,
- developing cellular models of radiation-induced carcinogenesis in rodents,
- identifying intrinsic human genes that govern susceptibility to radon-induced cancer, and
- investigating the cellular mechanisms of granulomatous disease from inhaled beryllium.

A wide variety of hazardous chemicals, some of which are carcinogenic, biological agents, and radioactive materials in small quantities, are handled in the facility. Air effluents are treated with various techniques such as high-efficiency particulate air (HEPA) filtration, activated charcoal filtration, and thermal oxidation. Air effluents are permitted under a Title V operating permit with the Albuquerque/Bernalillo County Air Quality Control District (A/BC AQCD).

Sanitary wastewater is discharged to the KAFB main line and a monitoring station is located upstream of that juncture. The facility is a small-quantity generator under RCRA regulations. Occasional small quantities of low-level waste are shipped to the Nevada Test Site (NTS), and very small amounts of TRU waste are occasionally shipped to SNL/NM. Hazardous and sanitary waste disposal is contracted to a local firm.

6.2.7 Federal Manufacturing & Technology/New Mexico (AlliedSignal)

FM&T/NM (also known as AlliedSignal) is an operating division of AlliedSignal FM&T in Kansas City, Missouri. FM&T/NM is an M&O contractor to the DOE. FM&T/NM operates six facilities, two in the city of Albuquerque and four at various locations on KAFB.

FM&T/NM is primarily tasked with producing or procuring nonnuclear components for the DOE's national security mission at the Kansas City Plant. FM&T/NM is an applied-science and engineering organization engaged in research, analysis, testing, and field operations that principally support the TSD, as well as the national laboratories, other DOE contractors, the DoD, and other Federal agencies.

FM&T/NM provides a wide range of technical support activities to the DOE and other Federal agencies in multi-disciplined fields. Activities include technical support in electronic and mechanical fabrication; electronic, mechanical, and optical design and development; accelerator design; experimental physics; software development, data gathering, and analysis; computer-based training; security system development and installation; security force training; drafting; videography; calibration; and support to the nation's nuclear SST system. These activities routinely involve field operations within the U.S. and occasionally involve worldwide field operations. FM&T/NM often uses the significant manufacturing capabilities of the Kansas City Plant to provide support to their customers.

Facilities and Operations

FM&T/NM operates facilities at the following sites in Bernalillo county, New Mexico: NC-135 Area, KAFB; Craddock Facility at 2540 Alamo SE; Mobile Electronic Maintenance Facility, Building 854, TSD Albuquerque Courier Section, KAFB; Electronics Site, KAFB; Transportation Safeguards Training Center Annex (2 buildings), KAFB; and Air Park Facility at 2100 Air Park SE.

The main facility is the NC-135 area. This site covers 20.5 ac with 3 concrete flight pads and multiple buildings totaling 56,728 ft^2. FM&T/NM administrative operations are located here, including engineering functions; various electronic equipment testing, repair, and fabrication areas; a spray paint shop; a small machine shop; and a facility maintenance area.

The Craddock Facility is a leased facility used for machine and metal work. The Air Park Facility is a leased facility used for classroom training. The remaining locations support TSD operations and are described under those operations.

All operations and processes conducted at FM&T/NM are of a type and nature routinely encountered by the public in general industry. Small quantities of chemicals typical of machining and electronics repair are used. FM&T/NM meets the definition of a small-quantity generator or conditionally exempt small-quantity generator.

6.2.8 U.S. Department of Defense Activities

The following section describes DoD activities at KAFB. The description of activities and the analysis of potential environmental impacts is not meant to be exhaustive or be totally inclusive of all DoD activities and operations. KAFB maintains an environmental management division that is independent of the DOE's environmental management division. KAFB is responsible for ensuring USAF compliance with all applicable Federal, state, and local environmental regulations.

Operations

KAFB is an Air Force Materiel Command base sharing installation facilities and infrastructure with over 200 associate organizations, including AL, KAO, and SNL/NM. DoD units on the base serve a variety of operational, research, and development missions, representing all branches of the DoD. The base covers approximately 51,560 ac in Bernalillo county adjacent to the southeast boundary of the city of Albuquerque.

The host organization at KAFB is the 377th Air Base Wing. The mission of the wing is to provide munitions maintenance, readiness, and base operating support to base associate organizations. Base support functions include civil engineering, transportation, medical, financial, and personnel services. The 898th Munitions Squadron, which operates the Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC), is a significant organization within the 377th Air Base Wing. Their mission is to receive, store, maintain, modify, and ship weapons and components. This function is available to all uniformed services and to the DOE worldwide.

Following are other major DoD associate organizations at KAFB and their missions.

- *Headquarters, USAF Operational Test and Evaluation Center*—Responsible for planning and conducting realistic, objective, and impartial testing and evaluation of USAF weapons systems, in an operational setting, to determine their effectiveness and suitability in meeting the needs of the USAF mission.
- *Field Command, Defense Special Weapons Agency (FCDSWA)*—As the field element of the Defense Nuclear Agency, the FCDSWA's major responsibilities include maintaining the database on

all nuclear weapons in the national stockpile and conducting nuclear weapons effects tests using high explosives, thermal, electromagnetic pulse, and radiation simulation facilities. FCDSWA also operates the Interservice Nuclear Weapons School at KAFB, which provides both classroom instruction and field exercises in handling emergency situations involving nuclear weapons.

- *The Air Force Research Laboratory (AFRL)*—Headquartered at Wright-Patterson Air Force Base, Ohio, AFRL (formerly known as the Phillips Laboratory) is responsible for space system, ballistic missile, geophysics, and directed energy system research. AFRL operations at KAFB are as follows:
- *AFRL Directed Energy Directorate*—Demonstrates the technical feasibility of lasers and imaging systems; also involved in the development of high-energy plasmas, microwave technology, electromagnetic pulse hardening, and advanced techniques and computer simulations for weapon effects.
- *AFRL Space Vehicle Directorate*—Develops spacecraft and ballistic missile technologies. The primary focus is on structures, power and thermal management, sensors, electronics, and geophysics.
- *The 58th Special Operations Wing (58th SOW)*—The 58th SOW is one of two flying wings at KAFB and is responsible for training all USAF helicopter and HC-130 Special Operations crews and pararescue specialists, handling over 1,000 students per year.

  The CV-22 Osprey, a modified MV-22 tilt-rotor aircraft, will replace the Air Force's MH-53J Pave Low Helicopter. KAFB will be the Air Force's initial operational test and evaluation base. After completion of developmental testing in spring 2002, the first four CV-22s will become part of the 58th Training Squadron at KAFB (Huxsoll 1999).
- *Headquarters, New Mexico Air National Guard*—Provides ready units and personnel as needed to support Federal, state, and community requirements out of a number of locations throughout New Mexico.
- *The 150th Fighter Wing (New Mexico Air National Guard)*—The other flying wing at KAFB, flying F-16 C/D aircraft in support of the Air National Guard's overall mission.
- *The Air Force Safety Center (AFSC)*—AFSC manages the USAF Mishap Prevention Program and the USAF Nuclear Surety Program. The AFSC field operating agency develops regulatory guidance, provides technical assistance in all safety disciplines, and maintains the USAF safety database. AFSC also maintains an Aircraft Crash Investigation site on KAFB.
- *The Air Force Inspection Agency*—Provides objective and independent assessments of USAF leadership and management functions to enhance readiness, discipline, efficiency, and effectiveness.

The Manzano Area is a major facility at KAFB. The Manzano Area was built in 1947 and became functional in 1950 as a location for storing and maintaining weapons during the Cold War. The Manzano Area consists of four weapons maintenance plants located inside the Manzanita Mountains as well as 122 storage magazines, 81 of which are covered with earth, and 41 are tunneled into the side of the mountain.

In June 1992, the Manzano Area was deactivated. The associated material and function was moved to the KUMMSC and the 898th Munitions Squadron. Currently, the maintenance bays are used primarily for classified research and development activities, and the bunkers are used for storing a variety of materials and administrative records.

The Manzano Area remains a controlled-access facility with a perimeter fence and a cipher-locked gate. Since 1992, SNL/NM has provided security. The perimeter intrusion detection and alarm system was deactivated with the termination of the main mission in 1992, although individual facilities continue to have intrusion alarms.

Environmental Quality

Hazardous Waste

Air Force installations typically generate waste solvents, oils, paints, paint sludges, and some R&D chemical wastes that are regulated as hazardous waste. KAFB's hazardous waste management plan sets local management procedures for managing hazardous waste and preventing pollution. The plan incorporates Federal (including Air Force), state, and local requirements regarding hazardous waste and applies to all host and associate organizations that generate hazardous waste on KAFB.

Solid Waste

KAFB collects all refuse, through a private contractor, from military family housing units and all support and associate-occupied areas of the installation. Collected refuse is then disposed of at a regional landfill off KAFB.

Fuel Storage Tanks

Fuel storage tanks represent a potential threat to the environment. Existing underground storage tanks have a phaseout schedule based on age, and all are scheduled to be upgraded with cathodic protection and spill/overflow control by December 1998.

Aircraft are fueled and defueled using tanker trucks. This also represents a potential for spills and leaks to the environment. KAFB has an annual throughput of about 15.7 M gal of JP-8 fuel, 257,000 gal of gasoline, and 243,500 gal of low-sulfur diesel fuel. JP-4 fuel is stored in two external roof tanks (one 2-M gal and one 4-M gal) located at the bulk fuel storage area. One 10,000-gal gasoline aboveground tank and two (one 10,000-gal and one 5,000-gal) low-sulfur diesel fuel aboveground tanks are also located at the bulk fuel storage area.

Used oil is periodically collected by a commercial contractor for offsite recycling. Used oil is randomly sampled by KAFB Environmental Management for the presence of polychlorinated biphenyls (PCBs) and RCRA constituents.

Environmental Restoration Program

KAFB conducts an environmental restoration program under the Air Force's Installation Restoration Program (IRP). There are currently 70 IRP sites and 12 areas of concern.

Air Emissions Sources and Inventory

Air Force installations typically have numerous sources of air pollutant emissions that are regulated and may require permits for construction and operation. Primary emissions sources are steam and hot water generation plants, paint shops, aircraft and ground vehicles, and processes and test activities. KAFB currently has two air permits in effect. The Title V permit application was submitted in December 1995 and lists over 340 "significant" sources. Approximately 150 of these sources are aerospace ground equipment, largely transportable generators, heaters, and cooling units, that are used intermittently. Another 60 are backup generators used to supply power to buildings during outages.

The SWEIS analysis (see Chapter 5, Air Quality) of chemical air emissions from SNL/NM show no individual or aggregate emissions of concern to human health. Emissions from KAFB are also unlikely to be of concern to human health because, like SNL/NM, hazardous chemical air emissions are below levels requiring monitoring by the *Clean Air Act* (42 U.S.C. §7401) or local air quality regulations. Carbon monoxide emissions from vehicle are the primary air pollutant of concern. Total carbon monoxide from SNL/NM and KAFB show decreasing trends and, combined, are less than 10 percent of the total carbon monoxide emissions in the area.

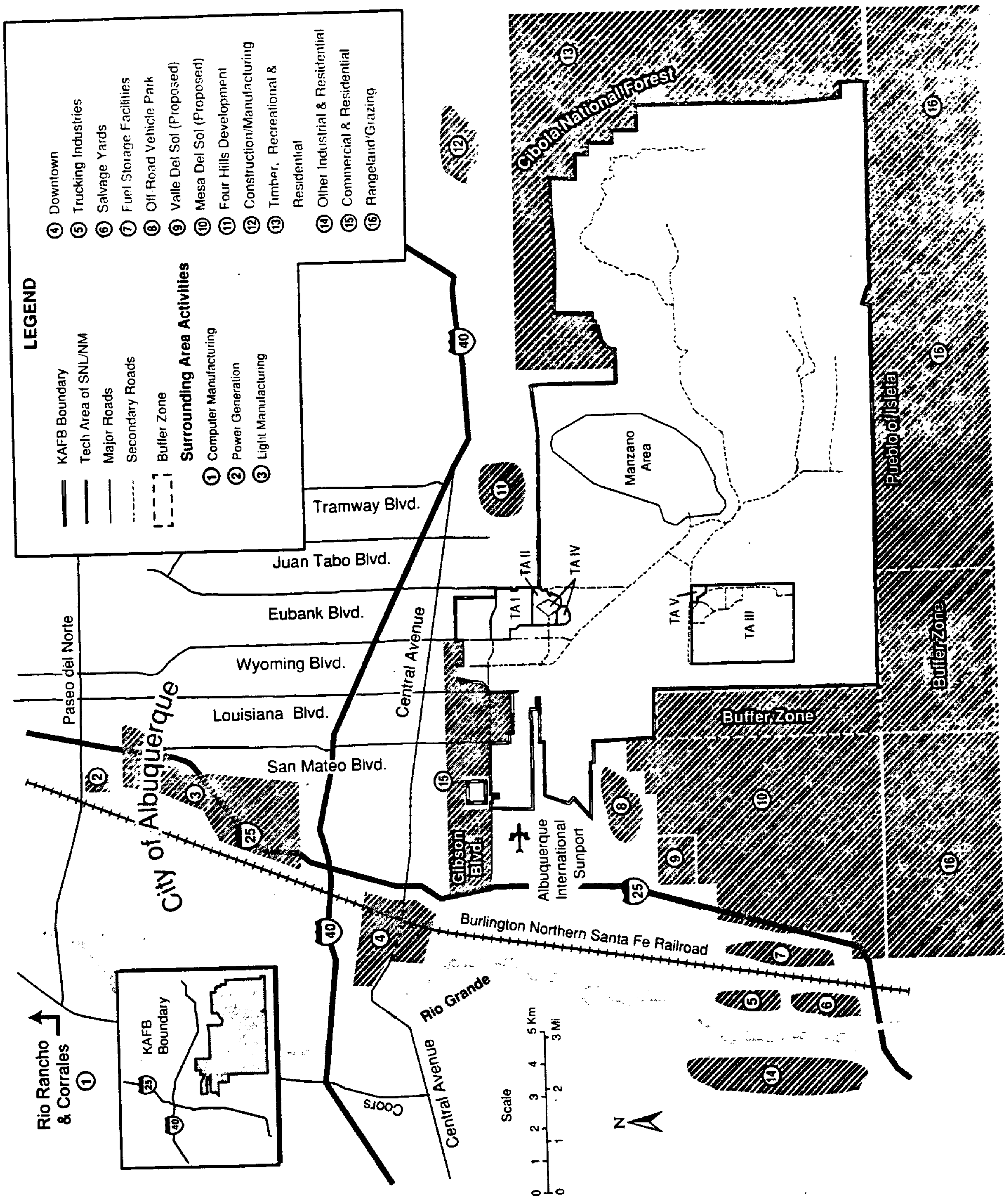
6.3 OTHER ACTIVITIES IN THE REGION OF INFLUENCE

Numerous other activities exist in the KAFB ROI that are not DOE- or DoD-related. The city of Albuquerque and its suburbs form the state's largest metropolitan area, with a population over 500,000. Over 400 local manufacturers produce a wide range of products, including electronic components, baked goods, computers, construction materials, and heavy trailers. The ROI has numerous existing and planned industrial facilities and residences with permitted air emissions and discharges to surface waters. Permitted sources generally include electric generating stations, computer chip production, construction materials industries, and other manufacturing facilities. The approximate locations of these activities are highlighted in Figure 6.3–1. KAFB has residential and commercial centers onsite as well as to the north, south, west, and northeast. There are many local and regional influences as well as private and public activities (such as USFS, city, and county).

The activities described in the SWEIS are by no means inclusive, but serve to highlight some major influences in the region and to provide perspective on the contribution to the environmental impacts posed by activities at KAFB within the various ROIs. Activities considered in the cumulative effects analysis include city-wide water use, residential land developments, regional transportation activities, energy utilities, and various construction materials industries.

Transportation Corridor Projects

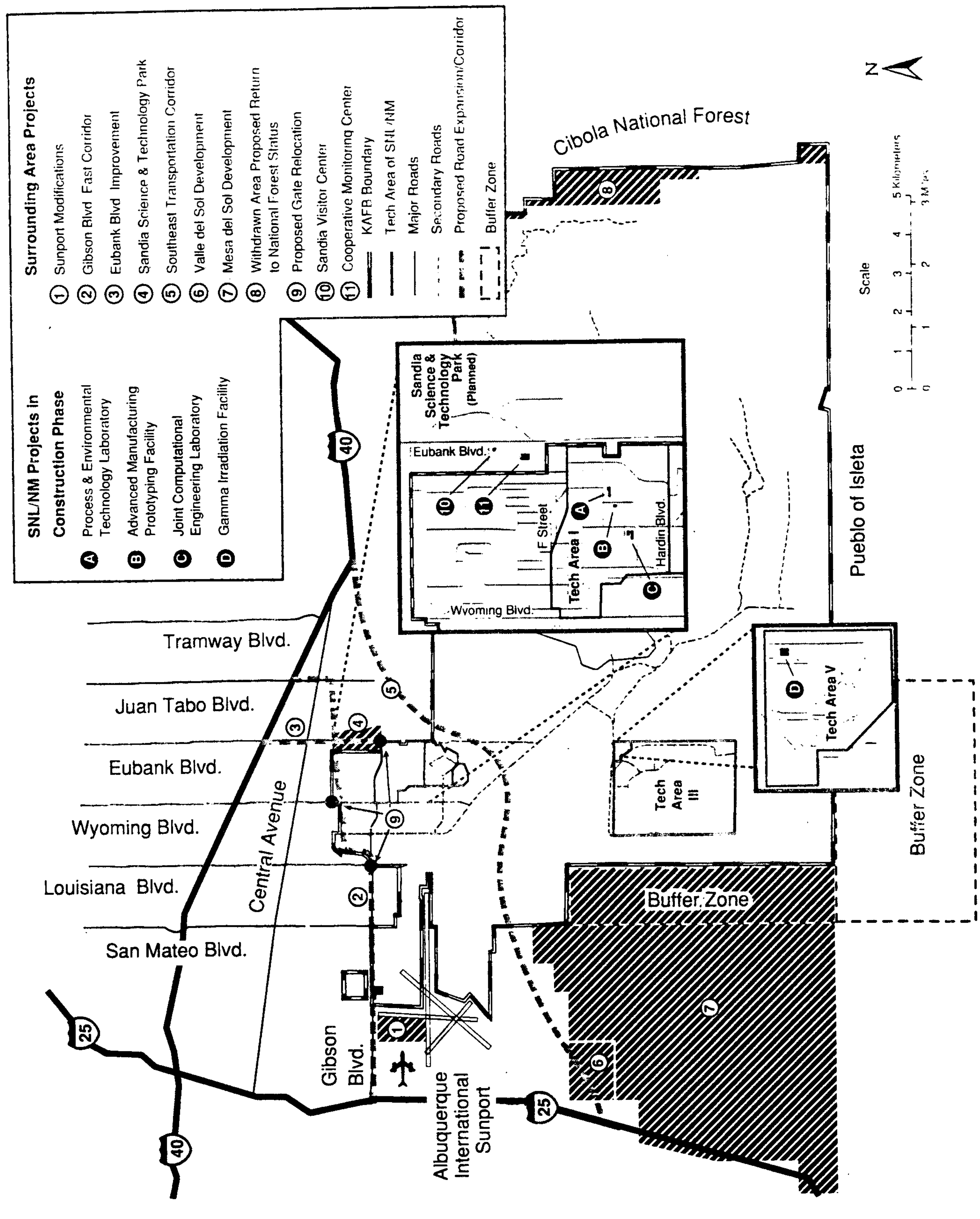
The Southeast Transportation Corridor is part of Bernalillo county's long-range transportation plans. This corridor is planned as part of a loop road system southeast of the Albuquerque International Sunport. The proposed corridor roughly follows the alignment of the Tijeras Arroyo (Figure 6.3–2). In addition, a proposed Gibson Boulevard Corridor would extend the corridor from the Gibson/Interstate I-25 interchange eastward to an intersection with Juan Tabo Boulevard. Gibson Boulevard currently terminates at Louisiana Boulevard. A



Source: Original

Figure 6.3–1. Additional Activities Near KAFB

Numerous other activities exist in the KAFB regions of influence that are not related to the U.S. Department of Energy or the U.S. Department of Defense.



Source: Original

Figure 6.3–2. Near-Future Projects on and near KAFB

There are new and proposed construction projects in the region of influence.

major infrastructure project funded by the city of Albuquerque, the corridor is planned as the southern segment of a system of roadways that would eventually ring large portions of the metropolitan area. Segments of the corridor may be planned as a limited-access, high-capacity arterial, and other segments may retain their current character as commercial corridors. Gibson Boulevard runs parallel to segments of KAFB's and Albuquerque International Sunport's perimeters. The improvements will enhance east-west vehicle circulation and may provide additional buffering to KAFB's northern boundary. The project is likely to occur prior to 2000 and would result in the relocation of some gates and the demolition of some KAFB housing.

Petroleum Products Pipeline

The Navajo Refining Company recently submitted a right-of-way application to the BLM for a proposed petroleum product pipeline that would cross KAFB. The proposed pipeline could affect DOE activities on KAFB, such as SNL/NM, the NNSI, and the TSD.

The BLM's Albuquerque Field Office coordinated a review of the right-of-way application for the proposed petroleum products pipeline with local officials from KAFB, the DOE KAO, and the USFS Sandia Ranger District. The DOE determined that the proposed route would impact current DOE research and development test activities that pose national security and personnel safety concerns. Testing by the DOE and its contractors could not be scheduled and coordinated with private interests due to national security issues, and an easement giving access to private interests could not be provided. In addition, the proposed route would pass through existing explosive safety zones and environmental restoration sites.

The DoD determined that the proposed route would affect current USAF activities and would be incompatible with current KAFB operation.

The proposed petroleum pipeline was also determined to be inconsistent with the intended land use. The withdrawn lands permitted to DOE on KAFB are designated for research and development and testing activities.

6.3.1 Land Development

Numerous existing residential and commercial developments surround KAFB. New projects outside of KAFB are also ongoing. Several proposed developments include Valle del Sol to be located southwest of KAFB, which calls for an extension of University Boulevard. Development would occur on approximately 520 acres. Mesa del Sol is another planned community south of KAFB that encompasses approximately 13,000 acres of undeveloped land. Current development plans estimate a maximum population of 97,500 persons. These developments are discussed further in Section 6.4.1.

6.4 CUMULATIVE EFFECTS BY RESOURCE AREA

This section describes the environmental effects of implementing the Expanded Operations Alternative on selected resource areas when combined with effects resulting from past and present activities at SNL/NM and other identified past, present, and reasonable foreseeable actions taken by public and private entities in the ROI. Activities examined include DOE activities at SNL/NM, DOE activities at the seven additional facilities, KAFB and DoD activities, and local and regional influences. Table 6.4–1 summarizes estimated parameters associated with SNL/NM, DOE, and KAFB activities. These parameters are presented to illustrate a comparison of the contributions of each entity. The parameters presented for SNL/NM represent annual figures under the Expanded Operations Alternative. The parameters presented for the seven other DOE facilities and KAFB represent 1998 data. Parameters for certain waste streams were in some cases not available. Estimates, including results of qualitative analysis, were used as necessary.

6.4.1 Land Use

The presence of a small incremental effect to land use resulting from operations of the DOE, SNL/NM, and KAFB would not significantly contribute to impacts resulting from other past, present, or reasonably foreseeable actions taken by public and private entities in the ROI. The analysis of cumulative land use effects is an examination of the DOE Expanded Operations Alternative at SNL/NM and near-future projects on and near KAFB (Figure 6.3–2). The ROI is defined as land SNL/NM uses in and adjacent to KAFB. This includes lands belonging to the city of Albuquerque, Bernalillo county, state of New Mexico, USFS, and the Pueblo of Isleta. Cumulative land use effects take into consideration the use of open land, adequacy of buffer zones surrounding site activities, and any potential conflicts between existing or projected onsite and offsite programs and operations. The extent of land used by SNL/NM in and adjacent to KAFB is sufficient for

Table 6.4–1. Parameters for SNL/NM, DOE, and KAFB Activities

PARAMETERS	UNITS	SNL/NM[a] EXPANDED OPERATIONS ALTERNATIVE	SEVEN OTHER DOE FACILITIES	KAFB/DoD
Number of Workers	FTEs	8,417	2,138[c]	9,863
Water	gal/yr	499 M	21.3 M[b]	910 M[d]
Wastewater	gal/yr	325 M	2.78 M[b]	335 M[c]
Electric Power	MWh	204,000	12.5[b]	307,000[c]
Annual Radiation Population Dose	person-rem	15.8	1.3×10^{-4}[b]	5.0
Discharge to Sanitary Sewer	gal/yr	325 M	2.78 M[b]	335 M[d]
RCRA Hazardous Waste	kg/yr	98,531	Negligible (see note)	43,455[e]
LLW	m^3/yr	280	Negligible	100[h]
LLMW	m^3/yr	7.31	Negligible	0.5[i]
MTRU Waste	m^3/yr	0.74	Negligible	1[j]
Groundwater Withdrawal	M ft^3/yr	63.5	2.53	85.16
Vehicular Traffic (individual)	Individual trips	29,880	NA	48,290
Solid Waste	m^3/yr	2,022	Small (see note)	2,900
Recycled Hazardous Waste	kg/yr	NA	NA	53,253
Vehicles (Number of)	vehicles	14,940[f]	2,000[b]	24,145[d]
ER/IRP Sites (Number of)	sites	182	NA	70[g]
(Proposed NFA)	sites	122	NA	8[g]
(Approved NFA)	sites	48	NA	28[g]

Sources: [a] SNL/NM 1998a (includes MESA), [b] DOE 1998a, [c] UNM 1997a, [d] USAF 1998a, [e] Houston 1998, [f] SNL/NM 1997a, [g] Gooch 1998
[h] Converted using 0.1 m^3/Ci from Ci/yr—LLW.
[i] Converted using 1,500 lb/m^3 from 720 lb/yr—LLMW.
[j] Converted using 1,500 lb/m^3 from 1,500 lb/m^3—MTRU.
Ci: Curie
DoD: U.S. Department of Defense
DOE: U.S. Department of Energy
ft^3: cubic feet
FTE: full-time equivalent
gal: gallon
IRP: Installation Restoration Program
KAFB: Kirtland Air Force Base
kg: kilogram
lb: pound
LLMW: low-level mixed waste
LLW: low-level waste
M: million
m^3: cubic meter
MESA: Microsystems and Engineering Sciences Applications
MTRU: mixed transuranic
MWh: megawatt-hour
NA: not available
NFA: no further action
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
yr: year
Note: Negligible – Actual quantities are not reported: however, due to nature and scope of operations, waste volumes are assumed to be negligible.
Small – Actual quantities are not reported: however, due to nature and scope of operations, waste volumes are assumed to be small.

current and future requirements. While urban growth and development is expected to continue in specific areas around KAFB, these activities do not hinder, nor are they restrained by, SNL/NM operations.

DOE Operations

In accordance with DOE policy to manage its land and facilities as valuable national resources, a Future Use Initiative was established in 1994 to define appropriate short- and long-term future uses for DOE land and facilities on KAFB. The initiative emphasizes environmental restoration and site development planning activities. This initiative created the Future Use Logistics and Support Working Group, consisting of representatives from the DOE and its affiliates, USAF, USFS, EPA, and New Mexico Environment Department (NMED). A citizens advisory board played a key role as a contributor of public input (Keystone 1995, SNL 1997a).

Preliminary recommendations recognized the high probability of continued Federal activity within KAFB for the foreseeable future. Under this continued use scenario, the Federal government would maintain institutional control of the site and restrict access. DP is the landlord for DOE laboratory operations on DOE-owned land and is expected to continue the use of the property in support of its missions. Based on current and expected future use and conditions, interim recommendations by the working group with input from the citizens advisory board have been given to DOE (Keystone 1995, SNL 1997a).

Sandia National Laboratories/New Mexico

SNL/NM is the largest of the DOE affiliates on KAFB and represents a major portion of continuing Federal investment. In general, future plans for SNL/NM include improved pedestrian and vehicular circulation and transportation and infrastructure upgrades planned in coordination with the USAF and the city of Albuquerque (SNL 1997c).

The main areas for limited future facility development include the east periphery of TA-I and TA-II. TA-I will have increased redevelopment potential as temporary and substandard structures are removed, such as buildings that have exceeded their useful life and cannot be cost effectively retained in service, or major renovations are achieved. ER sites within TA-II are planned for cleanup or are being proposed to the EPA for no further action (NFA). The success of these efforts will greatly increase the redevelopment potential of this area. TA-IV continues to have development opportunities, but its growth is limited by the Tijeras Arroyo to the east and south and USAF operations to the west. Due to buffer zones required by continuing activities in TA-III and TA-V, development opportunities will remain limited in those areas (SNL 1997c).

A number of near future facilities in SNL/NM's Five-Year Plan, which are in various phases of construction, have been reviewed under NEPA and approved. Most approved projects occur within the TAs in areas that are considered previously disturbed or underdeveloped. Examples include the Process and Environmental Technology Laboratory, Joint Computational Engineering Laboratory, and Advanced Manufacturing Prototyping Facility, all located within TA-I, and the New Gamma Irradiation Facility, located in TA-V (SNL 1997a).

Two additional facilities, the Sandia Visitor Center and Cooperative Monitoring Center, are not within TA boundaries, but are planned on undeveloped land owned by the DOE adjacent to Eubank Boulevard, in association with the proposed Sandia Science and Technology Park (SNL 1997a). A decision to develop this land will be addressed in future NEPA documentation.

The Sandia Science and Technology Park was initiated by SNL/NM to develop a high-technology campus that would strengthen alliances and advance partnerships with industry. Adjacent to KAFB on both sides of Eubank Boulevard, the planning area encompasses approximately 200 ac, with land ownership divided among the DOE, New Mexico State Land Office, Albuquerque Public Schools, and two private landowners. The project's planning and feasibility group consists of representatives from SNL/NM, the DOE, KAFB, the city of Albuquerque, and the state of New Mexico.

Additional DOE Facilities

In addition to SNL/NM, seven other DOE facilities are located on KAFB, as described in Section 6.2. The majority of these facilities operate on land owned by the USAF and permitted to the DOE; however, AL is partially located on DOE-owned land and the Lovelace Respiratory Research Institute is located on land withdrawn from the BLM by the USAF and permitted to the DOE. None of these operations affect land use based on current and projected operations for the foreseeable future (DOE 1998f).

U.S. Air Force Operations

Major portions of existing land use patterns on KAFB are the result of combining previously separate military installations. The most developed area is in the northwest where a variety of activities take place in association with day-to-day operations. Associated land uses that are likely to continue include airfield and aircraft operations/ maintenance, housing units, industrial areas, community commercial and service functions, administration and research areas, training sites, associate-owned land (such as the DOE) and open space (USAF 1998a).

Because of the variety of military activities on KAFB, a major emphasis of continued development by the USAF is to merge related land uses and similar functions. There are a number of sites available for future use that are either vacant or have been previously developed but scheduled for demolition or realignment of function. Future changes to the overall land use pattern on KAFB will be incremental and focus on consolidation (USAF 1998a).

U.S. Forest Service

The USFS has proposed opening portions of the Cibola National Forest currently withdrawn from public use by the USAF and the DOE in the preferred alternative of its *Environmental Analysis Ecosystem Management Plan for National Forest Lands in and Adjacent to the Military Withdrawal* (USFS 1996). The area under consideration consists of approximately 200 ac and 900 ac within the DOE and USAF withdrawals, respectively, and represents 5.3 percent of the total of 20,486 ac withdrawn from public access. The returned land would allow for the establishment and authorized public use of a ridge-top trail system. The DOE and USAF do not oppose the return of this property for recreational purposes and are currently in communication with the USFS. No time frame for completion of this action has yet been established (USFS 1996).

State of New Mexico

One potential impact to land use in the ROI is represented by the proposed Mesa del Sol development initiated by the state of New Mexico. Mesa del Sol is a planned community encompassing approximately 13,000 ac of undeveloped land south of the Albuquerque International Sunport and west of the KAFB boundary. The land is held in trust by the New Mexico State Land Office for the University of New Mexico and New Mexico Public Schools and was annexed by the city of Albuquerque in 1993, increasing the land area of the city by 20 percent. Current development assessments estimate a maximum population of 97,500 persons with 39 neighborhoods in urban and rural villages and in other activity centers (NMSLO 1997). A regional recreation center, consisting of a square-mile area of playing fields and other amenities anchored by an outdoor performing arts amphitheater, is the only project designed to date (USAF 1998a).

Due to USAF and DOE activities in areas adjacent to Mesa del Sol, the New Mexico State Land Office is reserving a 2,700-ac area along the development's eastern border for future planning. This effort is being made to ensure that land uses in that area, historically leased by the DOE as a buffer zone, are compatible for all parties concerned (NMSLO 1997).

Bernalillo County

Valle del Sol is a proposed affordable housing project on approximately 520 ac within the Tijeras Arroyo area of unincorporated Bernalillo county, southwest of KAFB and north of Mesa del Sol. The USAF has joined the city of Albuquerque in opposing the project, which would require significant site engineering to accommodate residential use. In addition, the development would place homes in an area adversely affected by noise resulting from current airport traffic (NMSLO 1997, USAF 1998a).

The Southeast Transportation Corridor is a proposed transportation link. The corridor would connect Interstates-25 and -40, bypassing the current interchange as shown in Figure 6.3–2. It is anticipated that this project would require an EIS involving several state, Federal, and local agencies.

Pueblo of Isleta

The expanse of land immediately south of KAFB, owned by the Pueblo of Isleta, has historically been and remains open rangeland used for grazing. Over 6,300 ac are currently leased by the DOE as a buffer zone in connection with SNL/NM operations at TA-III. It is likely that the surrounding area will remain open space, as the majority of Pueblo development has occurred and is expected to continue in the vicinity of the Broadway Boulevard/Interstate-25 interchange. Casino gambling and golfing activities have also been established there (NMSLO 1997, USAF 1998a).

City of Albuquerque

As the largest metropolitan entity in the area, the city of Albuquerque is engaged in several projects that could potentially affect land use adjacent to KAFB. Activities associated with the Albuquerque International Sunport and city road networks are most influential.

The city's Aviation Department is considering extending the northwest-southeast runway (Runway 12-30) to improve movement of air freight vehicles. This proposal may result in land use conflicts with existing topography and current KAFB transportation networks in the area. The north-south runway (Runway 17-35) is being studied for closure, which may result in redevelopment of the area for new or extended airport terminal facilities (COA 1997a) or new aircraft/transportation complexes (USAF 1998a).

The city's Public Works Department is currently involved in two transportation projects: the Gibson Boulevard East Corridor Study and the Eubank Boulevard Extension. The former proposes a high-speed, limited-access arterial, approximately 8 mi long, extending from the Gibson Boulevard/Interstate-25 interchange eastward along existing Gibson Boulevard, through a portion of KAFB, along existing Southern Boulevard, and northward to the Juan Tabo Boulevard/Interstate-40 interchange. The corridor would enter KAFB at Louisiana Boulevard and run east along its northern boundary. The project is intended to enhance the city's east-west traffic and may also provide additional buffering to KAFB. Construction would result in the relocation of several KAFB entry gates and the demolition of some military housing. The USAF supports the project, as long as provisions for gates are maintained, demolished structures are replaced, and the effects of noise and lighting on adjacent military housing areas are mitigated (USAF 1998a).

The city also proposes to widen Eubank Boulevard from four to six lanes along the segment that runs north from the KAFB boundary to Central Avenue. This project is intended to improve general access into the area and would be of particular benefit if the Sandia Science and Technology Park were to go forward, as well as for general urban renewal and economic development planning efforts in the area. Improvements to the Eubank Gate area could also be made, extending Eubank Boulevard on KAFB to Pennsylvania Avenue, thereby improving traffic flow to the southern portion of the installation (SNL 1997a, USAF 1998a).

6.4.2 Infrastructure

This section describes the impacts to infrastructure from DoD activities at KAFB, activities within the Albuquerque area, activities at SNL/NM (as discussed in Chapter 5), additional DOE activities at KAFB, and cumulative impacts on infrastructure. A primary area of concern is regional demands on the Albuquerque-Belen Basin aquifer. With or without conservation measures, demand exceeds aquifer recharge. Therefore, the city of Albuquerque has begun acquiring other water supply sources (see Section 6.4.4).

DoD Activities at KAFB

In general, the projected demands on infrastructure supporting DoD activities at KAFB would likely decrease over the next 10 years (Table 6.4–2). DoD's water consumption would potentially decrease from 910 M gal to an estimated 637 M gal per year. Annual electrical consumption would probably stay at 307,000 MWh. Consumption of natural gas, fuel oil, and propane would remain at recent historic levels. Small fluctuations in utility consumption rates would occur due to annual changes in weather.

The current infrastructure resources are capable of accommodating KAFB demands. No additional infrastructure facilities would be built to support KAFB. Buildings, services, communications, maintenance programs, roads, material storage, and waste storage activities supporting these facilities would not change substantially from recent historic levels. Specific details on these systems are presented in the *Comprehensive Plan, Kirtland Air Force Base, New Mexico* (USAF 1998a).

Other Activities in the Albuquerque Area

The demands on water supply and wastewater infrastructure in the city of Albuquerque would likely decrease over the next 10 years through expected conservation efforts. Water consumption would potentially decrease from 35 B gal to 30 B gal per year. Estimated annual electrical consumption would increase to 79 TWh by 2008 (Sullivan 1998), as the city's population increases. Consumption of natural gas, fuel oil, and propane would likely increase as a function of population growth. Small fluctuations in utility consumption rates would occur due to annual changes in weather.

The city of Albuquerque's infrastructure resources are capable of accommodating current demands. The demand on the aquifer, with or without conservation, exceeds aquifer recharge; therefore, the city would need to acquire other water supply sources. Future water supply projects would include use of Rio Grande water and San Juan/Chama water to compensate for the reduced capability of the Albuquerque-Belen Basin aquifer (CABQ n.d.[a][c]). See Section 6.4.4 for additional information regarding the Albuquerque-Belen Basin aquifer.

Additional power production plants would be needed if demand continues to rise at the rate experienced during most of the 1990s. City services, communications, maintenance programs, roads, and waste disposal activities supporting residents would likely continue to increase as population increases.

Table 6.4–2. Utility Usage and Utility Capacity

UTILITY	BASE YEAR[a] USAGE	PROJECTION	SYSTEM CAPACITY ANNUAL	PROJECTION AS PERCENT OF CAPACITY
DoD ACTIVITIES AT KAFB				
Water	910 M gal	637 M gal	2.0 B gal	32%
Wastewater (Discharge)	355 M gal	214 M gal	850 M gal	25%
Electricity	307,000 MWh	307,000 MWh	1.1 M MWh[b]	28%
ALBUQUERQUE				
Water	35 B gal	30 B gal[c]	72 B gal	42%
Wastewater (Discharge)	21.8 B gal	18.7 B gal[d]	27.7 B gal	68%
Electricity	70 TWh	79 TWh	95 TWh[d]	80%
SNL/NM ACTIVITIES AT KAFB (EXPANDED OPERATIONS ALTERNATIVE)				
Water	440 M gal	499 M gal[f]	2.0 B gal	25%
Wastewater (Discharge)	280 M gal	325 M gal[f]	850 M gal	38%
Electricity	197,000 MWh	204,000 MWh[f]	1.1 M MWh[b]	19%
ADDITIONAL DOE ACTIVITIES[e]				
Water	21.3 M gal	18.9 M gal	2.0 B gal	Less than 1%
Wastewater (Discharge)	2.78 M gal	2.58 M gal	850 M gal	Less than 1%
Electricity	12.5 MWh	10.7 MWh	1.1 M MWh[b]	Less than 1%

Sources: DOE 1997k; SNL/NM 1998a (includes MESA), 1998c; COA n.d.(a)(b)(c), Sullivan 1998
B: billion
DOE/AL: U.S. Department of Energy/Albuquerque Operations Office
ETC: Energy Training Complex
FM&T/NM: Federal Manufacturing & Technology/New Mexico
gal: gallon
NNSI: Nonproliferation and National Security Institute
TWh: terawatt-hour
TSD: Transportation Safeguards Division
M: million
MESA: Microsystems and Engineering Sciences Applications
MWh: megawatt-hour
[a] Base year is 1996 or 1997, whichever is the most representative of usage.
[b] Based on 125-MW rating
[c] 2006 projection
[d] Estimation by 2008, based on 20 percent capacity currently available.
[e] Includes utility estimations for DOE/AL complex, Ross Aviation, NNSI, TSD, Lovelace Respiratory Research Institute, and FM&T/NM. ETC utilities are supplied through the city of Albuquerque infrastructure and were not included in the table.
[f] Includes MESA

On April 8, 1999, New Mexico Governor Gary Johnson signed into law the Electric Utility Industry Restructuring Act of 1999. Residential and small business customers will have retail access beginning January 1, 2001. All other customers will be eligible on January 1, 2002.

The New Mexico State Legislature found that the generation and retail sale of electricity is becoming a competitive industry across the nation and that retail customers in New Mexico should have the opportunity to benefit from competition in the electricity generation markets and should have the choice to select their supplier of electricity (Retail Wheeling Update 1999, EVIRA 1999).

The costs of electricity to the consumer are likely to decrease. A loss of jobs at Public Service Company of New Mexico is possible; however, as discussed in Section 6.4.12, job growth in the ROI is expected to be strong through 2008.

SNL/NM Activities at KAFB

As discussed in Section 5.4.2, demands on the infrastructure supporting SNL/NM activities would increase over the next 10 years due to the Expanded Operations Alternative requirements (Table 6.4–2). SNL/NM's water consumption at KAFB would likely increase from 440 M gal to 499 M gal per year. Annual consumption of electricity would likely increase to 204,000 MWh. Consumption of natural gas, fuel oil, and propane would remain at recent historic levels. Small fluctuations in utility consumption rates would occur due to annual changes in weather.

The current infrastructure resources are capable of accommodating the facilities' demands. No additional infrastructure facilities would be built to support these facilities. Buildings, services, communications, maintenance programs, roads, material storage, and waste storage activities supporting these facilities would not change substantially from recent historic levels. Specific details on these systems are presented in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a).

Additional DOE Activities at KAFB

The demands on the infrastructure supporting the seven additional DOE activities would likely decrease over the next 10 years due to the intended conservation commitments (Table 6.4–2). DOE's water consumption at KAFB would likely decrease from 21.3 M gal to 18.9 M gal per year. Annual electrical consumption would likely decrease to 10.7 MWh. Consumption of natural gas, fuel oil, and propane would remain at recent historic levels. Small fluctuations in utility consumption rates would occur due to annual changes in weather.

The current infrastructure resources are capable of accommodating the facilities' demands. No additional infrastructure facilities would be built to support these facilities. Buildings, services, communications, maintenance programs, roads, material storage, and waste storage activities supporting these facilities would not change substantially from recent historic levels. Specific details on these systems are presented in the *U.S. Department of Energy "Other" DOE Facilities* (DOE 1998f).

Summary of Infrastructure Cumulative Impacts

As shown in Table 6.4–2, current and planned utility usage for water, wastewater, and electricity for KAFB, including SNL/NM, is within the capacities of existing systems. No additional infrastructure facilities would be built to support KAFB. Buildings, services, communications, maintenance programs, roads, material storage, and waste storage activities supporting these facilities would not change substantially from recent historic levels. Specific details on these systems are presented in the *Comprehensive Plan, Kirtland Air Force Base, New Mexico* (USAF 1998a), and the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a).

Based on information presented in Table 6.4–2, the expected water use of 1.16 B gal (SNL/NM's [Expanded Operations Alternative] 499 M gal plus DoD's 637 M gal plus DOE's 18.9 M gal) for the entire KAFB represents approximately 4 percent of the expected water use (30 B gal) by the city of Albuquerque. Similarly, by 2008, the 542 M gal projected amount of wastewater at KAFB (includes SNL/NM) would represent 3 percent of the expected wastewater processed (18.7 B gal) by the city of Albuquerque. If water conservation goals are met by SNL/NM and DoD/KAFB, these estimates of water use and wastewater discharge would be expected to decline.

Additionally, the Albuquerque area would consume 79 TWh per year of electricity. The entire KAFB consumption of 511,000 MWh per year by 2008 represents less than 1 percent of the ROI.

Because sufficient capacities exist, actual effect to infrastructure would not contribute significantly to any impacts that result from any other identified past, present, or reasonably foreseeable actions that may be taken by public and private entities in the ROI. Additionally, the city of Albuquerque is the largest user and consumer of infrastructure resources in the ROI.

6.4.3 Soils

There are limited, if any, cumulative impacts related to soils. Areas of soil contamination resulting from SNL/NM activities are distinct from other onsite entities, such as USAF facilities or IRP sites. No combined effects to human health or the environment would be expected at these areas.

6.4.4 Water Resources and Hydrology

Locations of known or suspected groundwater contamination are presented in Section 4.6. All locations, with the possible exception of Sandia North (beneath TAs-I and -II), are discrete areas of concern with no cumulative effect issues. Definitive attribution of contaminants at Sandia North has not been made. It is unclear whether contamination is a result of one source or many sources, and whether the source is the result of activities by SNL/NM, the USAF, the city of Albuquerque, or another entity. An environmental monitoring program (SNL 1997d) is in place to detect and track any migration of groundwater contamination so it does not become a public health concern.

The USAF operates 14 production wells on KAFB. A presentation of infrastructure capacity is given in Section 6.4.2. These wells supply water to the USAF, SNL/NM, and other DoD, DOE, and associate-occupied facilities at KAFB. These wells draw water from the Santa Fe Group aquifer system in the Albuquerque-Belen Basin aquifer, the same aquifer system that is the exclusive source of potable water for cities and towns north and south of SNL/NM, including Albuquerque and Rio Rancho. As explained in Section 4.6.3, an excess of withdrawal over recharge results in a continuing decline in groundwater levels in this aquifer. In the vicinity of KAFB, the water levels have been declining as much as 3 ft per year over the past 12 years (Section 5.3.4).

The majority of water withdrawn from the aquifer is by the city of Albuquerque, accounting for 78 percent of basin-wide groundwater withdrawals for the years 1985 through 1996 (Table 6.4–3). The total KAFB withdrawal over this period was 3 percent of basin-wide withdrawals. For the year 1996, SNL/NM water use was 58.9 M ft^3, 0.88 percent of the basin-wide withdrawal for the year (SNL/NM 1997a). The presence of a small incremental effect to the groundwater resources resulting from SNL/NM, would potentially contribute to impacts resulting from other identified past, present, or reasonably foreseeable actions taken by public and private entities in the ROI.

The impact analysis performed for this SWEIS determined that SNL/NM would account for 12 percent of projected groundwater withdrawal in the immediate vicinity of KAFB over the period 1998 to 2008 (Section 5.4.4.2 and Appendix B.2). The analysis described in Sections 5.3.4.2 and 5.4.4.2 examines all local groundwater withdrawals, thereby accounting for some level of cumulative impacts. It was possible to estimate SNL/NM withdrawal as a percentage of basin-wide withdrawal for each alternative. Assuming a 1.5-percent per year compounded population growth factor (COA n.d.[b]) and a 30-percent city of Albuquerque water conservation goal to be achieved by 2004 (COA n.d.[a]),

Table 6.4–3. 1985 through 1996 Groundwater Withdrawal in the Albuquerque-Belen Basin

YEAR	BASIN-WIDE		KAFB
	CITY OF ALBUQUERQUE WELLS (M ft^3)	PRIVATE AND OTHER MUNICIPAL WELLS (M ft^3)	KIRTLAND WITHDRAWAL (INCLUDES SNL/NM) (M ft^3)
1985	4,343	1,172	232.3
1986	4,538	1,186	237.4
1987	4,813	1,170	210.1
1988	4,796	1,222	199
1989	5,513	1,498	258.1
1990	5,095	1,401	208
1991	5,057	1,443	219.7
1992	5,026	1,456	235.7
1993	5,349	1,959	201.2
1994	5,376	1,665	166.7
1995	5,396	1,506	151.7
1996	5,209	1,489	155.5
TOTAL	**60,510**	**17,170**	**2,475**

Sources: USAF 1998b, USGS 1995
ft^3: cubic feet
KAFB: Kirtland Air Force Base
M: million
SNL/NM: Sandia National Laboratories/New Mexico

projected SNL/NM usage would be approximately 1 percent of basin-wide withdrawal (Appendix B.2).

This analysis may underestimate basin-wide usage as private and other municipal users have not necessarily committed to water reduction goals. Likewise, SNL/NM's water conservation commitment of a 30-percent reduction in water use (SNL/NM 1998b) is not included in the calculation of SNL/NM quantities. This analysis would, therefore, tend to overestimate the SNL/NM contribution to basin-wide withdrawal. Nonetheless, the 1998 to 2008 SNL/NM usage would remain about 1 percent of basin-wide withdrawal for any alternative.

The San Juan/Chama Project (COA n.d.[a]) is scheduled to come on-line in 2004. This project would allow the city of Albuquerque to meet its normal water demands from Rio Grande water. Groundwater withdrawals would be used only to supplement these normal demands. If this project is completed as scheduled, SNL/NM water use, as a percentage of basin-wide groundwater withdrawal, would increase substantially.

Therefore, the small incremental effect to groundwater would not contribute significantly to any impacts resulting from any other identified past, present, or reasonably foreseeable actions that may be taken by public and private entities in the ROI.

Storm water runoff from SNL/NM facilities or Environmental Restoration (ER) Project sites and USAF facilities or IRP sites could potentially combine in arroyos during storm events. The presence of contamination in surface soils, on paved surfaces, or from any discharges, could result in cumulative impacts to the surface water resource. However, analyses of surface water samples, discussed in Section 5.3.4, have repeatedly shown no surface water contamination near the downstream exit point of surface water from KAFB. No activities analyzed under the alternatives in the SWEIS are projected to increase the quantity of contaminants available for transport by surface water.

6.4.5 Biological and Ecological Resources

Because of the restricted access and limited planned development at KAFB, there has been a beneficial impact on biological and ecological resources. The presence of populations of the grama grass cacti on KAFB may, in fact, be due to the restriction on grazing. There is no indication that there has been a decline in wildlife or plant biodiversity as a result of activities conducted by SNL/NM. Potential effects to animals and plants due to soil contaminants have been found to be minimal.

Man-made activities, roads, fences and other infrastructure have fragmented wildlife habitat in portions of KAFB. This disruption in natural habitat patterns will continue because of the presence and activities of the DoD, USFS, DOE, and the surrounding population of the city of Albuquerque. KAFB is adjacent to Federal lands that are managed, in part, for wildlife and forest health. Management activities include wildlife habitat improvement, wildlife management plans, biomonitoring, restricted pedestrian and vehicular access, protection of natural springs, and prescribed burning to improve forest health and decrease the threat of a wildfire.

Therefore, there is no incremental effect on biological and ecological resources resulting from continuing SNL/NM operations that would contribute significantly to any other identified impacts that result from past, present, or reasonably foreseeable actions that may be taken by public and private entities in the ROI.

6.4.6 Cultural Resources

Actions taken by the DOE, SNL/NM, the USAF, and the USFS in the ROI, such as construction, testing activities, military exercises, infrastructure maintenance, decontamination and decommissioning (D&D), fire suppression, and any other ground-disturbing activities would be accomplished in accordance with Federal laws and regulations. Compliance with these laws and regulations, which involves consultation with the agency cultural resource managers and the New Mexico State Historic Preservation Officer, would preclude adverse impacts to cultural resources. The DOE has adopted department-wide orders and guidelines (DOE 1988a; DOE 1993d,e,f) that address the management of cultural resources and would remove the potential for appreciable incremental adverse effects resulting from past, present, or reasonably foreseeable future activities under the Expanded Operations Alternative in the ROI.

6.4.7 Air Quality

Nonradiological Air Quality

The analysis of cumulative air quality impacts involves examination of the DOE's proposed action at SNL/NM (defined as the next 10 years of foreseeable activities, 1998 to 2008) and reasonably foreseeable activities within the ROI. The *New Mexico Air Pollution Control*

Bureau Dispersion Modeling Guidelines defines the ROI for air quality as the maximum extent of a source's "significant" impact (NMAPCB 1996). The maximum extent of impact of the primary major stationary source at SNL/NM (the steam plant) is approximately 15 mi. A 15-mi radius about the SNL/NM steam plant falls largely within Bernalillo county, with a small portion extending into northern Valencia county to the south.

The air quality cumulative effects address the criteria pollutants: carbon monoxide, lead, particulate matter less than 10 microns in diameter (PM_{10}), sulfur dioxide, ozone, and nitrogen dioxide. The criteria pollutant emissions represent the major sources of pollutants from SNL/NM, as well as from emission sources from within the ROI.

This analysis of air quality cumulative effects from criteria pollutants is very similar to that in Chapter 5, because the ROI in both analyses is the same and there is no reasonable way to completely isolate the contributions of various sources when using monitoring data. The analysis in Chapter 5, however, provides more of a focus on effects from SNL/NM by using the following sources of data:

- modeled concentrations at the National Atomic Museum from SNL/NM 1996 actual emissions, and
- modeled concentrations at the National Atomic Museum from new sources that are planned for SNL/NM in the future.

Background concentrations added to this data set include

- concentrations consisting of carbon monoxide, nitrogen dioxide, and sulfur dioxide from monitoring stations located in the Albuquerque area, but subject to lesser influences from SNL/NM sources;
- background PM_{10} concentrations provided in the New Mexico state modeling guideline; and
- criteria pollutant concentrations resulting from operation of the Cobisa Power Station.

The discussion in this chapter provides the best available view of cumulative air quality effects in the vicinity of SNL/NM by selecting the following sources of data:

- the criteria pollutant monitoring station (CPMS) located in TA-I, for 1996, representing pollutant concentrations from SNL/NM and KAFB sources;
- modeled concentrations of criteria pollutants at the CPMS resulting from additional sources at SNL/NM added between 1996 and 2008; and
- the pollutant concentrations resulting from operation of the Cobisa Power Station.

The discussion in this chapter also provides more information on sources other than SNL/NM.

The Cobisa Power Station, to be located at Rio Bravo and Broadway SW in the southern part of Albuquerque, is expected to be in service by the summer of 2000. The plant will be a single gas-fired turbine peaking unit to be used primarily during peak demand periods with a permitted carbon monoxide emission rate of 23.3 tons per day. In addition to burning natural gas as a fuel, the plant will have the capability to burn No. 2 fuel oil.

Prevention of significant deterioration (PSD) incremental concentrations were calculated for Class II areas for each of the two fuels consumed. A Class II area may be considered any area outside of the facility boundary, excluding Class I areas. The No. 2 fuel oil produces the highest incremental concentrations of nitrogen dioxide, sulfur dioxide, and PM_{10}. The incremental concentrations for No. 2 fuel oil for these criteria pollutants were included in Table 6.4–4 as additional background concentrations contributing to cumulative criteria pollutant concentrations.

As for future concentrations of the remaining criteria pollutants, lead and ozone, it is uncertain as to whether or not the concentrations will increase, decrease, or remain the same within the ROI.

Major sources of nitrogen dioxide in the ROI include major energy utilities and construction materials industries. Major sources of PM_{10} in the ROI include construction materials industries and wood-burning fireplaces and stoves during the winter months. KAFB is a major source with respect to criteria pollutant emissions. A major source is one that has allowable emissions in excess of 100 tons per year of any regulated pollutant. KAFB's allowable emissions of nitrogen oxides, carbon monoxide, PM_{10}, and volatile organic compounds are greater than 100 tons per year. The majority of these sources are noncontinuous and spatially distributed over a large area. Many of these are portable generators for servicing and starting aircraft.

No changes in future emissions were reported for the seven other DOE facilities (DOE 1998f). The cumulative effects from their contributions, compared to other sources on KAFB, would remain small considering the nature and scope of operations at these seven facilities.

Table 6.4–4. Cumulative Criteria Pollutant Concentrations from Incremental SNL/NM Stationary Sources, Background Monitoring Data, and Cobisa Power Station with Applicable National and New Mexico Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	NAAQS (ppm[µg/m³])	NMAAQS (ppm[µg/m³])	CUMULATIVE CONCENTRATION (ppm[µg/m³])	PERCENT OF STANDARD
Carbon Monoxide	1 hour	35[33,305]	13.1[12,466]	8.5[8,130]	65
	8 hours	9[8,564]	8.7[8,279]	2.9[2,787]	34
	Annual	-	-	0.8[743]	NA
Lead	30 Days	-	-	0.0021[a]	NA
	Quarterly	1.5[a]	-	0.001[a,b]	0.07
Nitrogen Dioxide	Annual	0.053[83]	0.05[78]	0.014[21.5]	28
	24 hours	-	0.10[156]	0.044[69.2]	44
TSP	Annual	-	60[a]	15.01[a]	25
	30 days	-	90[a]	NA	NA
	7 days	-	110[a]	NA	NA
	24 hours	-	150[a]	53.5[a]	36
PM_{10}	Annual	50[a]	-	15.01[a, d]	30
	24 hours	150[a]	-	53.5[a, d]	36
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	0.0005[1.17]	3
	24 hours	0.14[305]	0.10[218]	0.006[13.8]	6
	3 hours	0.50[1,088]	-	0.029[62.1]	6
Ozone	Annual	-	-	0.033[54]	NA
	1 hour	0.12[196]	-	0.103[168][c]	85.8
Hydrogen Sulfide	1 hour	-	0.01[12]	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03[33]	NA	NA

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL/NM 1997c
- indicates no standard for listed averaging time
°R: degree Rankin
CPMS: criteria pollutants monitoring station
ft: feet
kw: kilowatt
NA: not available
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
µg/m³: micrograms per cubic meter
[a] µg/m³
[b] Highest quarterly lead monitoring data measured at the CPMS site in 1996
[c] Highest one-hour ozone monitoring data measured at the CPMS in 1996
[d] PM_{10} is assumed equal to TSP
Notes: 1) Some of the pollutants are stated in ppm. These values were converted to µg/m³ with appropriate corrections for temperature (530°R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).
2) Cumulative concentrations consist of 1996 CPMS concentrations, modeled concentrations from an "insignificant" boiler and emergency generator in Building 701 and a 600-kw-capacity generator in Building 870b, and prevention of significant deterioration (PSD) Class II incremental concentrations from Cobisa Power Station.

The total air pollutant concentrations in Table 6.4–4 consist of background criteria pollutant concentrations (which include concentrations generated by KAFB, the DOE, and SNL/NM) in the vicinity of SNL/NM, the additions from the new Cobisa Power Plant scheduled to begin operation in 2000, and the incremental concentrations from modeling new sources added at SNL/NM through 2008. The 1996 criteria pollutant concentrations were assumed to represent an estimate of the background concentrations for the year 2008. The

CPMS located in TA-I was selected to represent the background criteria pollutant concentrations in the vicinity of SNL/NM. This monitoring station is the closest station to SNL/NM emission sources and is, therefore, representative of the air quality in the vicinity of the maximum effects from the alternatives. The pollutant concentrations measured by the CPMS also include contributions from sources at SNL/NM. All criteria pollutants for each of the respective averaging periods are below the National Ambient Air Quality Standards or New Mexico Ambient Air Quality Standards.

The incremental contribution to carbon monoxide emissions under the Expanded Operations Alternative for SNL/NM commuter traffic is estimated to be 5.1 percent of the carbon monoxide emissions from highway sources within Bernalillo county in 2005. The concurrent contribution to carbon monoxide emissions from KAFB commuter traffic is estimated at 6,128 tons per year, or 8.2 percent of the carbon monoxide emissions from highway sources within Bernalillo county (SNL 1996c). The cumulative contribution of carbon monoxide emissions in 2005 for SNL/NM and KAFB commuter traffic is estimated at 13.3 percent of the total carbon monoxide emissions from highway mobile sources within Bernalillo county.

Projections of carbon monoxide emissions from vehicles in Bernalillo county, based on *The Maintenance Plan for Carbon Monoxide-Albuquerque/Bernalillo County, New Mexico* (AEHD 1998), show a downward trend from 1996 through the year 2000, with a constant rate through the year 2005. This is a worst-case scenario, assuming that none of the action scenarios to further reduce carbon monoxide emissions in the county would be performed. The reduction in carbon monoxide emissions during this period reflects better emission controls on future vehicles and maintenance and inspection programs to ensure peak emission control performance.

Radiological Air Quality

Two facilities (not operated by SNL/NM) with potential radiological air emissions were identified. The dose effects from each are combined with the calculated maximum dose under the Expanded Operations Alternative. These facilities are the Lovelace Respiratory Research Institute, located on KAFB east, and KAFB's 377th Air Base Wing IRP sites (RW-10, RW-68).

The Lovelace Respiratory Research Institute evaluated and presented the dose to the maximally exposed individual (MEI), located at a distance of 5.7 mi west-northwest, as a part of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) compliance for the calendar year 1996 (DOE 1997g). The collective dose to population was not evaluated. To be consistent with the dose evaluations performed for the Expanded Operations Alternative for the SWEIS, the *Clean Air Assessment Package (CAP88-PC)* model (DOE 1997e) was used to calculate the dose to the MEI and the total population within 50 mi, assuming Lovelace Respiratory Research Institute's total radiological air emissions centered at TA-V. The calculated MEI dose of $6.1x10^{-6}$ mrem/yr is lower than the Lovelace Respiratory Research Institute's reported value of $3.7x10^{-5}$ mrem/yr, due to different meteorological data and receptor location. However, the collective dose to the population was calculated to evaluate the potential cumulative effects on a consistent basis. Table 6.4–5 presents these doses for cumulative effects. For the year 1994, KAFB evaluated and presented the dose to the MEI at a distance of 2.2 mi in all directions, using EPA's screening computer model *COMPLY*. The reported dose to the MEI was 4.9 mrem/yr (USAF 1995b). Because the dose to the MEI was calculated based on using a screening type of model, it is claimed that the actual dose to the MEI from all sources combined is most likely to be many orders of magnitude smaller than this reported value (USAF 1995b). No collective dose to the population was evaluated for these sites. Therefore, in order to be consistent with the dose evaluations performed for the Expanded Operations Alternative for the SWEIS, the *CAP88-PC* model was used to calculate the dose to the MEI and to the total population within 50 mi, assuming KAFB's IRP total radiological air emissions are centered at TA-V.

The calculated MEI dose of 0.26 mrem/yr is lower than the KAFB-reported value of 4.9 mrem/yr; however, it is considered reasonable, based on the statement that the actual dose value could be many orders of magnitude lower compared to the reported value of 4.9 mrem/yr (USAF 1995b). Table 6.4–5 presents these doses for cumulative effects. The calculated total cumulative dose to the MEI of 0.77 mrem/yr is much lower than the regulatory limit of 10 mrem/yr. Even with the NESHAP reported doses to the MEI for the Lovelace Respiratory Research Institute and KAFB facilities, the total cumulative MEI dose of 5.4 mrem/yr is also lower than the regulatory limit of 10 mrem/yr. These doses are also

Table 6.4–5. Summary of Annual Cumulative Radiological Dose Estimates to the Public from All Sources on KAFB

FACILITY/SOURCE	ANNUAL MEI DOSE (EDE) (mrem)	ANNUAL POPULATION DOSE (person-rem)
SNL/NM Expanded Operations Alternative	0.51	15.8
Lovelace Respiratory Research Institute	6.1×10^{-6} [a] 3.7×10^{-5} [b]	1.3×10^{-4} [a]
Kirtland Air Force Base	0.26[a] 4.9[b]	5[a]
TOTAL FROM ALL SOURCES	0.77 5.4[c]	20.8[d]

Sources: DOE 1997g, USAF 1995b
CAP88-PC: Clean Air Assessment Package
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem
NESHAP: National Emissions Standards for Hazardous Air Pollutants
[a] *CAP88-PC* modeled values (DOE 1997e)
[b] Reflects the NESHAP reported values
[c] Based on NESHAP reported values
[d] Based on *CAP88-PC* modeled values

small compared to an individual background radiation dose of 360 mrem/yr. In summary, a small incremental effect to radiological air quality resulting from DOE, SNL/NM, and KAFB operations would not significantly contribute to impacts resulting from past, present, or reasonably foreseeable future actions taken by public and private entities in the ROI.

6.4.8 Human Health and Worker Safety

SNL/NM's location, adjacent to the city of Albuquerque and co-located with KAFB, other DOE facilities, and private industry, makes it possible that cumulative environmental effects exist. The potential for SNL/NM to contribute significantly to the cumulative effects from all present, past, and reasonably foreseeable future activities within the ROI was examined qualitatively and quantitatively in the area of human health and worker safety. Specifically, consequence analyses, presented in Chapter 5, identify human health and worker safety effects and were used to select other similar impact sources within the ROI for this cumulative effects assessment.

Occupational

The occupational health and safety of workers at SNL/NM is site-specific and would not be affected by other activities occurring within the ROI. Cumulative effects to workers would be the same as the effects presented in the consequence analyses for worker health and safety in Chapter 5 under each of the operational alternatives.

Air Quality – Criteria Pollutants

Air quality within the ROI is affected by numerous sources. The levels of criteria pollutants—carbon monoxide, lead, PM_{10}, sulfur dioxide, ozone, and nitrogen dioxide—are regulated regionally. SNL/NM's contribution and potential for air quality effects to affect the attainment of air quality standards are presented in Section 6.4.6. SNL/NM has a very small contribution to the overall attainment of regulated levels of these criteria pollutants within the ROI. Therefore, SNL/NM would not be a major source for human health effects from criteria air pollutants within the ROI.

Air Quality - Chemicals

Chemical air pollutants released by SNL/NM could have a cumulative effect with releases from other sources within the ROI. However, SNL/NM's chemical air releases show no potential for adverse health effects and similar analyses are not available for other sources. Therefore, to present an assessment of all potential sources of chemical air pollutants in the SNL/NM vicinity, a health-risk assessment was done using ambient air sampling data collected by chemical air monitoring stations at SNL/NM for volatile organic compounds (VOCs). The chemical air concentrations were assumed to be representative of local air quality, including other sources besides SNL/NM. A possible cumulative health risk was calculated from this information using maximum chemical concentrations (Table 6.4–6). Minimal health effects would be expected from these risk levels. If

Table 6.4–6. Cumulative Human Health Impacts Based on 1996 SNL/NM Onsite Ambient Volatile Organic Compound Air Monitoring

VOC CHEMICAL AIR MONITORING DATA	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
Onsite VOC Monitoring Stations (Maximum Concentrations)	Adult	0.04/<0.01	9.36×10^{-5}/3.79×10^{-6}
	Child	0.07/<0.01	3.42×10^{-5}/3.28×10^{-6}

Source: SmartRISK 1996
<: less than
AEI: Average Exposed Individual
RME: Reasonable Maximum Exposed
VOC: volatile organic compound

implemented, the MESA Complex configuration would result in a small decrease in chemical air quality impacts (see Section 5.4.7.1).

Air Quality – Radiological

Two facilities, not associated with but in proximity to SNL/NM, have potential radiological air emissions. These facilities are the Lovelace Respiratory Research Institute, located on KAFB east, and the KAFB 377th Air Base Wing IRP sites (RW-10, RW-68). The human health effects associated with maximum emissions from these sources were combined with calculated maximum health impacts from the SNL/NM Expanded Operations Alternative. The radiological doses calculated or reported to the MEI and to the population within 50 mi are discussed in Section 6.4.6.2. Based on the radiological risk estimator of 500 fatal cancers per 1 M person-rem to the public (ICRP 1991), the lifetime risk of fatal cancer from a 1-year dose to the MEI and the number of excess fatal cancers in the population within 50 mi of SNL/NM were calculated and are presented in Table 6.4–7. With regard to cumulative impacts, these results identify no additional fatal cancers in the population and a very low increased lifetime risk of cancer to individuals.

Environmental Restoration

Releases of hazardous and radiological materials from SNL/NM operations into surface soils, surface water, and groundwater have existed from historic operations. No additional releases are anticipated by future routine operations, but should they occur as a result of accidents under any of the alternatives, mitigation of impacts would take place. Cleanup of the historic contamination in these environmental media at SNL/NM is scheduled for completion under the ER Project between fiscal year (FY) 2003 and FY 2005, depending on budget availability.

Table 6.4–7. Summary of Annual Cumulative Health Impacts from all Radiological Emission Sources at KAFB

FACILITY SOURCE	ANNUAL EXCESS RISK OF FATAL CANCER MEI	ANNUAL EXCESS NUMBER OF FATAL CANCERS POPULATION
SNL/NM-Expanded Operations Alternative	2.6×10^{-7}	7.9×10^{-3}
Lovelace Respiratory Research Institute	3.1×10^{-12} [a] 1.9×10^{-11} [b]	6.5×10^{-8} [a]
KAFB	1.3×10^{-7} [a] 2.5×10^{-6} [b]	2.5×10^{-3} [a]
TOTAL FROM ALL SOURCES	**3.9×10^{-7} [a]** **2.8×10^{-6} [b]**	**1.04×10^{-2}**

Sources: DOE 1997e, g; USAF 1995b
MEI: maximally exposed individual
NESHAP: National Emissions Standards for Hazardous Air Pollutants
[a] Based on *CAP88-PC* modeled values
[b] NESHAP-reported values

The SNL/NM ER Project consists of more than 180 individual ER sites, within approximately 157 solid waste management units. Many of these sites (more than 50), after sampling or further investigation, have been identified as requiring NFA (DOE 1996c). A site would qualify for an NFA status if SNL/NM could demonstrate that the site poses no threat to human health or the environment. The DOE determined that the proposed environmental restoration actions would not significantly affect the quality of the human environment, and a Finding of No Significant Impact was signed on March 25, 1996 (DOE 1996c).

Environmental restoration site-specific risk assessments completed to date by SNL/NM show human health impacts from cleanup of historically contaminated sites would result in less than 10 mrem additional radiation dose per year to the population, a chemical exposures Hazard Index of less than 1, and an excess lifetime cancer risk of less than 10^{-6}. These impacts would only slightly increase if added to SNL/NM health impacts under the Expanded Operations Alternative. The overall health risk remains below levels considered by regulators to be protective of human health.

Other DOE Facilities

Cumulative human health impacts potentially exist from normal operations at the seven additional DOE facilities and other operations within KAFB. For example, the TSD is responsible for the maintenance and operation of weapons transportation equipment. TSD operations use hazardous chemicals and involve both air and ground transportation of hazardous materials. The NNSI, located in Coyote Canyon, has possible environmental soil contamination from deposits of lead at the firing range. Although none of the impacts from these facilities appear to be substantial incremental contributors of human health impacts within the ROI, any increases in future operational levels could increase the potential for cumulative impacts.

When considered in combination with impacts identified for the SNL/NM SWEIS operational alternatives and given the available data, it appears that these potential cumulative effects would relate to very low risk levels. Other nonrelated activities in the ROI may affect human health. However, they were not presented here because impacts were not similar or additive in nature and are not distinguishable within the ROI.

In summary, the presence of a small incremental effect to human health and worker safety resulting from SNL/NM operations would not significantly contribute to impacts resulting from any other identified past, present, or reasonably foreseeable actions taken by public and private entities in the ROI.

6.4.9 Transportation

Albuquerque's two major interstate highways, Interstate-25 and Interstate-40, handle large volumes of local traffic as well as regional commerce. As the city has grown, the overall impact of SNL/NM activities has decreased as a percentage of vehicle volume. This trend is projected to continue due to population growth and several new planned communities. Major arteries into KAFB are being improved based upon projected community needs and traffic flow patterns. Short-term and construction work (for example, MESA) will continue to disrupt transportation for a limited time. KAFB gate counts presented in Chapter 5 represent a total of all personnel living or working on KAFB.

Airport ground traffic has grown steadily as the airport has expanded to meet the needs of the region, which overshadows SNL/NM traffic effects. Although air traffic will continue to expand, sufficient capacity exists to meet the projected needs of the combined commercial and military operations. Appendix G.8 discusses cargo quantities.

Currently, the ER Project is in the process of remediating past disposal sites, thus generating a large volume of waste over a relatively short period of time. This has the short-term impact of increasing transportation and waste management requirements to the region. More detailed information is presented in Chapters 4 and 5.

In summary, a small incremental effect to transportation resulting from SNL/NM operations would not significantly contribute to impacts resulting from any other identified past, present, or reasonably foreseeable actions taken by public and private entities in the ROI.

6.4.10 Waste Generation

Multiple users of KAFB have a cumulative impact on the waste generated and transported from various facilities. In general, with the implementation of waste minimization programs, the DOE and DoD programs have, to the extent possible, minimized their impacts on local and regional waste management facilities. Based on the available data, the capacity to handle the anticipated waste streams being generated by all facilities is considered to be sufficient for the foreseeable future. Projected waste generation from the planned research park or the materials center is within the capacities for the local region. The current trend at SNL/NM is to maintain all hazardous materials in quantities sufficient for identifiable programmatic needs. As a result, materials are moved more frequently but in smaller quantities. This reduces the generation of legacy-type wastes and minimizes consequences in the event of an accident. In addition, the potential exists for offsite shipments of solid waste to the local landfill to increase if KAFB closes its onsite landfill. The demolition of the Compound Semiconductor Research Laboratory under the MESA Complex configuration for the Expanded Operations Alternative could add 2,000 tons of construction debris.

None of the seven DOE facilities manage hazardous waste under a RCRA hazardous waste permit. While some of the DOE facilities manage other types of wastes, including radioactive; historically, the wastes are generated infrequently and in small quantities. Municipal solid waste is managed through existing infrastructure provided by KAFB, SNL/NM, and the city of Albuquerque. No changes in waste generation rates were estimated for the seven DOE facilities (DOE 1998f).

In summary, a small incremental increase in waste generation resulting from SNL/NM operations would not significantly contribute to impacts resulting from any other identified past, present, or reasonably foreseeable actions taken by public and private entities in the ROI.

6.4.11 Noise and Vibration

While the ROI associated with noise and vibration at SNL/NM includes the Albuquerque basin, the primary area of interest is the area surrounding SNL/NM. Potential sources contributing to noise and vibration include increases in Albuquerque International Sunport air traffic and potential offsite construction activities. Any increase in the number of receptors (people) exposed to noise and vibration could result in increased cumulative effects.

Activities under the Expanded Operations Alternative would result in increased levels of noise/vibration due to increased vehicular traffic, testing activities, and construction. For this alternative, there would be an estimated 10 percent increase in commuter traffic to SNL/NM in 2008. Projections of the number of impulse noise tests for this alternative indicate a threefold increase in tests over those of the 1996 base year. These test activities would originate from facilities located in TA-III and the Coyote Test Field and would be remote relative to SNL/NM TAs and offsite receptors. Vehicular traffic and testing activities would likely result in a greater frequency of noise and vibration at current levels of intensity, similar to those presently experienced, whereas construction would be expected to increase peak noise levels. Construction activities would add to the ambient background noise levels at SNL/NM.

As is the case for SNL/NM vehicular traffic, increases in regional air and vehicular traffic would result in longer duration peak levels, with these levels remaining within current dB(A) ranges. Air traffic at Albuquerque International Sunport consists of a mix of commercial and military aircraft. Military fighter jets produce the highest single event noise level of any aircraft using the airport. The noise levels generated by the commercial jet aircraft vary significantly for each type of aircraft. The older low-bypass-ratio engines (Stage II) generate significantly higher noise levels than the newer generation high-bypass-ratio engines (Stage III). The average sound exposure level for Stage II aircraft is 10 to 15 dB(A) higher than for Stage III aircraft. It is expected that the older Stage II aircraft will be phased out of the fleet mix by the year 2000 and replaced with Stage III aircraft (KAFB 1998). Military fighter jet use of the Albuquerque International Sunport was assumed to remain similar to that observed during a 1997 noise survey. Therefore, the cumulative ambient background noise level in the vicinity of SNL/NM would be similar to or lower than current levels due to the phaseout of older Stage II aircraft. Construction in general, and at the Mesa del Sol project in particular, would also contribute to ambient background noise levels. The Mesa del Sol project, when completed, would also increase the number of receptors adjacent to SNL/NM, thereby further contributing to cumulative noise and vibration effects.

In summary, noise and vibration would remain within current dB(A) ranges, but increase in duration or frequency. Population increases would result in a greater number of receptors subject to noise and vibration effects. The small incremental effect resulting from SNL/NM operations would not significantly contribute to impacts resulting from any other identified past, present, or reasonably foreseeable actions taken by public and private entities in the ROI.

6.4.12 Socioeconomics

The recent growth in central New Mexico, which has resulted in regional economic and population changes, would be expected to continue as a result of growth in the private sector. Even with a 10 percent increase in SNL/NM expenditures and employment, as analyzed under the Expanded Operations Alternative, growth would not be expected to increase significantly from SNL/NM contributions.

No noticeable impact on existing demographic characteristics is anticipated. Overall expenditures and employment at SNL/NM are expected to expand gradually at a steady rate over the 10-year study period, which would, in turn, tend to maintain demographic characteristics within the ROI.

The steady rate was assumed because, historically, any increases or decreases in operational levels of activities at SNL/NM have been gradual and/or have fluctuated approximately one or two percent per year (SNL/NM 1997a).

According to the University of New Mexico, Bureau of Business and Economic Research, the population of the ROI will increase from 683,676 in 1996 to 856,927 in 2010 (UNM 1997b). Assuming a straight-line increase over time, approximately 12,375 people are added to the ROI each year. By 2008, the population of the ROI will be approximately 832,176.

In 1996, the number of people employed in the ROI was reported as 331,800. This represents 48.5 percent of the entire ROI (331,800/683,676). Assuming the same ratio in 2008, approximately 403,605 people would be employed.

Under the Expanded Operations Alternative, SNL/NM employment would increase by an estimated 765 employees, from 7,652 to 8,417. The 765 additional employees at SNL/NM would induce or indirectly add an estimated 2,646 employees to the ROI by 2008 for a total of 3,411 new jobs.

By 2008, the number of employed in the ROI would increase from 331,800 to 403,605, or 71,805 people. Excluding the SNL/NM direct and indirect contribution to the increase (3,411), the ROI employment increase would be 68,394.

By 2008, SNL/NM would represent 8,417 employees of 403,605 total employees in the ROI. This represents 2 percent of the ROI. The projected increase in jobs associated with SNL/NM (3,411), represents 5 percent of the projected job growth in the ROI.

Table 6.4–8 presents an estimate of the cumulative effects on the ROI economy from a 10-percent increase in operational levels of activity and associated increases in expenditures, income, and employment, both direct and indirect, at SNL/NM. Operational activities associated with selected facilities are included in the totals. If operations at SNL/NM were to increase by 10 percent over current levels, overall economic activity within the ROI would be expected to increase by about 0.8 percent, with slightly smaller increases in income and employment at about 0.7 percent. As presented in Table 6.4–8, a 10-percent increase in operational levels of activity at SNL/NM over the 10-year study would generate a total of $400 M in additional economic activity ($42.8 B minus $42.4 B) (an average increase of $40 M per year), a total of $100 M in additional income (an average increase of $10 M per year), and a total of 2,646 additional jobs (an average increase of 265 jobs per year) in the ROI. During the 10-year study period, contributory effects from other industrial and economic sectors within the ROI would reduce or mask some of SNL/NM's effects on the ROI economy.

The city of Albuquerque airport Master Plan determined that civilian activities at the airport produced an economic impact of $1.25 B in 1992 and supported 26,471 jobs in the Albuquerque area. This is very similar to SNL/NM's economic impact. The airport plan predicts that the impact will grow to $2.15 B and 47,077 jobs by 2010.

No measurable cumulative effects on existing housing and community services within the ROI are anticipated (Section 4.14.3). Overall expenditures and employment at SNL/NM are expected to expand at a steady rate over the 10-year study period, which would, in turn, tend to maintain housing availability, value, and levels of service.

In summary, a small incremental effect to socioeconomics resulting from SNL/NM operations would not significantly contribute to impacts resulting from any other identified past, present, or reasonably foreseeable actions taken by public and private entities in the ROI.

6.4.13 Environmental Justice

The estimated effects presented in Chapter 6 and in Chapter 5 under the Expanded Operations Alternative would be expected to bound environmental justice impacts. Under the Expanded Operations Alternative, effects were considered on groundwater quality and

Table 6.4–8. Impact on Central New Mexico's Economy if SNL/NM Operations Increased by 10 Percent

ECONOMIC MEASURE	FY 1996[a]			ASSUMING A 10% INCREASE IN OPERATIONS			
	SNL/NM	TOTAL ROI	PERCENT OF ROI	SNL/NM	TOTAL ROI	PERCENT OF ROI	PERCENT CHANGE
ECONOMIC ACTIVITY ($ BILLIONS)							
Direct Expenditures	1.43			1.57			
Indirect & Induced	2.50	42.4	9.3	2.75	42.80	10.1	0.8
Total Economic Activity	3.93			4.32			
Economic Activity Multiplier: 2.75[b]							
INCOME ($ BILLIONS)							
Net Wages & Salaries	0.48			0.53			
Indirect & Induced	0.58	13.4	8	0.64	13.51	8.7	0.7
Total Income	1.06			1.17			
Income Multiplier: 2.21[b]							
EMPLOYMENT (NUMBER OF EMPLOYEES)							
SNL/NM Employment	7,652			8,417			
Indirect & Induced	18,826	331,800	8	20,706	334,446	8.7	0.7
Total Employment	26,478			29,123			
Employment Multiplier: 3.46[b]							

Source: DOE 1997j
FY: fiscal year
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico

[a] Modeled results from SNL/NM 1997g
[b] The use of multipliers in calculating economic effects in the ROI is explained in Section 4.14.3

groundwater quantity (Section 5.4.4), cultural resources (Section 5.4.6), air quality (Section 5.4.7), noise emissions (Section 5.4.11), transportation (Section 5.4.9), human health during normal operations and facility accidents (Section 5.4.8), and socioeconomics (Section 5.4.12). The cumulative impacts presented would have no known disproportionately high or adverse health or environmental impacts on low-income or minority populations within the ROI.

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CHAPTER 7

Applicable Laws, Regulations, and Other Requirements

Environmental compliance requirements, including statutes, regulations, and orders, which are applicable to the proposed action and alternatives, will be presented in this chapter.

7.1 INTRODUCTION

As part of the *National Environmental Policy Act* (NEPA) process, the Sandia National Laboratories/New Mexico (SNL/NM) Site-Wide Environmental Impact Statement (SWEIS) should consider, in determining the significance of impacts, if actions described under the SWEIS alternatives threaten to violate any Federal, state, or local law or requirement and must list all required Federal permits, licenses, or other entitlements (40 Code of Federal Regulations [CFR] §1508.27(b)(10) and §1502.25, respectively). This chapter summarizes assessment of the major existing environmental requirements, agreements, and permits that relate to continuing operations at SNL/NM.

In addition to this introduction, Chapter 7 is divided into two sections. Section 7.2 describes general environmental laws, regulations, and other requirements under which the U.S. Department of Energy (DOE) must proceed in preparing the SWEIS. Section 7.3 describes specific environmental requirements for each resource area.

7.2 GENERAL ENVIRONMENT, HEALTH, SAFETY LAWS, REGULATIONS, AND OTHER REQUIREMENTS

7.2.1 Atomic Energy Act of 1954 (42 U.S.C. §2011)

The *Atomic Energy Act* (AEA) of 1954 makes the Federal government responsible for regulatory control of the production, possession, and use of three types of radioactive material: source, special nuclear, and byproduct. Regulations promulgated by the U.S. Nuclear Regulatory Commission (NRC) under the AEA establish standards for the management of these radioactive materials, licensing of nuclear facilities, and protection of the public and property against radiation. The AEA authorizes the DOE to set radiation protection standards for itself and its contractors for DOE nuclear facilities and provides exclusions from NRC licensing for defense production facilities. The NRC regulates private and commercial nuclear activities, but currently has no regulating authority at most DOE facilities. In December 1996, the DOE announced that it would begin a process of transferring oversight of nuclear safety to the NRC for all DOE nuclear facilities (DOE 1996a). The transfer, which requires legislative action, is to be phased-in over a 10-year period.

The AEA authorizes the DOE to establish standards that protect health and minimize danger to life or property from activities under the DOE's jurisdiction. The mechanisms through which DOE manages its facilities are the promulgation of regulations and the issuance of DOE orders and associated standards and guidance. Requirements for the protection of environment, safety, and health (ES&H) are implemented at DOE sites primarily through contractual mechanisms, which establish the applicable DOE requirements for management and operating contractors.

7.2.2 National Environmental Policy Act of 1969, as Amended (42 U.S.C. §4321)

NEPA requires Federal agencies to evaluate the environmental impacts of proposed actions on the quality of the human environment and to document this evaluation with a succinct statement. The act also created the Council on Environmental Quality (CEQ), which oversees the NEPA process. NEPA requires an agency to consider the environmental impacts of an action, prior to taking action that would preclude any reasonable alternative actions. It also provides for public input into the decision-making process.

7.2.3 Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508)

The implementing regulations for NEPA were developed by the CEQ. These regulations seek to

- integrate the NEPA process into the early planning phase of a project to insure appropriate consideration of NEPA policies and to eliminate delay;
- emphasize cooperative consultation among agencies before the environmental document is prepared;
- identify at an early stage the significant environmental issues deserving of study and de-emphasize insignificant issues, thus, narrowing the scope of the environmental document;
- provide a mechanism for putting appropriate time limits on the environmental documentation process; and
- provide for public participation in the NEPA process.

7.2.4 National Environmental Policy Act Implementing Procedures (10 CFR Part 1021)

The DOE established its NEPA implementing procedures to meet the requirements of Section 102(2) of NEPA, CEQ implementing regulations, and Executive Order (EO) 11514, *Protection and Enhancement of Environmental Quality* (35 Federal Register [FR] 4247). The procedures formalize the DOE's policy to follow the letter and spirit of NEPA, comply fully with the CEQ regulations, and apply the NEPA review process early in the planning stages for DOE proposals. The SWEIS is being prepared under 10 CFR §1021.330, programmatic (including site-wide) NEPA documents, requiring preparation of site-wide environmental documentation for certain of its large, multiple-facility sites.

7.2.5 Protection and Enhancement of Environmental Quality (EO 11514)

Under EO 11514, Federal agencies are required to monitor and control their activities continually to protect and enhance the quality of the environment (35 FR 4247). It directs agencies to develop programs and measures to protect and enhance environmental quality and further directs heads of agencies to consult with appropriate Federal, state, and local agencies in carrying out their activities as they affect the quality of the environment. EO 11514 contains requirements to ensure that Federal agencies include the public in the decision-making process. This order was in part responsible for the development of the DOE implementing procedures for NEPA and DOE Order 451.1A, *National Environmental Policy Act Compliance Program.*

7.2.6 Federal Compliance with Pollution Control Standards (EO 12088)

Under EO 12088, the head of each executive agency is responsible for ensuring that all necessary actions are taken for the prevention, control, and abatement of environmental pollution with respect to Federal facilities and activities under their control (43 FR 47707). Specifically, they must ensure compliance with applicable pollution control standards, including those established by, but not limited to, the *Clean Air Act* (CAA), *Noise Control Act* (NCA), *Clean Water Act* (CWA), *Safe Drinking Water Act* (SDWA), *Toxic Substances Control Act* (TSCA), and *Resource Conservation and Recovery Act* (RCRA).

7.2.7 DOE O 451.1A, National Environmental Policy Act Compliance Program

This order establishes DOE internal program requirements and responsibilities for implementing NEPA, CEQ implementing regulations, and DOE NEPA implementing procedures.

7.2.8 DOE 5400.1, General Environmental Protection Program

This order establishes the environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with applicable Federal, state, and local environmental protection laws and regulations, EOs, and internal DOE policies. This order also provides for environmental protection standards, notification and reporting requirements for discharges and unplanned releases, environmental protection and program plans, and environmental monitoring and surveillance requirements. It establishes formal recognition that DOE's environmental management activities are extensively, but not entirely, regulated by the U.S. Environmental Protection Agency (EPA), state, and local environmental agencies, and it provides requirements for satisfying these externally imposed regulations. In addition, it establishes requirements for those environmental protection programs that are not externally regulated.

7.2.9 New Mexico Environmental Oversight and Monitoring Agreement

This agreement, known as the Agreement in Principle, between the DOE and the state of New Mexico, provides for the DOE's technical and financial support of state activities in environmental oversight, monitoring, access, and emergency response. The agreement, which was initially signed in October 1990, covers SNL/NM, Los Alamos National Laboratory (LANL), the Waste Isolation Pilot Plant (WIPP), and the Lovelace Respiratory Research Institute. Under the agreement, the New Mexico Environment Department (NMED) is the lead state agency and provides independent environmental monitoring and emergency planning review services related to all DOE activities at these sites in New Mexico. On October 2, 1995, the DOE and NMED extended the Agreement in Principle for an additional five years.

7.3 ENVIRONMENT, HEALTH, AND SAFETY LAWS, REGULATIONS, AND OTHER REQUIREMENTS FOR EACH RESOURCE AREA

Because SNL/NM was constructed and began operations in the 1940s, before the advent of current environmental requirements, operational nuclear safety and national security were the dominant factors in the early design and operation of facilities. With the enactment of environmental laws and regulations from the 1960s to the present, resources and philosophies have changed to place greater emphasis on achieving compliance with all applicable environmental requirements. Due to its long history, SNL/NM has had difficulty in achieving compliance with some regulatory requirements and has a legacy from past management practices of environmental cleanup requirements for waste, spills, and releases. All environmental protection, legacy environmental cleanup, and operational compliance activities at SNL/NM are covered by laws, regulations, permits, and DOE orders. Several compliance orders and agreements are also in effect with regulatory agencies to bring SNL/NM into full compliance with some regulatory requirements. In general, the DOE and SNL/NM must now comply with applicable Federal and state requirements to the same extent as any other entity. Noncompliance with these requirements can lead to enforcement actions.

Applicable environmental laws, regulations, and other requirements have been identified for each of the resources evaluated in this SWEIS. These are discussed below by resource.

7.3.1 Land Use and Visual Resources

7.3.1.1 National Forest Management Act of 1976, as Amended (16 U.S.C. §472a)

This act reorganized, expanded, and otherwise amended the *Forest and Rangeland Renewable Resources Planning Act of 1974*, which called for the management of renewable resources on national forest lands. The act requires the Secretary of Agriculture to assess forest lands; develop a management program based on multiple-use, sustained-yield principles; and implement a resource management plan for each unit of the national forest system. It is the primary statute governing the administration of national forests.

7.3.1.2 Federal Land Policy and Management Act of 1976 (43 U.S.C. §§1701-1784)

This act governs the use of Federal lands that may be overseen by several agencies and establishes procedures for land withdrawals and rights-of-way.

7.3.1.3 Public Land Order 995 (19 FR 5443)

This order revokes previous land withdrawal orders and withdraws from public use, approximately 21,163 acres of the Cibola National Forest for use by the U.S. Department of Defense (DoD) in connection with Kirtland Air Force Base (KAFB).

7.3.1.4 Public Land Order 4569 (34 FR 1139)

This order withdraws from public use, 4,594 acres of the Cibola National Forest for use by the DOE for research and development.

7.3.1.5 DOE P 430.1, DOE Land Use and Facility Policy

This policy governs DOE's management of its land and facilities as valuable national resources, based on the principles of ecosystem management and sustainable development.

7.3.2 Infrastructure

7.3.2.1 Hazardous Materials (29 CFR Part 1910, Subpart H)

This regulation provides the health and safety requirements for work with and around hazardous materials. This subpart covers work involving compressed gas cylinders, hazardous compounds and elements (such as acetylene, explosive agents, and hydrogen), and mechanical processes involving dip tanks and spray finish units. It includes Subpart 1910.120, *Hazardous Waste Operations*, which is the main health and safety regulation for work in hazardous waste operations.

7.3.2.2 Hazardous Waste Operations and Emergency Response (29 CFR §1910.120)

This regulation specifies requirements for conducting waste operations and response activities. These requirements include both activity and training requirements for personnel.

7.3.2.3 Materials Handling and Storage (29 CFR Part 1910, Subpart N)

This regulation specifies requirements for material handling equipment such as cranes, derricks, helicopters, slings, and powered industrial trucks. This subpart covers the minimum distance a worker must be from a single rim and multi-piece rim wheel while servicing the tire and the maintenance and use of forklifts, cranes, and derricks.

7.3.2.4 Toxic and Hazardous Substances (29 CFR Part 1910, Subpart Z)

This regulation provides requirements for performing air monitoring and medical monitoring for a variety of hazardous chemicals and materials such as asbestos, methyl chloromethyl ether, vinyl chloride, benzene, bloodborne pathogens, and cotton dust. It also establishes acceptable levels for toxic and hazardous substances in the blood of workers, as well as proper collection and measuring techniques.

7.3.2.5 Electric Utility Industry Restructuring Act of 1999

The *Electric Utility Industry Restructuring Act of 1999* (New Mexico State Senate Bill 428) provides requirements for establishing the restructure of the electric utility industry, including customer choice in the supply of electricity, providing options to rural electric cooperatives and municipal utilities, creating a fund, and providing penalties.

7.3.2.6 DOE N 251.4, Environmental, Safety, and Health Program for Department of Energy Operations

This order applies to ES&H programs at all government-owned, contractor-operated facilities including the occupational safety and health programs for DOE contractor employees at facilities where the contracts include the occupational safety and health contract clause specified in 48 CFR, *Federal Acquisition Regulations*. This order also applies to environmental protection programs and programs for protection against accidental loss or damage to property as provided by law or contract and as implemented by the appropriate contracting officer.

7.3.2.7 DOE 5480.4, Environmental Protection, Safety and Health Protection Standards

This order specifies the requirements for the application of mandatory ES&H standards applicable to all DOE and DOE contractor operations, provides a listing of reference ES&H standards, identifies the sources of the mandatory and reference ES&H standards, and specifies several mandatory and reference standards applicable to nuclear criticality protection for all DOE nuclear facilities. It also mandates that hazardous waste regulations set forth in 40 CFR Parts 260-265 be followed as a matter of policy.

7.3.2.8 DOE 5480.5, Safety of Nuclear Facilities

This order establishes nuclear facility safety program requirements. It requires that ES&H programs include administrative and procedural controls that delineate

- clear lines of responsibility and methods for operation under normal and emergency conditions;
- a system of configuration control that requires independent safety review and approval of all changes to components, equipment, procedures, and systems required for the facility's safety;

- criticality safety program requirements for fissile material storage and handling facilities/operations;
- decontamination and decommissioning requirements of DOE facilities; and
- emergency plans to handle potential accidents.

7.3.3 Geology and Soils

Regulatory environmental protection statutes governing geology and soils are addressed under other resource areas in this chapter. They include the *Resource Conservation and Recovery Act* (RCRA) (42 U.S.C. §6901), the *Comprehensive Environmental Response Compensation and Liability Act* (CERCLA) (42 U.S.C. §6902), and the 1986 amendment to the CERCLA, the *Superfund Amendments and Reauthorization Act* (SARA) (42 U.S.C. §6902, as amended).

7.3.4 Water Resources and Hydrology

7.3.4.1 Clean Water Act of 1948, as Amended (33 U.S.C. §1251)

The goals of the CWA are to restore and maintain waters of the U.S. in order to protect human health and safety and to provide for the protection and propagation of fish, shellfish, and wildlife. The act authorizes regulations that establish limitations and permitting requirements for hazardous substances being discharged from point sources, dredge or fill operations at wetlands and other waters of the U.S., stormwater discharges from industrial runoff, and oil discharges. Key elements of the act include nationally applicable, technology-based effluent limitations set by the EPA for specific industry categories, and water quality standards set by states.

The EPA is the regulating authority for point source and stormwater discharge permits in New Mexico. Permits are issued and enforced by the EPA Region 6 in Dallas, Texas. New Mexico does not have a state point source discharge permit program. However, the NMED performs some compliance evaluation inspections and monitoring for the EPA through a water quality grant issued under Section 106 of the CWA. The U.S. Army Corps of Engineers administers the dredge or fill material permit program (Section 404) of the act.

The CWA contains provisions for the National Pollutant Discharge Elimination System (NPDES), a permitting program for the discharge of pollutants from any point source into waters of the U.S. Individual NPDES permits set parameters and maximum contaminant levels for specified pollutants at specific outfall sites. EPA Region 6 issued SNL/NM NPDES Storm Water Multi-Sector General Permit Number NMR05A181 on August 25, 1997.

To comply with the CWA, the city of Albuquerque issues wastewater permits under the *City of Albuquerque Sewer Use and Wastewater Control Ordinance* (Ordinance 21-1985). Under this ordinance, SNL/NM is subject to limitations on volumes and constituent concentrations for wastewater discharged to the sanitary sewer.

7.3.4.2 Safe Drinking Water Act of 1944, as Amended (42 U.S.C. §300f)

The SDWA sets national standards for contaminant levels in public drinking water systems, regulates the use of underground injection wells, and prescribes standards for groundwater aquifers that are a sole source of drinking water. Primary enforcement responsibility for the act is by the states. The EPA has given the NMED authority to administer and enforce Federal drinking water regulations and standards in New Mexico. The act authorizes regulations that establish national drinking water standards for contaminants in public drinking water systems. The EPA maintains oversight responsibilities over the states, sets new contaminant standards as appropriate, and maintains separate enforcement responsibility for the Underground Injection Control Program.

The SDWA applies to Federal facilities that own or operate a public water system. A public water system is defined as a system for the provision of piped water for human consumption that has at least 15 service connections or regularly serves at least 25 individuals. KAFB provides drinking water to SNL/NM and other associate occupants of the base. KAFB is required to monitor drinking water quality for organic and inorganic compounds, radionuclides, metals, turbidity, and total coliforms.

7.3.4.3 National Drinking Water Regulations (40 CFR Parts 141-143)

These regulations establish primary (40 CFR Part 141) and secondary (40 CFR Part 143) drinking water standards; 40 CFR Part 141 also establishes regulations applicable to public water systems. Although the primary standards are Federally enforceable (40 CFR Part 142), the secondary standards are intended as guidelines for the states. The primary and secondary standards have been adopted by New Mexico. Along with inorganic and organic constituents, the primary standards also establish limits for radioactive releases to drinking water. The annual dose to the general public from radioactive releases to drinking water is limited to 4 mrem. The DOE also establishes this same level in DOE 5400.5, *Radiation Protection of the Public and the Environment*. The secondary standards relate to contaminants in drinking water that primarily affect aesthetic qualities related to public acceptance of drinking water.

7.3.4.4 Spill Control and Countermeasures Plan (40 CFR Part 112)

SNL/NM has a spill control and countermeasures plan, as required by 40 CFR Part 112. The 1990 *Oil Pollution Act* rewrote sections of the CWA. This plan requires that secondary containment be provided for all above-ground storage tanks. The plan also provides for spill control at oil storage sites at SNL/NM. This plan meets requirements of both EPA and NMED for control of spills to surface areas and below the ground surface.

7.3.4.5 Standards for Use or Disposal of Sewage Sludge (40 CFR Part 503)

The purpose of these standards is to establish numerical, management, and operational standards for the beneficial use or disposal of sewage sludge through land application or surface disposal. Under these regulations, SNL/NM is required to collect representative samples of sewage sludge to demonstrate that it is not a hazardous waste and that it meets the minimum Federal standards for pollutant concentrations.

7.3.4.6 DOE 5400.1, General Environmental Protection Program (modified by DOE O 231.1)

This order requires SNL/NM to prepare a groundwater protection management program plan (GWPMPP) and to implement the program outlined by that plan. GWPMPP also fulfills the requirements of Chapter IV, Section 9, of the order, which requires development of a groundwater monitoring plan. The groundwater monitoring plan identifies all DOE requirements and regulations applicable to groundwater protection and includes strategies for sampling, analysis, and data management.

Chapter IV, Section 9c, of DOE 5400.1 requires that groundwater monitoring be determined by site-specific characteristics and, where appropriate, that groundwater monitoring programs be designed and implemented in accordance with RCRA regulations 40 CFR Part 264, Subpart F, or 40 CFR Part 265, Subpart F. These regulations also require that monitoring for radionuclides be in accordance with DOE 5400.5, *Radiation Protection of the Public and the Environment*.

7.3.4.7 New Mexico Ground Water and Surface Water Protection (20 NMAC 6.2)

This regulation is intended to protect groundwater and surface water in the state of New Mexico. The regulation has subparts covering general provisions and procedures, surface water protection, permitting and groundwater standards, prevention and abatement of water pollution, and underground injection control. The following provisions are of greatest significance to SNL/NM operations:

- Notification of Discharge—Removal (contained in Subpart I, General Provisions and Procedures). This part of the regulation provides for 24-hour notification of the Ground Water Protection and Remediation Bureau in the event of discharge of "oil or other water contaminant, in such quantity as may with reasonable probability injure or be detrimental to human health, animal or plant life, or property, or unreasonably interfere with the public welfare or the use of the property."
- Subpart II—Surface Water Protection. This subpart contains standards for effluent discharge to a watercourse (which includes arroyos). This regulation does not apply to NPDES-permitted discharges unless they are out of compliance.
- Subpart III—Permitting and Groundwater Standards. This subpart contains standards for discharges onto or below the ground surface to protect groundwater that has existing concentrations of 10,000 mg/L or less total dissolved solids.
- Subpart IV—Prevention and Abatement of Water Pollution. This subpart contains standards and requirements for the remediation and protection of groundwater and surface water. In addition to the abatement of groundwater pollution to standards specified in 20 NMAC 6.2, it calls for the abatement of surface water pollution to standards specified in 20 NMAC 6.1, Water Quality Standards for Interstate and Intrastate Streams (Section 7.3.4.8).

7.3.4.8 New Mexico Standards for Interstate and Intrastate Streams (20 NMAC 6.1)

This regulation includes a set of general standards applicable to all surface water in the state (including ephemeral streams) and additional or more stringent standards for designated bodies of water. The general standards include criteria for stream bottom deposits; floating solids, oil, and grease; color; odor and taste of fish; plant nutrients; toxic substances; radioactivity; pathogens; temperature; turbidity; salinity; and dissolved gases. Water flowing in arroyos within KAFB is subject to these quality standards.

7.3.5 Biological and Ecological Resources

7.3.5.1 Endangered Species Act of 1973, as Amended (16 U.S.C. §1531)

The *Endangered Species Act* requires that Federal agencies ensure that any actions authorized, funded, or carried out by the agency are not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat. The act is jointly administered by the U.S. Department of Commerce, National Marine Fisheries Service, and the U.S. Department of the Interior (DOI)/U.S. Fish and Wildlife Service (USFWS). Under the act, agencies undergo a process of informal and formal consultation, which may include preparation of a biological assessment, to determine if a threatened or endangered species would be affected by planned agency activities.

The DOE has consulted with the USFWS, U.S. Forest Service (USFS), Bureau of Indian Affairs (BIA), New Mexico Game and Fish Department (NMGFD), and New Mexico Forestry and Resources Conservation Division (Energy, Minerals, and Natural Resources Department) regarding concerns each agency may have about the impact of SNL/NM activities on protected animal and plant species.

7.3.5.2 Migratory Bird Treaty Act of 1918, as Amended (16 U.S.C. §703)

This act protects migratory birds by making it unlawful to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird, unless and except as permitted by regulation. The act is intended to protect birds that have common migratory patterns within the U.S., Canada, Mexico, Japan, and Russia.

7.3.5.3 Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. §668)

This act makes it unlawful to capture, kill, destroy, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the U.S. A permit must be obtained from the DOI to relocate a nest that interferes with resource development or recovery operations.

7.3.5.4 National Forest Management Act of 1976 (16 U.S.C. §§1600-1614)

This act requires the Secretary of Agriculture to assess forest lands; develop a management program based on multiple-use, sustained-yield principles; and implement a resource management plan for each unit of the national forest system. Resource management plans must be in accordance with NEPA.

7.3.5.5 Fish and Wildlife Coordination Act of 1934 (16 U.S.C. §661, *et seq.*)

This act requires Federal agencies involved in actions that result in structural modification or control of any natural stream or body of water for any purpose to take action to protect the fish and wildlife resources that may be affected by the action.

7.3.5.6 Section 404 of the Clean Water Act of 1948 (33 U.S.C. §1344)

Section 404 of the CWA requires permits to authorize the discharge of dredged or fill material into navigable waters or wetlands and to authorize certain structures or work in or affecting navigable waters. Authority to issue permits resides with the U.S. Army Corps of Engineers. Individual permits issued by the U.S. Army Corps of Engineers under Section 404 are reviewed at the Federal level by EPA. At the state level, the Surface Water Quality Bureau of the NMED provides Section 401 certification for Section 404 permits.

7.3.5.7 Protection of Wetlands (EO 11990) and Floodplain Management (EO 11988)

EO 11990 requires government agencies to avoid short- and long-term adverse impacts to wetlands whenever a practicable alternative exists (42 FR 26961). EO 11988 directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken (42 FR 26951). Impacts to floodplains are to be avoided to the extent practicable. The DOE issued regulations (10 CFR Part 1022) that establish procedures for compliance with these EOs. No floodplain/wetlands impacts were identified for the SWEIS for which a floodplain/wetlands assessment is required.

7.3.5.8 New Mexico Endangered Plant Species Act (NMSA 75-6)

This act protects endangered plant species within New Mexico. An endangered plant species is defined as any plant whose prospects of survival within the state of New Mexico are in jeopardy or are likely to become jeopardized in the foreseeable future. Species of plants determined to be endangered may not be taken, possessed, transported, exported from the state, processed, or sold.

7.3.5.9 New Mexico Wildlife Conservation Act (NMSA 17-2, Part 3)

This act establishes requirements for protecting wildlife, primarily related to taking for sport purposes, and permits for collecting and use. The act also protects endangered and threatened animals listed by the state of New Mexico.

7.3.5.10 New Mexico Raptor Protection Act (NMSA 17-2-14)

This act makes it unlawful to take, attempt to take, possess, trap or ensnare or injure, maim, or destroy any of the species of hawks, owls, and vultures.

7.3.5.11 New Mexico Wetlands Regulations (NMSA 75-8-2)

New Mexico has promulgated regulations for the protection of wetlands. New Mexico's definition of wetlands is identical to the Federal definition, except that constructed wetlands are not included. The DOE follows these regulations in evaluating proposed actions for wetlands impacts.

7.3.6 Cultural Resources

7.3.6.1 National Historic Preservation Act of 1966, as Amended (16 U.S.C. §470)

This act directs that sites with significant national historic value be placed on the National Register of Historic Places (NRHP). Government agencies must locate and inventory historic properties and cultural resources under their jurisdiction prior to taking an action that might harm them, with the intent of minimizing such harm through appropriate mitigation actions. As required by Section 106 of the act, proposed SNL/NM activities are evaluated in consultation with the State Historic Preservation Officer (SHPO) for possible effects on cultural resources. Most surveys are conducted on DOE property; however, when appropriate, surveys are conducted on land owned by other Federal agencies. The DOE holds discussions, as appropriate, with various Native American tribes to determine how new SNL/NM activities might affect cultural resources. The tribes are also requested to provide input on what mitigation measures they want implemented before SNL/NM begins an activity. The DOE must also obtain comments from the Advisory Council on Historic Preservation prior to taking a proposed action at SNL/NM.

7.3.6.2 The American Indian Religious Freedom Act of 1978 (42 U.S.C. §1996)

This act establishes that it is the policy of the United States to protect and preserve for Native Americans their inherent right of freedom to believe, express, and exercise their traditional religions. This includes access to sites, uses and possession of sacred objects, and the freedom to worship through ceremonies and traditional rites. In accordance with the *American Indian Religious Freedom Act,* SNL/NM activities are planned so that they do not adversely affect the practice of traditional religions. Tribal groups are notified of projected construction activities and are asked to inform the DOE if any activity will affect a traditional cultural property.

7.3.6.3 Religious Freedom Restoration Act of 1992 (42 U.S.C. §2000bb)

This act states that the Federal government will not, through its actions, substantially burden a person's free exercise of religion. If a government action will burden the exercise of religion, the agency involved must demonstrate that the action is in the furtherance of a compelling government interest and that the action is the least restrictive means of furthering that compelling interest.

7.3.6.4 The Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. §3001)

This act states that tribal descendants shall own Native American human remains and cultural items discovered on Federal lands after November 16, 1990. When items are discovered during an activity on Federal lands, the activity is to cease and the appropriate tribal government is to be notified. Work on the activity can resume 30 days after the receipt of certification that notice has been received by the tribal government. A consultation process is used to determine which tribe(s) is affiliated with the items, and disposition and treatment of the items is accomplished in accordance with the wishes of the affiliated tribe.

7.3.6.5 Archaeological Resource Protection Act of 1979, as Amended (16 U.S.C. §470aa)

This act requires the preservation and management of archaeological resources on lands administered by Federal agencies. SNL/NM maintains a cultural resources management database, and this information continues to be used in planning remediation and other construction activities to prevent damage to or destruction of archaeological resources at SNL/NM. Archaeological survey reports are prepared for the DOE by cultural resource specialists and are submitted to the SHPO for review and concurrence.

7.3.6.6 Protection of Historic and Cultural Properties (36 CFR Part 800)

This regulation defines the process used by Federal agencies to meet their responsibilities under Section 106 of the *National Historic Preservation Act*. Section 106 of the act requires Federal agencies to take into account the effects of the agency's activities on properties included in or eligible for the NRHP and, prior to approval of an undertaking, to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the activity. The overall goal is to accommodate historic preservation concerns during Federal undertakings.

7.3.6.7 National Historic Preservation (EO 11593)

This EO requires Federal agencies, including the DOE, to locate, inventory, and nominate properties under their jurisdiction or control to the NRHP if those properties qualify (36 FR 8921). The DOE is required to provide the Advisory Council on Historic Preservation the opportunity to comment on possible impacts of a proposed activity on any potentially eligible or listed resources.

7.3.6.8 Indian Sacred Sites (EO 13007)

This EO requires that 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, accommodate access to and ceremonial use of sacred sites by Native American religious practitioners and avoid adversely affecting the physical integrity of such sacred sites (61 FR 26771).

7.3.7 Air Quality

7.3.7.1 Clean Air Act of 1955, as Amended (42 U.S.C. §7401)

The CAA establishes air quality standards to protect public health and the environment from the harmful effects of air pollution. The act requires establishment of national standards of performance for new stationary sources of atmospheric pollutants, emissions limitations for any new or modified structure that emits or may emit an air pollutant, and standards for emission of hazardous air pollutants. In addition, the CAA requires that specific emission increases be evaluated to prevent a significant deterioration in air quality.

The *Clean Air Act Amendments of 1990*, signed into law on November 15, 1990, enhanced and expanded existing authorities and created new programs in the areas of permitting, enforcement, and operations in nonattainment areas (areas not meeting air quality standards), control of acid rain, regulation of air toxins, mobile sources, and protection of the ozone layer. Section 118 of the act and EO 12088, *Federal Compliance With Pollution Control Standards* (43 FR 47707), require that each Federal agency, such as the DOE, with jurisdiction over any property or facility 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 to the same extent as any nongovernmental entity.

The EPA is the regulating authority for the CAA. However, the EPA has granted authority to the state of New Mexico for regulating air quality under an approved state implementation plan (SIP). The EPA has not yet delegated to the state the authority for implementing the regulations promulgated for stratospheric ozone protection and the accidental release provisions of the act. The EPA also continues to regulate the radionuclide National Emissions Standards for Hazardous Air Pollutants (NESHAP) and radon emissions. In New Mexico, all of the CAA regulations, with these exceptions, have been adopted by the state as part of the SIP and are regulated under the *New Mexico Air Quality Control Act* (New Mexico Statutes Annotated [NMSA] 74-2).

On July 18, 1997, the EPA adopted a new National Ambient Air Quality Standard (NAAQS) for particulate matter with a diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) and reference methods for determining attainment with the standard. However, on May 14, 1999, the U.S. Court of Appeals for the District of Columbia overturned the new air quality standards. On June 5, 1998, ambient air quality became subject to a new 8-hour, 0.08-ppm ozone standard, replacing the previous 1-hour, 0.12-ppm ozone standard (63 FR 31066). This new ozone standard was also overturned on May 14, 1999. In addition to the existing Federal programs, the *Clean Air Act Amendments of 1990* mandates new programs that may affect future SNL/NM programs. These programs require technology for controlling hazardous air pollutants and replacing chlorofluorocarbons. Regulations are still being developed to implement these aspects of the act.

7.3.7.2 Approval and Promulgation of Air Quality Implementation Plans, New Mexico (40 CFR Part 52)

This regulation provides for a revision to the New Mexico SIP. It provides changes to the plan to clarify that any monitoring approved for the source (and included in the Federally enforceable operating permit) may form the basis of the compliance certification, and any credible evidence may be used for purposes of enforcement in Federal court.

7.3.7.3 Protection of Environment: National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61)

This regulation limits the radiation dose to the public from airborne radionuclide emissions from DOE facilities to 10 mrem/yr effective dose equivalent (EDE) (40 CFR §61.92). The standards also prescribe emission monitoring and test procedures for determining compliance with the 10 mrem/yr standard and reporting and permit provisions.

7.3.7.4 Accidental Release Prevention Requirements: Risk Management Programs (40 CFR Part 68)

The intent of this regulation is to prevent accidental releases to the air and mitigate the consequences of such releases by focusing prevention measures on chemicals that pose the greatest risk to the public and the environment. This regulation requires the preparation of risk management plans for listed regulated chemicals at SNL/NM by June 1999 and within 3 years after listing any new regulated chemical.

7.3.7.5 Protection of Stratospheric Ozone (40 CFR Part 82)

The primary purposes of this regulation are to eliminate the production of certain ozone-depleting substances and require users of the substances to reduce emissions to the atmosphere through recycling and mandatory use of certified maintenance technicians. These requirements are applicable to SNL/NM and are implemented accordingly.

7.3.7.6 DOE 5400.5, Radiation Protection of the Public and the Environment

This order incorporates EPA NESHAP standards for public doses from air emissions and provides for additional monitoring and evaluation of the total public radiation dose from other pathways. The DOE's annual limit of radiation dose to a member of the general public from all DOE facilities is 100 mrem from all pathways. Unplanned releases of radioactive effluents to the air are also reported and analyzed under provisions of this order.

7.3.7.7 New Mexico Air Quality Control Act (NMSA 74-2)

Nonradioactive air emissions from SNL/NM facilities are subject to the regulatory requirements established under this act. The New Mexico Environmental Improvement Board (NMEIB), as provided by the act, regulates air quality through a series of air quality control regulations. These regulations also include emission standards for emission sources and processes such as open burning, boilers, and asphalt plants. These regulations are administered by the NMED.

7.3.7.8 New Mexico Ambient Air Quality Standards (20 NMAC 2.3)

The objective of this regulation is to establish ambient air quality standards for the areas of New Mexico under the jurisdiction of the NMEIB. The adoption of these statewide ambient air quality standards does not prohibit the promulgation of standards for specific areas, functions, and conditions within the state by municipalities and certain counties. Standards are established in the regulations for total suspended particulates, sulfur dioxide, hydrogen sulfide, total reduced sulfur, carbon monoxide, and nitrogen dioxide.

7.3.7.9 New Mexico Operating Permits (20 NMAC 2.70)

On July 21, 1992, the EPA promulgated 40 CFR Part 70, *Operating Permit Program*, which implements Title V of the CAA. The purposes of this program are to identify all the air quality regulations and emission limitations applicable to an air pollution source and establish monitoring, record-keeping, and reporting requirements necessary to demonstrate continued compliance with these requirements. This regulation required each state to develop an operating permit program meeting the minimum requirements set forth in 40 CFR Part 70 and submit their program to the EPA for review by November 1993. The NMED Operating Permit Program was approved by the EPA in 1993. It requires that all major producers of air pollution obtain an operating permit from NMED. Due to SNL/NM's potential to emit large quantities of regulated air pollutants (nitrogen oxides and carbon monoxide—primarily from steam plants), SNL/NM is considered a major source. In accordance with this regulation, SNL/NM submitted an operating permit application to NMED in 1996.

7.3.7.10 New Mexico Construction Permits (20 NMAC 2.72)

Provisions of this regulation require construction permits for any new or modified source of any regulated air contaminant if the source is expected to exceed threshold emission rates. More than 500 toxic air pollutants are regulated, and each chemical's threshold hourly rate is based on its toxicity. Each new or modified air emission source is reviewed and conservative estimates are made of maximum hourly chemical use and emissions. These estimates are compared with the applicable 20 New Mexico Administrative Code (NMAC) 2.72 limits to determine whether additional permits are required.

7.3.7.11 Prevention of Significant Deterioration (20 NMAC 2.74)

This regulation has stringent requirements that must be addressed before construction can begin on any new, large, stationary source. Under this regulation, wilderness areas, national parks, and national monuments receive special protection. All of the new or modified air emission sources at SNL/NM are reviewed for compliance with the requirements of 20 NMAC 2.74. Because the total emissions of any criteria pollutant from SNL/NM are below the prevention-of-significant-deterioration-threshold of 250 tons a year, currently this regulation does not apply to SNL/NM.

7.3.7.12 Emission Standards for Hazardous Air Pollutants (20 NMAC 2.78)

This regulation has adopted by reference all of the Federal NESHAP provisions, except those for radionuclides and residential wood heaters. The only two nonradionuclide NESHAP provisions applicable to SNL/NM are those for asbestos and beryllium.

Under NESHAP provisions for asbestos, SNL/NM is required to notify NMED of asbestos removal operations and disposal quantities and to ensure that these operations produce no visible emissions. Asbestos removal activities involving less than 160 ft^2 are covered by an annual small-job notification to NMED. Projects involving greater amounts of asbestos require separate advance notification to NMED. Quantities of asbestos wastes for both small and large jobs are reported to NMED on a quarterly basis. These reports include any asbestos contaminated, or potentially contaminated, with radionuclides. Radioactively contaminated material is disposed of in a designated radioactive asbestos burial area. Nonradioactive asbestos is transported offsite to designated commercial asbestos disposal areas.

The beryllium NESHAP provisions include requirements for preconstruction and preoperation approval of beryllium machining operations and for start-up testing of stack emissions from these operations. Before the beryllium NESHAP became applicable for DOE operations in the mid-1980s, NMED, DOE, and SNL/NM agreed to follow the NMED new-source preconstruction/preoperation approval process for large, existing beryllium-machining operations at SNL/NM. Since then, several very small beryllium-machining operations that were already in existence have been registered with NMED.

7.3.7.13 Conformity of General Federal Actions to the State Implementation Plan (20 NMAC 2.98)

The purpose of this regulation is to implement Section 176(c) of the CAA and regulations under 40 CFR Part 51, Subpart W, *Determining Conformity of General Federal Actions to State or Federal Implementation Plans*, with respect to the conformity of general Federal actions to the SIP. Under those authorities, no department, agency or instrumentality of the Federal government shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity that does not conform to a SIP. This regulation sets forth policy, criteria, and procedures for demonstrating and assuring conformity of such actions to the SIP.

7.3.8 Human Health and Worker Safety (Including Accidents)

7.3.8.1 Occupational Radiation Protection (10 CFR Part 835)

This regulation derives regulatory requirements from the AEA and not from the Occupational Safety and Health Act of 1970 (OSHA). 10 CFR Part 835 establishes worker radiation protection standards limiting exposures from ionizing radiation. For the occupational worker, the standard is 5 rem (5,000 mrems) in any one year; and for the public the standard is 100 mrems/yr. The standards for both internal and external exposure are described in Subpart C. The as low as reasonably achievable (ALARA) goal is set forth as the approach to be implemented by the DOE for radiation protection of workers and the general public. The management and control of radiation exposure will involve ALARA when considering individual and collective exposures.

7.3.8.2 Occupational Safety and Health Act of 1970 (29 U.S.C. §651)

OSHA, administered and enforced by the U.S. Department of Labor (DOL), establishes a national policy to provide safe and healthful working conditions for every working man and woman. States are encouraged to assume responsibility for administration of their own safety and health standards. Only public employers, (that is, Federal, state, and municipal governments) and mining employers are excluded. Mining employers are covered by other safety and health acts. Federal agencies such as the DOE must have in place equivalent safety standards, as a minimum.

OSHA standards are designed to reduce on-the-job injuries and to develop health standards to limit workers risk of developing occupational disease. OSHA standards are universal and cover hazards that exist in a wide variety of industries. These are compiled as general industry standards. 29 CFR Part 1910 covers general industry standards, including walking and working surfaces, platforms and their use, health and environmental controls, hazardous materials, personal protective equipment, medical and first aid, fire protection, compressed gas and air equipment, materials handling and storage, machinery and machine guarding, hand and portable tools, welding, cutting and brazing, electrical, commercial diving, and toxic and hazardous substances. OSHA has promulgated industry-specific standards for construction, agriculture, and maritime sectors.

The provisions of Section 19 of the OSHA; EO 12196 (45 FR 12769); and Part 1925 *(Safety and Health Standards for Federal Service Contracts)* and Part 1960 *(Basic Program Elements for Federal Employees OSHA)* of Title 29 identify OSHA's applicability to DOE operations. These provisions are summarized as follow:

- Furnish employees with places and conditions of employment that are free from recognized hazards that are causing or are likely to cause death or serious physical harm.
- Set up procedures for responding to employee reports of unsafe and unhealthful working conditions.
- Acquire, maintain, and require the use of approved personal protective equipment and safety equipment.
- Inspect all workplaces at least annually with participation by representatives of employees.
- Establish procedures to ensure that no employee is subject to restraint, interference, coercion, discrimination, or reprisal for exercising his/her right under the agency's safety and health program.
- Post notices of unsafe or unhealthful working conditions found during inspections.
- Ensure prompt abatement of hazardous conditions. Employees exposed to the conditions must be so informed and Imminent-danger corrections must be made immediately.
- Set up management information systems to keep records of occupational accidents, injuries, illnesses, and their causes, and post annual summaries of injuries and illnesses for a minimum of 30 days at each establishment.
- Conduct occupational safety and health training programs for top management, supervisors, safety and health personnel, employees, and employee representatives.

7.3.8.3 Occupational Safety and Health Standards (29 CFR Part 1910)

29 CFR Part 1910 provides standards for safe operations of facilities. Part 1910 includes 19 subparts, all of which are applied to SNL/NM operations. These subparts cover items such as toxic and hazardous substances, personal protective equipment, material handling and storage, permissible exposure limits, general environmental controls, and reporting of occupational accidents, injuries, and illnesses.

7.3.8.4 Federal Employee Occupational Safety and Health Programs and Related Matters (29 CFR Part 1960)

29 CFR Part 1960 provides regulations and guidelines for implementation of EO 12196, *Occupational Safety and Health Programs for Federal Employees*, which establishes requirements and procedures for Federal agencies to provide occupational safety and health programs for their employees (45 FR 12769). Federal agencies such as the DOE must have in place equivalent safety standards, as a minimum.

The head of each Federal agency is charged with the responsibility to "establish and maintain an effective and comprehensive occupational safety and health program which is consistent with the standards" set by OSHA for private sector employees. That broad mandate is further defined by EO 12196, which identifies the responsibilities of the agencies and the role of the Secretary of Labor in developing, implementing, and evaluating such programs.

DOE safety standards are specified in DOE Orders. Although OSHA does not directly apply to DOE employees, SNL/NM's prime contract with the DOE requires adherence to DOE O 440.1, which states that contractors and contractor employees shall adhere to DOE-prescribed OSHA standards and requirements (29 CFR) for worker safety. Sandia Corporation, as a private company, is required to abide by OSHA regulations as well as any DOE contractual obligations or requirements in its operation of SNL/NM. These two sets of agency requirements (DOE and OSHA) may overlap in numerous health and safety areas.

7.3.8.5 Recording and Reporting Occupational Injuries and Illnesses (29 CFR Part 1904)

29 CFR Part 1904 specifies *The Record-Keeping Guidelines For Occupational Injuries and Illnesses, 1986*, which contains the description of the system requirements that businesses must follow in keeping records of work-related occupational deaths, injuries, or illnesses. It includes requirements for recording and reporting to the U.S. Bureau of Labor Statistics, all occupational injuries and illnesses requiring more than a first-aid response and reporting of all occupational fatalities. These occupational injury and illness records have multiple purposes. Mainly, they are to provide information for employers and employees, raising their awareness of the frequency and kinds of injuries and illnesses occurring in the workplace and their related hazards. They also serve as a "management tool" for the administration of company safety and health programs. The information is also used by OSHA compliance staff to focus their inspections on the safety and health hazards revealed by the injury and illness records. Lastly, the records may be used to produce statistical data on the incidence of workplace injuries and illnesses, thereby measuring the magnitude of the injury and illness problem across the country.

7.3.8.6 New Mexico-Approved State Plans for Enforcement of State OSHA Standards (29 CFR Part 1952, Subpart DD)

29 CFR Part 1952 establishes the record-keeping and reporting requirements for states that have their own occupational safety and health programs and that have been approved by OSHA to enforce safety and health regulations in their own state. The state of New Mexico has adopted the *Federal Field Operations Manual* and all the Federal standards except those related to the maritime sector. The plan identifies the New Mexico Environmental Improvement Agency (NMEIA), with its subordinate organization, the Occupational Radiation Protection Division (ORPD), as the state agency designated to administer the plan. In addition, the ORPD will enforce state standards under the *Radiation Protection Act* (Ch. 284, Laws of 1971, NMSA 12-9-1 through 12-9-11). In the event of a conflict of standards, employee protection will be enforced using the more stringent regulation.

7.3.8.7 DOE O 232.1A Occurrence Reporting and Processing of Operations Information

DOE O 232.1 establishes a system for occurrence reporting and defines a number of situations that must be formally reported, all of which are important to the overall safety, health, and security of workers in the workplace. Many of the elements contained in cancelled DOE 5000.3B, *Occurrence Reporting and Processing of Operations Information*, are linked with DOE O 232.1. These requirements include the categorization of occurrences that have potential safety, environmental, health, or operational significance; DOE notification of these occurrences; and the development and submission of documented follow-up reports. Occurrence reports must be done in a timely manner and contain sufficient information describing the occurrence, significance, causal factors, and corrective actions. Occurrence reporting increases sensitivity to potentially unsafe conditions, requires analysis to determine causes of events, is a vehicle for formal corrective actions, and fosters lessons-learned programs. The documentation and distribution requirements for the occurrence reports are satisfied through the use of a centralized, unclassified operational database called the Occurrence Reporting and Processing System (ORPS) (DOE 1998o).

7.3.8.8 DOE O 231.1, Environment, Safety, and Health Reporting

The objective of this order is to ensure the collection and reporting of information on environment, safety, and health that is required by law or regulation or that is essential for evaluation of DOE operations and for identifying opportunities for improvement needed for planning purposes within the DOE. Elements contained in this order link to requirements specified in parts of cancelled DOE 5483.1A, *Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities*, and parts of cancelled DOE 5484.1, *Environmental Protection, Safety, and Health Protection Information Reporting Requirements*. Requirements for an annual site environmental report, containing summary environmental data, are set forth in DOE O 231.1. It also specifies the need for the annual reporting of occupational safety and health information to the Secretary of Energy in order to allow the Secretary to comply with 29 CFR Part 1960.

7.3.8.9 DOE 5400.5, Radiation Protection of the Public and Environment

This order establishes standards and requirements for operations of the DOE and its contractors with respect to protection of members of the public and the environment against undue risk from radiation. This order provides for general standards; requirements for radiation protection of the public and the environment; derived concentration guides for air and water; and guidelines, limits, and controls for residual radioactive materials. The order also establishes the DOE's objective to operate its facilities and conduct its activities so that radiation exposures to members of the public are maintained within the limits established by this order, and to control radioactive contamination through the management of the DOE's real and personal property. This order limits the annual EDE to any member of the public from all sources to 100 millirems per year. The requirements of this order are being incorporated into a nuclear safety regulation.

7.3.8.10 DOE O 440.1A, Worker Protection Management for DOE Federal and Contractor Employees

The purpose of DOE O 440.1A is to establish the framework for an effective worker protection program that will reduce or prevent injuries, illnesses, and accidental losses by providing Federal and contractor employees with a safe work environment. This order replaces elements contained in cancelled DOE 5480.4. It contains requirements for mandatory environmental, safety, and health standards for areas such as fire protection, threshold limit value (TLVs) for chemical substances and physical agents in the workplace and other industrial hygiene requirements; construction safety, general safety, explosives safety, firearms safety, and motor vehicle safety. It also establishes radiological protection program requirements that, combined with 10 CFR Part 835 and associated implementation guidance, form the basis of a comprehensive radiological protection program.

7.3.8.11 DOE 5480.1B, Environment, Safety, and Health Program for Department of Energy Operations

The purpose of DOE 5480.1B is to establish the environment, safety, and health program for the DOE. It establishes standards and requirements for the DOE and DOE contractor operations regarding protection of the public and the environment from undue radiological risk. It contains the DOE's policy of adopting and implementing radiation protection standards consistent with those of the NRC. These standards are applied to DOE facilities and activities not subject to NRC licensing.

The related DOE 5480.4 specifies application of the mandatory ES&H standards applicable to all DOE contractor operations, provision of a listing of reference ES&H standards, and identification of the sources of these standards. This order is applicable for all facility design, construction, operation, modification, and decommissioning actions.

7.3.8.12 DOE O 225.1A, Accident Investigations

The objective of this DOE Order is to prescribe requirements for conducting investigations of certain accidents occurring at DOE sites. The prevention of reoccurrence of such accidents is also prescribed. The order aims to contribute to the improved environmental protection and safety of DOE employees, contractors, and the public. Requirements set forth in this order include the categorization of accidents, the notification of other agencies, the conduct of investigations of the accidents, and the closeout of the investigations.

7.3.8.13 Accidents

Risk Management Program Rule (40 CFR Part 68, Subpart G)

This rule establishes the contents of Risk Management Plans (RMP) that the owner or operator of a facility handling regulated substances must submit to the EPA. An RMP includes information on the accidental release prevention and emergency response policies in effect, regulated substances handled, worst-case release scenario(s), the general accidental release prevention program and chemical-specific prevention steps, a 5-year accident history, the emergency response program, and planned changes to improve safety. In addition, the owner or operator must complete a single registration form that covers all regulated substances handled.

7.3.8.14 DOE 5480.23, Nuclear Safety Analysis Reports

This order establishes requirements for contractors responsible for the design, construction, operation, decontamination, or decommissioning of nuclear facilities to develop safety analyses reports (SARs) that establish and evaluate the adequacy of the safety basis of the facilities. The purposes and objectives of SARs are to accomplish the following:

- provide the basis for approval of new facilities and operations, major modifications thereto, and eventual decommissioning;
- define and control the safety basis and commitments;
- support DOE and contractor management safety oversight of facilities and operations; and
- be the primary reference on facility safety for use by the responsible contractor.

This order applies to all DOE elements and to covered contractors to the extent implemented under a contract or other agreement.

7.3.8.15 Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety *Analysis Report. U.S. Department of Energy (DOE-STD-3009-94)*

The purpose of this standard is to describe the SAR preparation method that is acceptable to the DOE. It was developed to assist Hazard Category 2 and 3 facilities in preparing SARs that will satisfy the requirements of the DOE 5480.23, *Nuclear Safety Analysis Reports*. Hazard Category 1 facilities are typically expected to be Category A reactors, for which extensive precedents for SARs already exist.

Guidance provided by this standard is generally applicable to any facility required to document its safety basis in accordance with the DOE 5480.23. For new facilities for which conceptual design or construction activities are in progress, elements of this guidance may be more appropriately handled as an integral part of the overall design requirement process. The methodology provided by DOE-STD-3009-94 focuses more on characterizing facility safety, with or without well-documented design information, than on the determination of facility design. Accordingly, contractors for facilities that are documenting conceptual designs for preliminary SARs should apply the process and format of this standard to the extent it is judged to be of benefit.

Beyond conceptual design and construction, the methodology described in this standard is applicable to the spectrum of missions expected to occur over the lifetime of a facility (production, shutdown/standby, decontamination, and decommissioning). As the phases of facility life change, suitable methodology is provided for use in updating an existing SAR and in developing a new SAR if the new mission is no longer adequately encompassed by the existing SAR. This integration of the SAR with changes in facility mission and associated updates should be controlled as part of an overall safety management plan.

7.3.8.16 Hazard Categorization and Accident Analysis Techniques for Compliance with DOE 5480.23, Nuclear Safety Analysis Reports (DOE-STD-1027-92)

This standard is to be used with the DOE 5480.23, *Nuclear Safety Analysis Report*, and may not be applicable to other DOE orders. Regarding the applicability of the other nuclear safety orders to those facilities that fall below Category 3 criteria, as defined by the standard, program senior officials shall provide guidance, as appropriate. The DOE has the responsibility to establish rules, regulations, and orders, as necessary, to protect health or to minimize danger to life or property. In carrying out this responsibility, the DOE has issued Order 5480.23, which specifies requirements for safety analyses involving DOE nuclear facilities, and for submittal, review, and approval of contractor plans to meet these requirements.

The purpose of DOE-STD-1027-92 is to establish guidance for the preparation and review of hazard categorization and accident analysis techniques as required in DOE 5480.23. This order requires further guidance to ensure consistency across all nuclear facilities within DOE complex. DOE-STD-1027-92 imposes no new requirements on nuclear facilities. Instead, it focuses on

- the definition of the standard identifying nuclear facilities required to have SARs in order to comply with DOE 5480.23;
- the SAR implementation plan and schedule;
- the hazardous categorization methodology to be applied to all facilities; and
- the accident analysis techniques appropriate for the graded approach addressed in DOE 5480.23.

The objective of a graded approach is to apportion SAR requirements for analysis, evaluation, and documentation to the potential hazards associated with a particular operating DOE nuclear facility.

7.3.9 Transportation

7.3.9.1 Hazardous Materials Transportation Act of 1994 (49 U.S.C. §5101, *et seq.*)

Under this act, the Secretary of Transportation may establish regulations for the safe transport of hazardous materials. Such regulations may be applicable to manufacturers as well as transporters. Covered activities include packing, handling, labeling, marking, and routing of hazardous materials, as well as manufacturing, marking, maintaining, repairing, and testing of packages or containers used in the transportation of such materials.

7.3.9.2 DOE O 460.2. Departmental Materials Transportation and Traffic Management

This order establishes DOE policies and procedures for the management of materials transportation activities, including traffic management, for other than intrabuilding and intrasite transfers. The provisions of this order apply to all elements of the DOE involved in transportation activities and responsible for the payment or reimbursement of charges for transportation services. It is DOE policy to ensure that traffic and transportation management shall be accomplished in a manner commensurate with operational requirements for transportation services, established practices and procedures for transportation safety, economy, efficiency, and cargo security, national transportation policy as established in 49 U.S.C. §1801 et seq., *Transportation*, and implemented by the Federal agencies, and applicable Federal, state, local, and international transportation regulations.

7.3.9.3 DOE 5610.12, Packaging and Offsite Transportation of Nuclear Components and Special Assemblies Associated with the Nuclear Explosives and Weapon Safety Program

This order establishes DOE policy, requirements, objectives, authorities, procedures, and responsibilities for the safe packaging and offsite transportation of nuclear components and special assemblies associated with the nuclear weapons program requiring the use of the Transportation Safeguards System. This order is part of DOE 5610-series of orders that implement the DOE's Nuclear Explosives and Weapon Safety Program, conducted in the interest of national security or in support of mutual defense treaty obligations and agreements.

7.3.9.4 International Atomic Energy Agency, Regulations for the Safe Transport of Radioactive Materials (1996 Edition)

The International Atomic Energy Agency, a specialized agency of the United Nations, is the primary international organization that enforces a system of safeguards to ensure that nonnuclear weapons states do not divert shipments of sensitive nuclear-related equipment from peaceful applications to the production of nuclear weapons. The agency's regulations for transporting radioactive materials have gained worldwide adoption, helping to control the radiation hazards associated with all modes of transport. They cover general provisions, activity limits and material restrictions, requirements and controls for transport, test procedures, and administrative requirements. Schedules are also included detailing transport requirements for specific radioactive material consignments.

7.3.9.5 International Civil Aviation Organization, Technical Instruction for Safe Transport of Dangerous Goods by Air, plus Supplement (Doc. 9284-AN/905)

The International Civil Aviation Organization was created in 1944 to promote the safe and orderly development of civil aviation in the world. As a specialized agency of the United Nations, it sets international standards and regulations necessary for the safety, security, efficiency, and regularity of air transport and serves as the medium for cooperation in all fields of civil aviation among its 183 contracting states. This technical guide provides requirements and standards for shipping dangerous goods by aircraft throughout the world.

7.3.9.6 International Air Transport Association, Dangerous Goods Regulations (38th Edition, 1996)

These regulations were published to provide procedures for the shipper and operator for the safe commercial air transport of articles and substances with hazardous properties. They also define necessary packaging materials and requirements.

7.3.9.7 United Nations, Recommendation on the Transport of Dangerous Goods (Document No. ST/SG/AC.10/1/Rev. 9)

These recommendations provide a uniform basis for development of harmonized regulations for all modes of transport, in order to facilitate trade and the safe transport of hazardous materials. These recommendations enhance safety, improve enforcement capability, and ease training requirements while enhancing global trade and economic development.

7.3.10 Waste Generation

7.3.10.1 Solid Waste Disposal Act of 1976 (42 U.S.C. §6902)

This act regulates the management of solid waste. Solid waste is broadly defined to include any garbage, refuse, sludge, or other discarded material including solid, liquid, semisolid, or contained gaseous materials resulting from industrial, commercial, mining, or agricultural activities. Specifically excluded as solid waste is source-special nuclear or byproduct material as defined by the AEA.

7.3.10.2 Resource Conservation and Recovery Act of 1978 (42 U.S.C. §6901)

This act amends the *Solid Waste Disposal Act* and establishes requirements and procedures for the management of hazardous wastes. As amended by the *Hazardous and Solid Waste Amendments of 1984* (HSWA), RCRA defines hazardous wastes that are subject to regulation and sets standards for generation, treatment, storage, and disposal facilities. The HSWA emphasize reducing the volume and toxicity of hazardous waste. They also establish permitting and corrective action requirements for RCRA-regulated facilities. RCRA was also amended by the Federal Facilities Compliance Act (FFCA) in 1992. It requires the EPA, or a state with delegated authority, to issue an order for compliance. A federal facilities compliance order was issued by the NMED, requiring the DOE and SNL/NM to comply with the FFCA. Compliance with the order is achieved through site treatment plans prepared by the DOE.

Original jurisdiction for implementing RCRA was with EPA; however, RCRA authorizes EPA to turn this responsibility over to individual states as they develop satisfactory implementation programs. EPA granted base RCRA authorization to New Mexico on January 25, 1985, transferring regulatory control of hazardous wastes under RCRA to NMED. State authority for hazardous waste regulation is set forth in the *New Mexico Hazardous Waste Act*, which adopted, with a few minor exceptions, all of the Federal requirements in effect on July 1, 1993, concerning the generation and management of hazardous waste. On July 25, 1995, the state of New Mexico's Hazardous Waste Program was authorized by the EPA, in lieu of the Federal program, to regulate mixed waste.

SNL/NM received a RCRA Part A permit for interim status in August 1990, which has been updated regularly since that date. A Part B permit, which established requirements for management of existing hazardous waste management units, was granted on August 6, 1992.

The HSWA modified the permitting sections of RCRA (Sections 3004 and 3005). In accordance with these provisions, SNL/NM's permit to operate includes a section (HSWA Module VUI) that prescribes a specific corrective action program for SNL/NM, the primary focus of which is the investigation and cleanup, if required, of inactive sites called solid waste management units (SWMU). The HSWA Module specifies the corrective action process, which is being implemented at SNL/NM by the Environmental Restoration (ER) Project.

The corrective action process at SNL/NM consists of

- preparing RCRA facility investigations to identify the extent of contamination in the environment and the pathways along which these contaminants could travel to human and environmental receptors;
- preparing corrective measures studies to evaluate alternative remedies for reducing risks to human and environmental health and safety in a cost-effective manner; and
- implementing corrective measures—the remedy chosen by the regulatory authority is implemented, its effectiveness is verified, and ongoing control and monitoring requirements are established.

7.3.10.3 Underground Storage Tanks (42 U.S.C. §6901, Subtitle I)

Underground storage tanks (UST) are regulated as a separate program under RCRA, which establishes regulatory requirements for underground storage tanks containing hazardous or petroleum materials. NMED has been delegated authority for regulating SNL/NM under the *New Mexico Underground Storage Tank Regulations*, derived from the *New Mexico Hazardous Waste Act.*

7.3.10.4 Federal Facility Compliance Act of 1976 (42 U.S.C. §6961)

This 1992 act waives sovereign immunity from fines and penalties for RCRA violations at Federal facilities. However, it postponed the waiver for 3 years for storage prohibition violations with regard to land disposal restrictions for the DOE's mixed wastes. It also required the DOE to prepare plans for developing the required treatment capacity for each site at which it stores or generates mixed waste. The state or EPA must approve each plan (referred to as a site treatment plan) after consultation with other affected states, consideration of public comments, and issuance of an order by the regulatory agency requiring compliance with the plan. The act further provides that the DOE will not be subject to fines and penalties for storage prohibition violations for mixed waste as long as it is in compliance with an existing agreement, order, or permit.

The FFCA requires that site treatment plans contain schedules for developing treatment capacity for mixed waste for which identified technologies exist. The DOE must provide schedules for identifying and developing technologies for mixed waste without an identified existing treatment technology.

SNL/NM has submitted site treatment plans to the NMED to address the development of new treatment capabilities in compliance with the act. A Federal Facility Compliance Order was signed on October 4, 1995, to address storage and treatment of mixed waste (SNL/NM 1998f). A negotiation of a Mixed Waste Land Disposal Restriction Federal Facilities Compliance Agreement of March 15, 1994 terminated this new agreement order.

7.3.10.5 Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as Amended (42 U.S.C. §9601, *et seq.*)

This act, commonly referred to as the CERCLA, or Superfund, establishes liability standards and governmental response authorization to address the release of a hazardous substance or contaminant into the environment. The EPA is the regulating authority for the act. SNL/NM has been ranked and, having scored very low, was not placed on the National Priority List for past releases into the environment. Therefore, all legacy contamination found in the environment at SNL/NM is primarily cleaned up under RCRA corrective action authority (HSWA Permit Module VIII).

CERCLA was amended by the SARA in 1986. SARA Title III establishes additional requirements for emergency planning and reporting of hazardous substance releases. These requirements are also known as the *Emergency Planning and Community Right-to-Know Act* (EPCRA), which, due to its unique requirements, is discussed separately below. SARA also created liability for damages to or loss of natural resources resulting from releases into the environment and required the designation of Federal and state officials to act as public trustees for natural resources. The *New Mexico Natural Resources Trustee Act* (NMSA 75-7) is the New Mexico statute designed to protect state natural resources. The DOE, as the Federal trustee, and the state of New Mexico have authority to act as trustees for most resources at SNL/NM. The DOI retains authority for certain designated sensitive natural resources. Other natural resource trustees act for lands surrounding SNL/NM, including the Pueblo tribes. Procedures for conduct of natural resource damage assessments are codified at 43 CFR Part 11 (*Natural Resource Damage*

Assessments). A strategy and plan are being developed for integrating the natural resource damage assessment requirements into the HSWA corrective action process at SNL/NM.

SNL/NM is subject to, and required to report releases to the environment under the notification requirements in, 40 CFR Part 302 (*Designation, Reportable Quantities, and Notification*) and EPCRA, as applicable.

7.3.10.6 Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S.C. §11001)

EPCRA is also known as SARA Title III. Section 313 of the act requires facilities meeting certain standard industrial classification code criteria to submit an annual toxic chemical release inventory report (*Toxic Chemical Release Reporting: Community-Right-to-Know* [40 CFR Part 372]). For covered facilities, a report describing the use of, and emissions from, Section 313 chemicals stored or used onsite and meeting threshold planning quantities, must be submitted to the EPA and the New Mexico Emergency Management Bureau every July for the preceding calendar year. Other provisions of the act require planning notifications (Sections 302 and 303), extremely hazardous substance release notifications (Section 304), and annual chemical inventory/material safety data sheet reporting (Sections 311 and 312). Federal agencies were also defined as persons for the purposes of EPCRA, requiring all Federal facilities, regardless of standard industrial classification code, to meet the requirements of the act.

SNL/NM does not meet standard industrial classification code criteria for Section 313 reporting, but has voluntarily submitted annual toxic chemical release inventory reports since 1987. All research operations are exempt under provisions of the regulation, and only pilot plants, production, or manufacturing operations at SNL/NM are reported.

7.3.10.7 Pollution Prevention Act of 1990 (42 U.S.C. §13101)

This act sets the national policy for waste management and pollution control that focuses first on source reduction, followed sequentially by environmentally safe recycling, treatment, and disposal. In response, the DOE committed to voluntary participation in EPA's 33/50 Pollution Prevention Program, as set forth in Section 313 of SARA. The goal for facilities already involved in Section 313 compliance was to achieve a 33 percent reduction in release of 17 priority chemicals by 1997 from a 1993 baseline. SNL/NM did not have reportable thresholds for any of the 17 priority chemicals listed. In August 1994, EO 12856 (*Right-to-Know Laws and Pollution Prevention Requirements*) was issued, expanding the 33/50 program and requiring the DOE to reduce its total release of all toxic chemicals by 50 percent by December 31, 1999 (58 FR 41981). In response, the DOE has developed departmental pollution prevention goals and pollution prevention program plans to meet these goals. Each DOE site, including SNL/NM, develops its own site goals contributing to the DOE-wide goals and implements actions to achieve those goals. For (FY) 1996, SNL/NM met or exceeded all waste pollution prevention commitments.

7.3.10.8 Toxic Substances Control Act of 1977 (15 U.S.C. §2601)

The TSCA, unlike other statutes that regulate chemicals and their risk after they have been introduced into the environment, was intended to require testing and risk assessment before a chemical is introduced into commerce. It also establishes record-keeping and reporting requirements for new information regarding adverse health and environmental effects of chemicals. The act governs the manufacture, use, storage, handling, and disposal of polychlorinated biphenyls (PCBs); sets standards for cleaning up PCB spills, and establishes standards and requirements for asbestos identification and abatement in schools. It is administered by the EPA.

Because SNL/NM's research and development activities are not related to the manufacture of new chemicals, PCBs are SNL/NM's main concern under the act. Activities at SNL/NM that involve PCBs include, but are not limited to, management and use of authorized PCB-containing equipment, such as transformers and capacitors, management and disposal of substances containing PCBs (dielectric fluids, contaminated solvents, oils, waste oils, heat transfer fluids, hydraulic fluids, paints, slurries, dredge spoils, and soils), and management and disposal of materials or equipment contaminated with PCBs as a result of spills.

The TSCA regulates PCB items and materials having concentrations exceeding 50 ppm. Implementing regulations (40 CFR 761) contain an antidilution clause that requires waste to be managed based on the PCB concentration of the source (transformer, capacitor, PCB equipment, etc.), regardless of the actual concentration in the waste. If the concentration at the source is unknown, the waste must be managed as though it were a spill of mineral oil with an assumed PCB concentration of 50 to

500 ppm. At SNL/NM, PCB-contaminated wastes are transported offsite for treatment and disposal unless they also have a radioactive component. Solid wastes containing PCBs are disposed of at an offsite facility that has been approved by the EPA for such disposal (provided that strict requirements are met with respect to notification, reporting, record-keeping, operating conditions, environmental monitoring, packaging, and types of wastes disposed).

SNL/NM currently has no treatment or disposal facilities for liquid wastes that contain PCBs. Such wastes have been stored at the Hazardous Waste Management Facility (HWMF)(see Section 4.12).

The asbestos abatement implementing regulations of the act (40 CFR Part 763) relate primarily to the identification and abatement of asbestos-containing materials in schools. SNL/NM conducts asbestos abatement projects in accordance with OSHA requirements (29 CFR Part 1926), applicable requirements of the CAA (NESHAP, 40 CFR Part 61, Subpart M, for notification and waste management/ disposal), and the *New Mexico Solid Waste Management Regulations.*

7.3.10.9 Radioactive Waste Management Regulations

Low-level radioactive waste is a waste that contains radioactivity and is not classified as high-level radioactive waste, transuranic (TRU) waste, or spent nuclear fuel. Solid low-level radioactive waste usually consists of clothing, tools, and glassware. Low-level radioactive liquid waste consists primarily of water circulated as cooling water. Radioactive waste management at SNL/NM is regulated under the AEA, through applicable DOE orders (primarily DOE Order 5820.2A, *Radioactive Waste Management*, and DOE 5400.5, *Radiation Protection of the Public and the Environment).* DOE 5400.5 also provides criteria and processes for the release of materials (through sale or disposal) to assure that released materials do not constitute a hazard to the public and the environment due to their radioactive content. This includes materials that are not waste.

Low-level mixed waste (LLMW) is waste containing both hazardous and low-level radioactive components. As a hazardous waste, LLMW is regulated under RCRA and the *New Mexico Hazardous Waste Act.* Because it is radioactive, the radioactive component is also regulated under the AEA through applicable DOE orders. LLMW is scheduled to be disposed of at an offsite facility.

Due to the nationwide lack of DOE treatment capacity and capability for mixed waste, SNL/NM has continued to store mixed wastes on site. On March 15, 1994, the DOE and the EPA signed a FFCA to ensure complete compliance with the storage prohibitions for mixed waste at SNL/NM. This agreement was terminated with signing of the Federal Facility Compliance Order in October 1995, implementing the site treatment plan for SNL/NM, under provisions of the consent agreement.

TRU waste, regardless of form or source, is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than or equal to 100 nanocuries per gram at the time of assay. TRU waste at SNL/NM will be sent to the WIPP when that facility opens. TRU waste is subject to waste acceptance criteria for the WIPP, U.S. Department of Transportation shipping requirements, and applicable DOE orders dealing with its safe handling and management.

7.3.10.10 Superfund Implementation (EO 12580)

This EO, which applies to facilities that are not on the National Priorities List, delegates responsibility to the heads of executive departments and agencies at those facilities for undertaking remedial and removal actions for releases or threatened releases (52 FR 2923). This authority applies to any cleanup actions not included as a RCRA corrective action.

7.3.10.11 Right-to-Know Laws and Pollution Prevention Requirements (EO 12856)

This EO directs all Federal agencies to reduce and report toxic chemicals entering any waste stream; improve emergency planning, response, and accident notification; and encourage clean technologies and testing of innovative prevention technologies (58 FR 41981). The DOE and SNL/NM meet applicable reporting requirements under the provisions of EPCRA and the *New Mexico Hazardous Chemicals Information Act,* in accordance with the EO.

7.3.10.12 DOE O 435.1, Radioactive Waste Management

This order establishes the policies, guidelines, and minimum requirements by which the DOE and its contractors manage radioactive waste, mixed waste, and contaminated facilities. This order establishes DOE policy that radioactive and mixed wastes be managed in a manner that ensures protection of the health and safety of the public, the DOE, contractor employees, and the environment. In addition, the generation, treatment, storage, transportation, and disposal of radioactive wastes, and the other pollutants or hazardous substances they contain, must be accomplished in a manner that minimizes the generation of such wastes across program office functions and complies with all applicable Federal, state, and local environmental, safety, and health laws and regulations and DOE requirements.

7.3.10.13 New Mexico Solid Waste Act (NMSA 74-9-1 through 74-9-42)

This act established a comprehensive state-wide solid waste management program. It seeks to provide technical, financial, and program development assistance to counties and municipalities for solid waste management; promote source reduction, recycling, reuse, treatment, and transformation of solid waste; regulate all aspects of solid waste handling; and conserve, recover, and recycle resources. It also requires permits for the construction, operation, closure, and post-closure maintenance of solid waste facilities.

7.3.10.14 New Mexico Solid Waste Management Regulations (20 NMAC 9.1)

These regulations outline the specific requirements for New Mexico's counties and municipalities for the transportation, storage, transfer, processing, transformation, recycling, and disposal of solid waste. The objectives of the regulations are to establish the standards of practice in the following areas of solid waste management: facility permits, facility size, closure and post-closure operation, operator certification, special waste, groundwater monitoring, and financial assurance.

7.3.10.15 New Mexico Underground Storage Tank Regulations (20 NMAC 5.1)

These regulations include requirements for design, construction, and installation of new tanks; maintenance of a leak detection system and associated record-keeping; reporting of hazardous or petroleum releases; corrective action in the event of a release; and closure of UST systems. All existing tank systems must either meet new tank performance standards or undergo RCRA closure by December 22, 1998. All SNL/NM USTs will be upgraded or undergo RCRA closure by the December 22, 1998, deadline.

7.3.10.16 New Mexico Hazardous Chemicals Information Act (NMSA 74-4E-1 through 74-4E-9)

This act implements the hazardous chemical information and toxic release reporting requirements of SARA Title III for covered facilities in New Mexico.

7.3.10.17 New Mexico Hazardous Waste Act (NMSA 74-4-1 through 74-4-13)

This act establishes New Mexico's program for hazardous waste management and control. Since its initial adoption in 1997, the act has been substantially amended to bring its provisions more closely in conformance with RCRA and its amendments. The major provisions of the act have been taken directly from Subtitle C, *Hazardous Waste Management*, and Subtitle I, *Regulation of Underground Storage Tank*, of RCRA.

7.3.11 Noise and Vibration

7.3.11.1 Noise Control Act of 1972 (42 U.S.C. §4901)

By this act, Congress directed all Federal agencies to carry out the programs under their control to promote an environment free from noise that jeopardizes public health or welfare. Furthermore, it requires any Federal agency engaged in any activity resulting, or which may result, in the emission of noise, to comply with Federal, state, interstate, and local requirements regarding control and abatement of environmental noise to the same extent that any person is subject to such requirements. Beyond the general obligation in the act and implementing regulations, there are no specific Federal or state requirements regulating environmental noise.

7.3.11.2 Occupational Noise Exposure (29 CFR §1910.95)

This regulation provides protection to workers from excessive levels of noise. It establishes sound levels that are not to be exceeded for specific periods of time without protective measures being taken. When employees are subjected to sound exceeding the specified levels, feasible administrative or engineering controls are to be instituted. If such controls fail to reduce sound levels to the prescribed levels, personal protective equipment must be provided and used to reduce sound levels.

7.3.11.3 City of Albuquerque Noise Control Ordinance (Ord. 21-1975)

This ordinance establishes acceptable noise levels for various activities within the City of Albuquerque, including construction of buildings and projects, vehicles, and aircraft. In addition, Subsection 9-9-12, *General Noise Regulation*, states that it shall be unlawful for any person to make any noise in excess of 50 dB(A), or 10 dB(A) above the ambient noise level, whichever is higher at any residential property line, unless otherwise provided in the ordinance.

7.3.11.4 Environmental Justice—Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898)

This EO directs each Federal agency to identify and address disproportionately high adverse human health or environmental impacts on minority and low-income populations resulting from an agency's programs, policies, or activities (59 FR 7629). The order further directs each Federal agency to collect, maintain, analyze, and make information publicly available on the race, national origin, and income level of populations in areas surrounding facilities or sites expected to have a substantial environmental, human health, or economic effect on these populations. This requirement applies when such facilities or sites become the subject of a substantial Federal environmental administrative or judicial action. Environmental justice impacts are being identified and addressed through the SWEIS, and the policies and data analysis requirements of this EO remain applicable to future actions at SNL/NM.

CHAPTER 8

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20 NMAC 9.1 "Solid Waste Management"; Title 20, Environmental Protection; Chapter 9, Solid Waste; *New Mexico Administrative Code*; Environmental Improvement Board, Santa Fe, NM; November 30, 1995.

20 NMAC 11 "Albuquerque/Bernalillo County Air Quality Control Board"; Title 20, Environmental Protection; *New Mexico Administrative Code*; Water Quality Commission, Santa Fe, NM; December 1, 1995, as amended.

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NMSA 17-2-37 through 17-2-46 *"Wildlife Conservation Act"*; Chapter 17, Game and Fish; Article 2, Hunting and Fishing Regulations; Part 3, *Wildlife Conservation Act*; *New Mexico Statutes Annotated*; Game and Fish Commission, Santa Fe, NM; 1953, as amended.

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U.S. Department of Energy

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DOE O 440.1A "Worker Protection Management for DOE Federal and Contractor Employees," U.S. Department of Energy, Washington, D.C., December 21, 1994.

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Ord. 21-1975 "Noise Control Ordinance"; Chapter 9, Health, Safety and Sanitation; Article 9, Noise Control; *City of Albuquerque Code of Ordinances*, Albuquerque, NM, 1975.

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DE-AM04-97AL77613

QUALIFICATION CRITERION NO. 1

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE SANDIA NATIONAL LABORATORIES/NEW MEXICO SWEIS FOR CONTINUED OPERATIONS

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 18026-18038 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)". See 46 FR 18026-18031.

In accordance with these requirements, the offeror and the proposed subcontractors hereby certify as follows: (check either (a) or (b) and list financial or other interest if (b) is checked)

(a) ☒ Contractor has 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 Interest

1.

2.

3.

Certified By:

[signature]

Signature

Evaristo J. Bonano, Ph.D.

Name (Printed)

President, Beta Corporation

Title, Company

20 November 1998

Date

Beta Corporation International Disclosure Statement

DE-AM04-97AL77613

QUALIFICATION CRITERION NO. 1

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE SANDIA NATIONAL LABORATORIES/NEW MEXICO SWEIS FOR CONTINUED OPERATIONS

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 18026-18038 at Question 17a and b.

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(a) ☒ Contractor has 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 Interest

1.

2.

3.

Certified By:

John M. Teel
Signature

JOHN M. TEEL
Name (Printed)

MANAGER NEW MEXICO OPERATIONS
FOSTER WHEELER ENVIRONMENTAL
Title, Company

Date 11/20/98

Foster Wheeler Environmental Corp. Disclosure Statement

DE-AM04-97AL77613

QUALIFICATION CRITERION NO. 1

NEPA DISCLOSURE STATEMENT FOR
PREPARATION OF THE SANDIA NATIONAL LABORATORIES/NEW MEXICO
SWEIS FOR CONTINUED OPERATIONS

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 18026-18038 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)". See 46 FR 18026-18031.

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(a) ☒ Contractor has 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 Interest

1.

2.

3.

Certified By:

[signature]
Signature

James S. Holm
Name (Printed)

Director of Contracts
Title, Company

November 18, 1998
Date

Jason & Associates Disclosure Statement

DE-AM04-97AL77613

QUALIFICATION CRITERION NO. 1

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE SANDIA NATIONAL LABORATORIES/NEW MEXICO SWEIS FOR CONTINUED OPERATIONS

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 18026-18038 at Question 17a and b.

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(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 Interest

1.

2.

3.

Certified By:

[signature]
Signature

Louis F. Restrepo
Name (Printed)

President, OMICRON
Title, Company

11/21/98
Date

Omicron Safety and Risk Technologies, Inc. Disclosure Statement

DE-AM04-97AL77613

QUALIFICATION CRITERION NO. 1

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE SANDIA NATIONAL LABORATORIES/NEW MEXICO SWEIS FOR CONTINUED OPERATIONS

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 18026-18038 at Question 17a and b.

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(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 Interest

1.

2.

3.

Certified By:

[signature]
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11/18/98
Date

Tetra Tech NUS Disclosure Statement

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CHAPTER 10

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CHAPTER 11

List of Agencies, Organizations, Individuals to Whom Copies of this SWEIS were Sent

1. FEDERAL AGENCIES

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Shirley Bellson	Bureau of Indian Affairs	Ramah	NM
Butch Blazer	Bureau of Indian Affairs	Mescalero	NM
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Danny Breuninger	Bureau of Indian Affairs	Ignacio	CO
Marsha Carra	U.S. Air Force	Kirtland Air Force Base	NM
Tom Cartlege	U.S. Forest Service	Albuquerque	NM
Michelle Chavez	U.S. Bureau of Land Management	Santa Fe	NM
Kimberly Depaul	Office of Chief of Naval Operations/N456	Arlington	VA
Christopher Dewitt	Kirtland Air Force Base Environmental Working Group	Kirtland Air Force Base	NM
Cliff Dills	U.S. Department of Agriculture Forest Service	Tijeras	NM
Jennifer Fowler-Props	U.S. Fish and Wildlife Service	Albuquerque	NM
Sam Gooch	U.S. Air Force	Kirtland Air Force Base	NM
Florine Gutierrez	Bureau of Indian Affairs	Albuquerque	NM
Mike Hackett	Bureau of Indian Affairs	Zuni	NM
Michael Jansky	U.S. Environmental Protection Agency	Dallas	TX
Nancy Kaufman	U.S. Fish and Wildlife Service	Albuquerque	NM
Susan Lacy	U.S. Department of Energy	Albuquerque	NM
James Leatherwood	U.S. Air Force	Kirtland Air Force Base	NM
Yamie Leeds	Bureau of Indian Affairs	Laguna	NM
Bill Leeds	Bureau of Indian Affairs	Towaoc	CO
Julianne Levings	U.S. Department of Energy	Albuquerque	NM
Lorraine Lucero	Bureau of Indian Affairs, Southern Pueblos Agency	Albuquerque	NM
Joel Lusk	U.S. Fish and Wildlife Service	Albuquerque	NM
Jon Lutz	AFRL/DEOS	Kirtland Air Force Base	NM
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Cameron Martinez	Bureau of Indian Affairs	Espanola	NM

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John Ordaz	U.S. Department of Energy	Germantown	MD
Polly Peyer	Kirtland Air Force Base	Albuquerque	NM
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Steve Rowe	U.S. Corps of Engineers	Omaha	NE
Connie Soden	U.S. Department of Energy	Albuquerque	NM
Willie Taylor	Office of Environmental Policy and Compliance	Washington	DC
Andrew Thibadeau	Division of Information Technology and Security	Washington	DC
Chris Tuttle	U.S. Air Force	Kirtland Air Force Base	NM
Bruce Verhaaren	Argonne National Laboratory	Argonne	IL
Sherryl Vigil	Bureau of Indian Affairs	Dulce	NM
Michael Zamorski	U.S. Department of Energy, Kirtland Area Office	Kirtland Air Force Base	NM
John Zavitz	U.S. Department of Justice	Albuquerque	NM

2. UNITED STATES SENATE

Jeff Bingaman	United States Senate	Albuquerque	NM
Jeff Bingaman	United States Senate	Washington	DC
Jeff Bingaman	Subcommittee on Strategic Forces	Washington	DC
Lisa Breeden	Senator Dominici's Office	Albuquerque	NM
Pete Domenici	Subcommittee on Energy and Water Dev.	Washington	DC
Pete Domenici	United States Senate	Albuquerque	NM
Pete Domenici	United States Senate	Washington	DC
Harry Reid	United States Senate	Las Vegas	NV
Harry Reid	Subcommittee on Energy and Water Dev.	Washington	DC
Robert Smith	Subcommittee on Strategic Forces	Washington	DC
Maria Wolfe	Senator Bingaman's Office	Albuquerque	NM

3. UNITED STATES HOUSE OF REPRESENTATIVES

Jane Altwies	Congressman Wilson's Office	Albuquerque	NM
Duncan Hunter	Subcommittee on Military Procurement	Washington	DC
Ron Packard	Subcommittee on Energy and Water Dev.	Washington	DC
Norman Sisisky	Subcommittee on Military Procurement	Washington	DC
Joe Skeen	U.S. House of Representatives	Washington	DC

Thomas Udall	U.S. House of Representatives	Washington	DC
Pete Visclosky	Subcommittee on Energy and Water Dev.	Washington	DC
Heather Wilson	U.S. House of Representatives	Washington	DC

4. TRIBAL GOVERNMENTS

Terry Aguilar	Pueblo of San Ildefonso	Santa Fe	NM
Inez Baca	Pueblo of Sandia	Bernalillo	NM
Alex Bailon	Pueblo of Santo Domingo	Santo Domingo	NM
Richard Begay	Navajo Nation Historic Preservation Department	Window Rock	AZ
Kelsey Begaye	Navajo Nation	Window Rock	AZ
Malcolm Bowekaty	Pueblo of Zuni	Zuni	NM
Todd Caplan	Pueblo of Santa Ana	Bernalillo	NM
Ronald Charlie	Pueblo of Acoma	Acomita	NM
Everett Chavez	Pueblo of Santo Domingo	Santo Domingo Pueblo	NM
Carl Concha	Pueblo of Taos	Taos	NM
Barbara Cywinska-Bernacik	Pueblo of Laguna	Laguna	NM
Walter Dasheno	Pueblo of Santa Clara	Espanola	NM
Alan Downer	Navajo Nation Historic Preservation Department	Window Rock	AZ
David Duffey	Pueblo of Jemez	Jemez	NM
Harry Early	Pueblo of Laguna	Laguna Pueblo	NM
Raymond Gachupin	Pueblo of Jemez	Jemez Pueblo	NM
Celestino Gachupin	Pueblo of Zia	San Ysidro	NM
Martha Garcia	Ramah Navajo Chapter	Ramah	NM
Petuuche Gilbert	Pueblo of Acoma	Acoma	NM
Rhea Grahm	Pueblo of Sandia	Bernalillo	NM
Frank Guerro	Alamo Chapter	Magdelena	NM
Clay Hamilton	Hopi Cultural Preservation Office	Kykotsmovi	AZ
Isaac Herrera	Pueblo of Cochiti	Cochiti Pueblo	NM
Milton Herrera	Pueblo of Tesuque	Santa Fe	NM
Beth Janello	Pueblo of Sandia	Bernalillo	NM
Leigh Kuwanwisiwma	Hopi Cultural Preservation Office	Kykotsmovi	AZ
Alvino Lucero	Pueblo of Isleta	Isleta Pueblo	NM
Anthony Moquino	Pueblo of San Juan	San Juan Pueblo	NM
Vincent Munoz	Ysleta Del Sur Pueblo	El Paso	TX
Wilton Niiha	Pueblo of Zuni	Zuni	NM

Paul Ortega	Mescalero Apache Tribe	Mescalero	NM
Anthony Ortiz	Pueblo of San Felipe	San Felipe Pueblo	NM
Loren Panteah	Zuni Heritage & Historic Preservation Office	Zuni	NM
Stanley Paytiamo	Pueblo of Acoma	Acomita	NM
Jacob Pecos	Cochiti Environmental Protection Office	Cochiti Pueblo	NM
David Perez	Pueblo of Nambe	Nambe Pueblo	NM
Jim Piatt	Pueblo of Isleta	Isleta	NM
Peter Pino	Pueblo of Zia	Zia Pueblo	NM
Eagle Rael	Pueblo of Picuris	Penasco	NM
Michael Romero	Pueblo of San Felipe	San Felipe	NM
Bruce Sanchez	Pueblo of Santa Ana	Bernalillo	NM
Daniel Sanchez	Pueblo of Acoma	Pueblo of Acoma	NM
Doris Sandoval	Pueblo of San Felipe	San Felipe Pueblo	NM
Merton Sandoval	Jicarilla Cultural Preservation Office	Dulce	NM
Victor Sarracino	Pueblo of Laguna	Laguna Pueblo	NM
Tony Secatero	Canoncito Reservation	Canoncito	NM
Maxine Seletsewa	Hopi Cultural Preservation Office	Kykotsmovi	AZ
Octavius Seowtewa	Pueblo of Zuni	Zuni	NM
Amadeo Shije	Pueblo of Zia	Zia Pueblo	NM
Wayne Taylor	The Hopi Tribe	Kykotsmovi	AZ
Gary Tenorio	Pueblo of Santa Domingo	Santo Domingo	NM
Lloyd Tortalita	Pueblo of Acoma	Acomita	NM
Jacob Viarrial	Pueblo of Pojoaque	Santa Fe	NM
Rodger Vicente	Jicarilla Apache Tribe	Dulce	NM
Henry Walt	Pueblo of Isleta	Albuquerque	NM
William Whatley	Department of Archaeology and Preservation	Jemez Pueblo	NM
Lorene Willis	Jicarilla Culture Center	Dulce	NM

5. NEW MEXICO STATE GOVERNMENT

Janice Archuleta	New Mexico Environment Department	Santa Fe	NM
Gedi Cibas	New Mexico Environment Department	Santa Fe	NM
Jean Crockett	New Mexico Environment Department	Santa Fe	NM
Benito Garcia	New Mexico Environment Department	Santa Fe	NM
Miguel Garcia	New Mexico House of Representatives	Albuquerque	NM

David Henderson	National Audobon Society	Santa Fe	NM
Ted Hobbs	New Mexico House of Representatives	Albuquerque	NM
Gary Johnson	State of New Mexico	Santa Fe	NM
Max Johnson	State of New Mexico	Santa Fe	NM
Roger Kennett	New Mexico Environment Department-DOE Oversight Bureau	Albuquerque	NM
Linda Lopez	New Mexico Senate	Albuquerque	NM
Peter Maggiore	New Mexico Environment Department	Santa Fe	NM
Mike Matush	New Mexico State Land Office	Santa Fe	NM
John Parker	New Mexico Environment Department	Santa Fe	NM
Ray Powell	New Mexico State Land Office	Santa Fe	NM
Pete Rahn	NM State Highway and Transportation Department	Santa Fe	NM
Shannon Robinson	New Mexico Senate	Albuquerque	NM
Jennifer Salisbury	New Mexico Energy, Minerals & Natural Resources Department	Santa Fe	NM
Lynne Sebastian	New Mexico Office of Cultural Affairs	Santa Fe	NM
Charles Spath	New Mexico State Land Office	Santa Fe	NM
Mimi Stewart	New Mexico House of Representatives	Albuquerque	NM

6. LOCAL GOVERNMENT

Alan Armijo	Albuquerque City Council	Albuquerque	NM
Jim Baca	City of Albuquerque	Albuquerque	NM
Richard Brusuelas	Bernalillo County Environmental Health Department	Albuquerque	NM
Stephen Burstein	Middle Rio Grande Council of Governments	Albuquerque	NM
Tim Callahan	New Mexico State Land Office	Albuquerque	NM
Jay Czar	City of Albuquerque	Albuquerque	NM
Tom Duker	Bernalillo County Environmental Health Department	Albuquerque	NM
Dennis Foltz	Middle Rio Grande Council of Governments	Albuquerque	NM
Richard Harris	Bernalillo County Health Department	Albuquerque	NM
Danny Hernandez	Albuquerque Metropolitan Arroyo Flood Control Authority	Albuquerque	NM
Morris Huling	Albuquerque Fire Department	Albuquerque	NM
Tom Leatherwood	New Mexico State Land Office	Santa Fe	NM

John Messier	City of Albuquerque Planning Department	Albuquerque	NM
Stephen Miller	Bernalillo County Public Works Division	Albuquerque	NM
Celina Paulsen	City of Albuquerque	Albuquerque	NM
Tom Rutherford	Bernalillo County Commissioners	Albuquerque	NM
Dennis Soltz	Middle Rio Grande Council of Governments	Albuquerque	NM
Harry Stowers	Village of Los Ranchos	Albuquerque	NM
Theresa Trujeque	City of Albuquerque	Albuquerque	NM

7. COMPANIES AND INSTITUTIONS

Tom Baca	Los Alamos National Laboratory	Los Alamos	NM
David Ball	Gram, Inc.	Albuquerque	NM
Robert Chavez	Perma Fix of New Mexico, Inc.	Albuquerque	NM
James Doenges	URS Greiner Woodward Clyde	Denver	CO
John Donnellon	Mjd Business Systems	Albuquerque	NM
Paul Friesema	Institute For Policy Research	Evanston	IL
Lee Gamelsky	Gamelsky Benton Archts Pc	Albuquerque	NM
Kathy Grebstad	Jason Associate Citizens Advisory Board	Idaho Falls	ID
Paul Grogger	University of Colorado	Colorado Springs	CO
Stan Hafenfeld	New Ventures Exploration, Inc.	Albuquerque	NM
Sarah Hardgrave	Dekker/Perich	Eugene	OR
John Hawley	Earth Matters Southwest	Albuquerque	NM
Jerry Kamieniecki	Weaver Boos Consultant	Bernalillo	NM
Kimmel King	Rinchem Co., Inc.	Albuquerque	NM
Ralph Laho	Phillips Electronics	Albuquerque	NM
Lopez Lehua	Native Land Institute	Albuquerque	NM
Diane Lindsay	BDM	Albuquerque	NM
Walt Migdal	Jacobs Engineering	Albuquerque	NM
Abby Nagy	Dames & Moore	Albuquerque	NM
Marshall Nay	BDM	Albuquerque	NM
Robert Neill	Environmental Eval. Group	Albuquerque	NM
Anita Padilla	Albuquerque Career Institute	Albuquerque	NM
Bruce Papier	NMHU	Santa Fe	NM
Maria Pincus	Leedshill-Herkenhoff, Inc.	Albuquerque	NM
Karen Rohde	Keystone Environmental & Planning, Inc.	Albuquerque	NM
Charles Sanchez	TVI Swceeo	Albuquerque	NM

Liz Shipley	KOAT-TV	Albuquerque	NM
Larry Spohn	Albuquerque Tribune	Albuquerque	NM
Bruce Thomson	University of New Mexico	Albuquerque	NM
Gary Tonjes	Albuquerque Economic Development	Albuquerque	NM
Krishan Wahi	Gram, Inc.	Albuquerque	NM
Gordon Walhood	Bohannan Huston, Inc.	Albuquerque	NM
Stanley Waligora	Environmental Dimensions, Inc.	Albuquerque	NM
Veronica Ybarra	Benchmark Environmental Corp.	Albuquerque	NM

8. ORGANIZATIONS

	Citizens For Alternatives to Radioactive Dumping	Albuquerque	NM
	Environmental Evaluation Group	Albuquerque	NM
	Espanola Outreach Center	Espanola	NM
	Hansen Environmental Consultants	Pagosa Springs	CO
	League of Women Voters of Alb./Bernalillo	Albuquerque	NM
	Los Alamos Outreach Center	Los Alamos	NM
	Santa Fe Outreach Center	Santa Fe	NM
Jesus Anzures	Artisco Land Rights Council	Albuquerque	NM
Loretta Armenta	Hispano Chamber of Commerce	Albuquerque	NM
Lila Bird	Water Information Network	Albuquerque	NM
Dori Bunting	Albuquerque Center For Peace and Justice	Albuquerque	NM
Carlton Canady	Four Hills Homeowner Association	Albuquerque	NM
Edwin Candelaria	Four Hills Mobile Home Association	Albuquerque	NM
John Carey	Association of Commerce and Industry of New Mexico	Albuquerque	NM
Christine Chandler	Responsible Environmental Action League	Los Alamos	NM
Lois Chemistruck	Royal Heights Association	Albuquerque	NM
Thomas Cochran	Nuclear Programs	Washington	DC
Jay Coghlan	Concerned Citizens For Nuclear Safety	Santa Fe	NM
Terry Cole	Greater Albuquerque Chamber of Commerce	Albuquerque	NM
Wendell Cosner	Siesta Hills Neighborhood Association	Albuquerque	NM
Jay Czar	Airport Advisory Board	Albuquerque	NM
Steven Dolley	Nuclear Control Institute	Washington	DC
Dennis Domrzalski	Weekly Alibi	Albuquerque	NM

Mike Du Mond	Monticello Neighborhood Association	Albuquerque	NM
Greg Edgar	Homestead Hills N.	Albuquerque	NM
Maureen Eldredge	Alliance For Nuclear Accountability	Washington	DC
Michael Emerson	Parkland Hills Neighborhood Association	Albuquerque	NM
Deidre Firth	Albuquerque Economic Development	Albuquerque	NM
John Fleck	The Albuquerque Journal	Albuquerque	NM
Barbara Ford	Sierra Club	Albuquerque	NM
George Gibbs	Four Hills Village	Albuquerque	NM
Susan Gordon	Alliance For Nuclear Accountability	Seattle	WA
Dorothy Gordon	Wyoming Terrace Mobile Home Park Tenant Association	Albuquerque	NM
Susan Gorman	Sierra Club	Albuquerque	NM
Janet Greenwald	Citizens for Alternatives to Radioactive Dumping	Albuquerque	NM
Michael Guerrero	Southwest Organizing Project	Albuquerque	NM
Becky Gurka	Nevada Citizens Advisory Board	Las Vegas	NV
Don Hancock	Southwest Research & Information Center	Albuquerque	NM
Robert Hanna	Casa De Suenos Foundation	Albuquerque	NM
H. Heacock	Hanford Advisory Board	Kennewick	WA
Dolores Herrera	San Jose Community Awareness Council	Albuquerque	NM
David His	New Mexico Advocates for Children & Families	Albuquerque	NM
Robert Hoffman	Economic Forum	Albuquerque	NM
Valarie Jaramillo	Kirtland Addition	Albuquerque	NM
Jake Jekowski	Technology Industries Association of New Mexico	Albuquerque	NM
Joan Jones	Unified Neighbors For Crime Prevention	Albuquerque	NM
Dan Kerlinsky	Physicians For Social Responsibility	Albuquerque	NM
Charles Kilbury	Hanford Advisory Board	Pasco	WA
Stephanie Lawton	Nts Citizens Advisory Board	Dyer	NV
James Lewis	New Mexico Citizens Clean Air & Water	Albuquerque	NM
Becky Lopez	Pantex Plant Citizens Advisory Board	Amarillo	TX
Frank Martinez	Citizens' Information Committee of Martineztown	Albuquerque	NM
Pete Marutiak	Princess Jeanne Neighborhood Association	Albuquerque	NM
Martin Matlack	Sierra Vista Utilidades Coop., Inc.	Cedar Crest	NM

Suzanne Matthews	Savannah River Citizens Advisory Board	Aiken	SC
Mildred Mcclain	Citizens For Environmental Justice, Inc.	Savannah	GA
Doug Meiklejohn	New Mexico Environmental Law Center	Santa Fe	NM
Greg Mello	Los Alamos Study Group	Santa Fe	NM
Alden Meyer	Union of Concerned Scientists	Washington	DC
Richard Moore	SW Network For Environmental and Economic Justice	Albuquerque	NM
Wm. Naegele	Briarwood Home Owners Association	Albuquerque	NM
David Navarro	Rocky Flats Citizens Advisory Board	Westminster	CO
Jo Ann Neel	Office and Professional Employees Intl. Union	Albuquerque	NM
Elinor Ochoa	Rio Grande Minority Purchasing Council	Albuquerque	NM
Christopher Paine	Natural Resources Defense Council	Washington	DC
Jerry Pardilla	National Tribal Environmental Council	Albuquerque	NM
Stanley Pino	All Indian Pueblo Council	Albuqueque	NM
Evangeline Quintana	South Broadway Cultural Center	Albuquerque	NM
Fred Rael	East Mountain Area Association	Tijeras	NM
Shari Reed	Siesta Hills	Albuquerque	NM
William Riley	Big Bend Economic Development Council	Moses Lake	WA
Virginia Sanchez	Citizen Alert Native American Program	Reno	NV
Kathy Sanchez	Tewa Women United	Espanola	NM
Peggy Schwebach	Salt Mission Trails Mainstreet	Mcintosh	NM
Marion Stevens	Elder Homestead	Albuquerque	NM
Lloyd Suina	All Indian Pueblo Council Office	Albuquerque	NM
Diane Terry	Princess Jeanne Neighborhood Association	Albuquerque	NM
Mervyn Tilden	Zuni Mountain Coalition Dine Bureau	Church Rock	NM
Frank Tussing	Nevada Community Advisory Board	Las Vegas	NV
Joseph Valentine	Yale Village	Albuquerque	NM
Aldolfo Vasquez	Fair West Neighborhood Association	Albuquerque	NM
Victoria Verrett	Shared Vision Office of Economic Development	Albuquerque	NM
Alfred Volden	Mountainview Advisory Council	Albuquerque	NM
Douglas Wilfon	Metal Trades Council	Albuquerque	NM
Mary Wilson	Transitions to Tomorrow, Inc.	Albuquerque	NM
John Wright	Mobile Home Owners Association	Albuquerque	NM
Tom Zamora Collina	Union of Concerned Scientists	Washington	DC

9. INDIVIDUALS

Orlando Arellano	Holman	NM
Rodney Arnold	Brooks Air Force Base	TX
K. Barnhill	Albuquerque	NM
Yugal Behl	Albuquerque	NM
Mavis Belisle	Pan Handle	TX
Richard Benison	Albuquerque	NM
William Bierck	Albuquerque	NM
Morris Blumberg	Albuquerque	NM
Colleen Bogovich	Allison Park	PA
John Bowannie	Zuni	NM
Smith Cachini Sr.	Zuni	NM
H. Cahn	Richland	WA
Steve Campbell	Denver	CO
Donna Campbell	Oak Ridge	TN
Paul Catacosinos	Albuquerque	NM
Lynda Celnik	Albuquerque	NM
John Chappell	Reno	NV
Marvin Clawson	Hamilton	OH
Carla Cohen	Albuquerque	NM
J. Coleman	Arvada	CO
Claude Cornett	Chesterland	OH
John Dimarzio	Damascus	MD
Jesse Dompreh	Albuquerque	NM
Cliff Duke	Arlington	VA
Ron Faich	Albuquerque	NM
Carmella Gabaldon	Albuquerque	NM
Pia Gallegos	Albuquerque	NM
Ernest Garcia	Albuquerque	NM
Nola Gearhart	Tijeras	NM
John Geddie	Albuquerque	NM
Nani Gould	Arlington	VA
Angelina Griego	Albuquerque	NM

P. Guggino	Santa Fe	NM
Beth Hale	Albuquerque	NM
Glen Hanson	Las Vegas	NV
Barbara Harper	West Richland	WA
Joan Harris	Albuquerque	NM
John Hart	Albuquerque	NM
Robert Hoffman	Germantown	MD
Keri Holley	Albuquerque	NM
Jennie Holmes	Bernalillo	NM
Diego Jordan	Albuquerque	NM
Tracy Jordan	Albuquerque	NM
Hubert Joy	Albuquerque	NM
William Joyce	Gaithersburg	MD
Will Keener	Albuquerque	NM
Brian Kelly	Bosque Farms	NM
Hank Khan	Berkeley	CA
Mary Leger	Albuquerque	NM
Melanie Majors	Albuquerque	NM
Renee Maloy	Albuquerque	NM
John Marr	Tijeras	NM
Salvador Martinez	Albuquerque	NM
Loyoda Martinez	Fairview	NM
Felipe Martinez	El Rito	NM
Darryl Millet	Albuquerque	NM
Marty Mitchell	Albuquerque	NM
Chuck Montano	Santa Fe	NM
Kim Ong	Albuquerque	NM
Dawn Palmieri	Albuquerque	NM
C. Pasterczyk	Albuquerque	NM
Joanne Ramponi	Albuquerque	NM
Jeff Rikhoff	Arlington	VA
John Ritts	Albuquerque	NM
Robby Robinson	Denver	CO

Linda Robinson		Gaithersburg	MD
Paul Robinson		Albuquerque	NM
Andy Saiz		Albuquerque	NM
Dolores Salazar		Espanola	NM
Les Shephard		Albuquerque	NM
Don Silva		Albuquerque	NM
Betty Sladek		Montrose	CO
Chuck Stanton		Albuquerque	NM
Larry Tichenor		Rio Rancho	NM
Manuel Trujillo		Espanola	NM
Ted Truske		Albuquerque	NM
Perry Tsadiasi		Zuni	NM
Stephen Tumolo		Albuquerque	NM
John Weckerle		Albuquerque	NM

10. OTHER

Larry Adcock	U.S. Department of Energy	Albuquerque	NM
Richard Ahern	U.S. Department of Energy	Washington	DC
Khawaja Akhtar	U.S. Department of Energy	Germantown	MD
Jim Bartolino	U.S. Geological Survey	Albuquerque	NM
Donna Bergman	U.S. Department of Energy	Grand Junction	CO
Dave Binkley	Rio Grande Environmental Products	Albuquerque	NM
Tracy Bishop	U.S. Department of Energy	Germantown	MD
Rex Borders	U.S. Department of Energy	Albuquerque	NM
Donald Brady	U.S. Department of Energy	Albuquerque	NM
Bruce Buvinger	U.S. Department of Energy	Albuquerque	NM
Gary Chenevert	U.S. Department of Energy	Germantown	MD
Jim Davis	U.S. Department of Energy	Germantown	MD
Rudy Engelmann	U.S. Department of Energy	Germantown	MD
Arnold Epstein	U.S. Department of Energy	Germantown	MD
Steven Frank	U.S. Department of Energy	Washington	DC
Henry Garson	U.S. Department of Energy	Germantown	MD
Shiv Goel	U.S. Department of Energy	Albuquerque	NM
Mary Greene	U.S. Department of Energy	Washington	DC

Boyd Hathaway	Duncorp	Richland	WA
Clarence Hickey	U.S. Department of Energy	Germantown	MD
James Hoyal	U.S. Department of Energy/Al/Oma	Albuquerque	NM
Mark Jackson	U.S. Department of Energy	Albuquerque	NM
Robert Jones	U.S. Department of Energy	Germantown	MD
Jeff Kimball	U.S. Department of Energy	Germantown	MD
Franz Lauffer	SNL/Groundwater Protection Program	Albuquerque	NM
Stanley Lichtman	U.S. Department of Energy	Washinton	DC
Kim Loll	U.S. Department of Energy	Germantown	MD
Tom Longo	U.S. Department of Energy	Germantown	MD
Tracylynn Loughead	U.S. Department of Energy	Albuquerque	NM
Richard Lynch	Sandia National Laboratories	Albuquerque	NM
Michael Mazaleski	U.S. Department of Energy	Washington	DC
Doug Minnema	U.S. Department of Energy	Germantown	MD
Buffy Naake	Center for Applied Research	Denver	CO
John Neave Jr.	U.S. Department of Energy	Germantown	MD
Corville Nohava	U.S. Department of Energy	Albuquerque	NM
Carolyn Osborne	U.S. Department of Energy	Washington	DC
Gary Palmer	U.S. Department of Energy	Washington	DC
Magal Rao	U.S. Department of Energy	Germantown	MD
Jeff Robbins	U.S. Department of Energy	Albuquerque	NM
Carmen Rodriguez	Los Alamos National Laboratory	Los Alamos	NM
Laila Rodriguez	KLUZ TV	Albuquerque	NM
Don Senovich	Tetra Tech NUS Inc.	Pittsburg	PA
Raj Sharma	U.S. Department of Energy	Germantown	MD
Mark Sifuentes	U.S. Department of Energy	Albuquerque	NM
Jim Slawski	U.S. Department of Energy	Germantown	MD
Nelson Soucek	Jason Associates Corporation	Idaho Falls	ID
Richard Speidel	U.S. Department of Energy	Washington	DC
Ted Wolff	Sandia National Laboratories	Albuquerque	NM

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CHAPTER 12

List of Agencies and People Contacted

ORGANIZATION	LAST NAME	FIRST NAME	TITLE	LOCATION	STATE
Bureau of Indian Affairs, Albuquerque Area Office	Sedik	Allen	Environmental Scientist	Albuquerque	NM
	Whitener	Don	Deputy Area Director	Albuquerque	NM
Hopi Tribe	Kuwanwisiwma	Leigh J.	Director, Cultural Preservation Office	Kykotsmovi	AZ
	Taylor	Wayne	Chairman	Kykotsmovi	AZ
Jicarilla Apache Tribe	Cassador	Arnold	President	Dulce	NM
	Sandoval	Merton	Cultural Preservation Office	Dulce	NM
	Willis	Lorene	Director, Jicarilla Apache Culture Committee	Dulce	NM
Los Alamos National Laboratory	Murphy	Robert		Los Alamos	NM
	Schumman	Paul		Los Alamos	NM
Navajo Nation	Begay	Richard	TCP Coordinator	Window Rock	AZ
	Downer	Alan	Director, Navajo Nation Historic Preservation Department	Window Rock	AZ
	Guerro	Frank	President of Alamo Chapter	Alamo	NM
	Hale	Albert	President	Window Rock	AZ
	Noyes	Peter	Navajo Nation Historic Preservation Department	Window Rock	AZ
	Secatero	Tony	President of Ca oncito Chapter	Ca oncito	NM
NM Environment Department	Brinkerhoff	Debbi		Albuquerque	NM
	Gallagher	Pat		Albuquerque	NM
	Kolwalski	Judy		Albuquerque	NM
	O Connel	John		Albuquerque	NM
	Turncoat	John		Albuquerque	NM
NM Forestry Division	Sivinski	Bob	Forester	Santa Fe	NM
NM Office of Cultural Affairs, Historic Preservation Division, Archaeological Records Management Section	Geister	Scott	Data Coordinator	Santa Fe	NM

List of Agencies and People Contacted (continued)

ORGANIZATION	LAST NAME	FIRST NAME	TITLE	LOCATION	STATE
NM Office of Cultural Affairs, Historic Preservation Division	Cushman	David	NM State Archaeologist	Santa Fe	NM
	Sebastian	Lynne	NM State Historic Preservation Officer	Santa Fe	NM
Pueblo of Acoma	Gilbert	Petuuche	Realty Officer	Acoma	NM
	Pasqual	Reginald T.	Governor	Acoma	NM
	Paytiamo	Stanley	Environmental Protection Specialist	Acomita	NM
Pueblo of Cochiti	Pecos	Jacob	Coordinator, Cochiti Environmental Protection Office	Cochiti Pueblo	NM
	Suina	Henry	Governor	Cochiti Pueblo	NM
Pueblo of Isleta	Hostak	John	Director, Environmental Department	Isleta Pueblo	NM
	Lucero	Alvino	Governor	Isleta Pueblo	NM
	Lujan	Fred	Governor	Isleta Pueblo	NM
	Walt	Henry	Ethnographer, Cultural Group Coordinator	Albuquerque	NM
Pueblo of Jemez	Toya	Vincent	Governor	Jemez Pueblo	NM
	Whatley	William	Director, Department of Archaeology and Preservation	Albuquerque	NM
Pueblo of Laguna	Cywinska-Bernacik	Barbara	Director of Environmental Division	Laguna Pueblo	NM
	Johnson	Roland	Governor	Laguna Pueblo	NM
	Sarracino	Victor	Cultural Consultation Group	Laguna Pueblo	NM
Pueblo of San Felipe	Romero	Mike	Environmental Director	San Felipe Pueblo	NM
	Sandoval	Doris	Tribal Administrator	San Felipe Pueblo	NM
	Velasquez	Robert	Governor	San Felipe Pueblo	NM
Pueblo of Sandia	Holmes	Jennie	Assistant Librarian	Bernalillo	NM
	Janello	Beth	Environmental Director	Bernalillo	NM
	Lujan	Alex	Governor	Bernalillo	NM

List of Agencies and People Contacted (continued)

ORGANIZATION	LAST NAME	FIRST NAME	TITLE	LOCATION	STATE
Pueblo of Santa Ana	Montoya	Ron	Governor	Bernalillo	NM
Pueblo of Santo Domingo	Chavez	Everett	Environmental Coordinator	Santo Domingo Pueblo	NM
	Tortalita	Tony	Governor	Santo Domingo Pueblo	NM
Pueblo of Zia	Pino	Peter	Tribal Administrator	Zia Pueblo	NM
	Shije	Edwin	Governor	Zia Pueblo	NM
Pueblo of Zuni	Dishta	Joseph	Director, Heritage and Historic Preservation Office	Zuni	NM
	Eriacho	Donald	Governor	Zuni	NM
	Panteah	Loren	Cultural Preservation Coordinator	Zuni	NM
Rinchem Co., Sandia National Laboratories/New Mexico, Hazardous Waste Management Facility	Gorgone	Lisa		Albuquerque	NM
Sandia National Laboratories/New Mexico	Boom	Ross		Albuquerque	NM
	Cheng	Chui Fan		Albuquerque	NM
	Cheng	Wu-Ching		Albuquerque	NM
	Conway	Earl		Albuquerque	NM
	Guerrero	Joe		Albuquerque	NM
	King	Gabe		Albuquerque	NM
	Kuzio	Ken		Albuquerque	NM
	Lincoln	Maureen		Albuquerque	NM
	Lojek	Carole		Albuquerque	NM
	Losi	Don		Albuquerque	NM
	Medrano	Carlos	Space and Real Estate Specialist	Albuquerque	NM
	Miller	Dennis		Albuquerque	NM
	Molley	Kylene		Albuquerque	NM
	Moore	Darlene		Albuquerque	NM
	Peterson	Phyllis		Albuquerque	NM
	Roma	Chip		Albuquerque	NM

List of Agencies and People Contacted (continued)

ORGANIZATION	LAST NAME	FIRST NAME	TITLE	LOCATION	STATE
Sandia National Laboratories/New Mexico (continued)	Roybal	Tony		Albuquerque	NM
	Stone	Brian		Albuquerque	NM
	Tooley	Ed	Sites Planning Specialist	Albuquerque	NM
	Trujillo	Manny		Albuquerque	NM
	Vigil	Francine		Albuquerque	NM
	Wheeler	Tim		Albuquerque	NM
Sandia National Laboratories/New Mexico Microelectronics Development Laboratory	Rohr	Don		Albuquerque	NM
Sandia National Laboratories/New Mexico Aerial Cable Facility, Centrifuge Complex, Drop/Impact Complex, Lurance Canyon Burn Site, Radiant Heat Facility, Sled Track Facility	Bickel	David	Consultant	Albuquerque	NM
	Stibick	Frank		Albuquerque	NM
Sandia National Laboratories/New Mexico Advanced Manufacturing Processes Laboratory	Vaughan	Johnny		Albuquerque	NM
Sandia National Laboratories/New Mexico Center for National Security and Arms Control	Dunbar	Dan		Albuquerque	NM
	Lucero	Frank		Albuquerque	NM
	Scott-Patterson	Liz		Albuquerque	NM
Sandia National Laboratories/New Mexico Compound Semiconductor Research Laboratory	Esherick	Peter		Albuquerque	NM
Sandia National Laboratories/New Mexico Explosive Components Facility	Johnson	Dennis		Albuquerque	NM

List of Agencies and People Contacted (continued)

ORGANIZATION	LAST NAME	FIRST NAME	TITLE	LOCATION	STATE
Sandia National Laboratories/New Mexico Exterior Intrusion Sensor Facility	Miller	Larry		Albuquerque	NM
	Sandoval	Martin		Albuquerque	NM
Sandia National Laboratories/New Mexico Facilities Engineering	Duran	Ernie		Albuquerque	NM
	Nevada	Ernie		Albuquerque	NM
Sandia National Laboratories/New Mexico Hazardous Waste Management Facility	Roma	Charles		Albuquerque	NM
Sandia National Laboratories/New Mexico Integrated Materials Research Laboratory	Davis	Wayne		Albuquerque	NM
Sandia National Laboratories/New Mexico Microelectronics Development Laboratory	Jones	Ron		Albuquerque	NM
Sandia National Laboratories/New Mexico Molybdenum-99 Project	McDonald	Marion		Albuquerque	NM
Sandia National Laboratories/New Mexico Neutron Generator Facility	Pope	Larry		Albuquerque	NM
Sandia National Laboratories/New Mexico National Solar Thermal Test Facility	Kolb	William		Albuquerque	NM
Sandia National Laboratories/New Mexico Photovoltaic Device Fabrication Laboratory	Bode	Mike		Albuquerque	NM

List of Agencies and People Contacted (continued)

ORGANIZATION	LAST NAME	FIRST NAME	TITLE	LOCATION	STATE
Sandia National Laboratories/New Mexico Radioactive and Mixed Waste Management Facility	Jarry	Jeffrey		Albuquerque	NM
	Mantay	Donald	Consultant	Albuquerque	NM
	Miller	Kenny		Albuquerque	NM
Sandia National Laboratories/New Mexico Technical Area-V	Schmidt	Ted		Albuquerque	NM
Sandia National Laboratories/New Mexico Terminal Ballistics Facility	Bonzon	Lloyd		Albuquerque	NM
	Johnson	Dennis		Albuquerque	NM
	Johnson	Floyd		Albuquerque	NM
	Mulligan	Ed		Albuquerque	NM
	Castillo	David		Albuquerque	NM
Sandia National Laboratories/New Mexico Z-Machine	Harris	Mark		Albuquerque	NM
TRC Companies, Inc.	Goar	Toni	Archaeologist	Albuquerque	NM
U.S. Air Force, 377th Air Base Wing, Environmental Management Division	Gooch	Sam	Chief, Programs Branch	Kirtland AFB	NM
	Leatherwood	James	Director	Kirtland AFB	NM
	Tuttle	Christine	Cultural Resource Manager	Kirtland AFB	NM
U.S. Army Corps of Engineers, Albuquerque District	Clark	Lewis	Biologist	Albuquerque	NM
	Manger	Jean	Biologist	Albuquerque	NM
U.S. Department of Energy	Pietrok	Ted		Albuquerque	NM
U.S. Department of Energy/Kirtland Area Office	Garcia	Deborah	Real Estate Specialist	Albuquerque	NM
U.S. Forest Service	Geuss	Cynthia	Cartographer	Albuquerque	NM
U.S. Forest Service, Cibola National Forest	Benedict	Cynthia	Assistant Forest Archaeologist	Albuquerque	NM
	Cartledge	Tom	Forest Archaeologist	Albuquerque	NM
	Kosper	Larry	Biologist	Albuquerque	NM
U.S. Forest Service, Cibola National Forest, Sandia Ranger Station	De Gruyter	Beverly	Biologist	Tijeras	NM

List of Agencies and People Contacted (concluded)

ORGANIZATION	LAST NAME	FIRST NAME	TITLE	LOCATION	STATE
University of New Mexico, Earth Data Analysis Center	Gleasner	Laura	GIS Specialist	Albuquerque	NM
University of New Mexico, Maxwell Museum of Anthropology	Dorr	Brenda	Curator of Archaeology/ *Native American Graves Protection and Repatriation Act* Project Director	Albuquerque	NM
Ysleta del Sur Pueblo	Mu oz	Vincent	Governor	El Paso	TX

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CHAPTER 13

Glossary

This glossary lists terms that may not be familiar to some readers of this document. Several sources of definitions are available including *Glossary of Terms used in DOE NEPA Documents* (DOE 1998l) and *Environment, Safety and Health Thesaurus/Dictionary* (DOE 1998k). The last citation is available through the Internet (http://tis.eh.doe.gov/docs/dict/).

– A –

Abatement: Reducing the degree or intensity of, or eliminating, pollution.

Absorbed dose: For ionizing radiation, the energy imparted to matter by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray, where 1 rad equals 0.01 gray.

Accelerator: A device that accelerates the motion of charged particles (such as electrons, protons, or atomic nuclei) to high velocities, thus giving them high kinetic energies. The accelerated particles may be used in industrial and medical applications or in research on nuclear or subnuclear phenomena.

Accident: An unplanned event or sequence of events that result in undesirable consequences.

Advanced components: A part or material that has been improved such that it is considered state-of-the-art.

Advanced manufacturing technologies: The science or study of the technology associated with the design, fabrication, theory, and application of state-of-the-art manufacturing that uses prototype research and development of new technologies.

Advanced materials: A material that has been improved such that it is considered state-of-the-art.

Air dispersion modeling: A mathematical simulation, usually computer-generated, of how gases, vapors, or particles disperse into the air.

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 (AQCR): Geographic subdivisions of the United States established to regulate pollution on a regional or local level. Some regions span more than one state.

Air quality standards: The level of pollutants prescribed by regulations that may not be exceeded during a specified time in a defined area.

Airblast noise: Noise, typically from the detonation of explosives. The noise is of short duration (less than three seconds) and in the form of an impulse.

Alluvial fan: A fan-shaped accumulation of sediment deposited by flowing water, marking the place where a stream moves from a steep slope to a flatter slope and suddenly loses its transporting power.

Alluvial slope: The sloping surface formed by an alluvial fan.

Alluvium layer: Layer of soil deposited by running water. Typically, alluvium has a high rate of groundwater transmission.

Alpha particle: A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It has low penetrating power and a short range (a few centimeters in air).

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.

Ambient air: Any unconfined portion of the atmosphere: open air, surrounding air. That portion of the atmosphere, external to buildings, to which the general public has access.

Analytical modeling: Computer-generated mathematical calculations used to determine the potential results of an action.

Aquifer: A body of rock or sediment under the earth's surface that is capable of transmitting groundwater and yielding usable amounts of groundwater to supply wells and springs. A saturated geologic unit through which significant quantities of water can migrate under natural hydraulic gradients.

Archaeological sites (resources): Any material remains of past human life or activities that are of archaeological interest.

Artifact: An object produced or shaped by human workmanship that is of archaeological or historical interest.

As low as reasonably achievable (ALARA): An approach to radiation protection to manage and control 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 limit, but a process for minimizing doses to as far below limits as is practicable.

Asphyxiant: Chemical vapors or gases that replace oxygen in air. Chemical asphyxiants prevent oxygen transfer from the blood to body cells. Physical asphyxiants prevent oxygen from reaching the blood.

Atmospheric photochemical reactions: Chemical reactions that occur in the atmosphere and are initiated by sunlight.

Attainment area: An area that the U.S. Environmental Protection Agency (EPA) has designated as being in compliance with one or more of the National Ambient Air Quality Standards (NAAQS) 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.

— B —

Background radiation: Radiation from 1) cosmic sources; 2) decay of naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material); and 3) global fallout from nuclear weapons as it exists in the environment (such as from the testing of nuclear explosive devices).

Baseline: The existing environmental conditions against which impacts of the alternatives can be compared. For this Site-Wide Environmental Impact Statement (SWEIS), the environmental baseline is the environmental condition of the site as it existed in 1997, unless otherwise stated.

Beta radiation: Ionizing radiation consisting of fast moving, positively or negatively charged elementary particles emitted from atomic nuclei during radioactive decay. Beta radiation is more penetrating but less ionizing than alpha radiation.

Bioassay: Using living organisms to measure the effect of a substance, factor, or condition by comparing before and after data. Term is often used to mean cancer bioassays.

Biohazardous waste: Any waste that is capable of transmitting an infectious agent to a living organism. This includes discarded materials such as live and weakened vaccines, blood, excretions or secretions, animal carcasses and animal waste products, hypodermic needles, syringes, and broken glass items such as blood vials.

Biological province: A continuous geographic area that possesses an animal life distinguishable, at the species and subspecies levels, from the animal life of adjacent areas.

Biological resource: Plants, animals, and other living organisms.

Biomass: All the living and once-living material in a given area; often refers to the vegetation.

Bioscience: The science or study of the technology associated with the design, fabrication, theory, and application of biological processes.

Biouptake: Absorption or incorporation of an element or chemical compound, such as lead, dioxin, polychlorinated biphenyl (PCB), or uranium, into a living organism.

Block group: A basic unit of estimated population used by the U.S. Census Bureau to define the demographics of an area. In urban areas, block groups are comprised of clusters of 1 to 4 city blocks, generally containing between 250 and 550 housing units. In rural areas, where population densities are smaller, block groups are larger areas defined by physical features such as rivers, political boundaries (such as city limits or county lines), and other reasonable criteria.

Bounding analysis: An analysis designed to determine an upper limit to potential impacts or risks.

Buffer zone: On Kirtland Air Force Base, the area surrounding a testing site. The size and configuration of a buffer zone is designed to accommodate different types and quantities of explosives and the type(s) of facilities or land use adjacent to the site.

– C –

Cancer: A group of diseases characterized by uncontrolled cellular growth with invasive characteristics, such that the disease can transfer from one organ to another.

Candidate species: Plants and animals that the U.S. Fish and Wildlife Service or the National Marine Fisheries Service has sufficient information on biological vulnerability and threats to justify proposing to add them to the threatened and endangered species list, but cannot do so immediately because of the relative listing priority of candidates.

Carbon coating: Surface coating with carbon.

Carbon dioxide (CO_2): A colorless, odorless, nonpoisonous gas that is a normal component of the ambient air; it is a product of normal plant and animal respiration and of the decay of organic matter.

Carbon monoxide (CO): A colorless, odorless gas that is toxic if breathed in high concentration over a period of time. It is formed as the product of the incomplete combustion of hydrocarbons (fuels).

Carcinogen: A substance that can cause or contribute to the production of cancer.

Cathodic protection: A technique to prevent corrosion of metal surfaces.

Centrifuge: A device that spins items in a circle at high velocities (speed), which can be used to simulate high gravity conditions.

Ceramic processing: Operations and activities involving heat-resistant and corrosion-resistant nonmetallic materials.

Chemical plating: A process in which chemicals are used to coat a surface (typically metallic) with another material. The purpose is typically to improve the material properties such as rust protection.

Clean room: An area that is maintained virtually free of contaminants (such as dust or bacteria); used in laboratory work and in the production of precision parts for electronic equipment.

Climatology: The science that deals with climates and investigates their phenomena and causes.

Cobalt array: An arrangement of the metal cobalt that provides low-intensity gamma radiation.

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 radiation sources external to the body.

Committed effective dose equivalent: The dose value obtained by multiplying the committed dose equivalent for the organ or tissues that are irradiated and the weighting factors applicable to those organs or tissues, and summing all the resulting products.

Community (biotic): All plants, animals, and living organisms occupying a specific area.

Comprehensive Test Ban Treaty: A proposed treaty prohibiting nuclear tests of all magnitudes.

Container: Portable devices in which a material is stored, transported, treated, disposed of, or otherwise handled.

Contaminant: Physical, chemical, biological, or radiological substances or matter that may have an adverse effect on air, water, or soil.

Cooling tower: A structure that helps remove heat from water used as a coolant.

Cooperating agency: Any Federal agency, other than the lead agency, that has jurisdiction by law or special expertise over any environmental impact resulting from a proposed Federal action.

Criteria pollutants: An air pollutant that is regulated by National Ambient Air Quality Standards (NAAQS). The U.S. Environmental Protection Agency (EPA) must describe the characteristics and potential health and welfare effects that form the basis for setting or revising the standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter.

Cultural resources: Prehistoric or historic sites, buildings, structures, districts, or other places or objects (including biota of importance) considered to be important to a culture, subculture, or community for scientific, traditional, or religious purposes or for any other reason. This includes archaeological sites, traditional use areas, and sacred or religious locations.

Cultural resource survey: An inventory across the landscape to find and identify cultural resources and an evaluation of those resources for eligibility for listing on the National Register of Historic Places.

Cumulative impacts: The impacts on the environment that result when the impact of a proposed action is added to the impacts from other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions. Cumulative impacts can result from individually minor, but collectively more significant, actions taking place over a period of time.

– D –

Daughter: The immediate product of the radioactive decay of an element.

Decommission: The process of withdrawing a building, equipment, or a facility from active service.

Decontamination: The actions taken to reduce or remove substances that pose a substantial present or potential future hazard to human health or the environment. Examples are removal of radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

Deflagration: Burning or causing to burn with intense heat and light.

Degradation: Process by which a chemical or compound is reduced to a less complex form.

Depleted uranium: Uranium whose content of the fissile uranium-235 isotope is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium.

Deposition technologies: Technologies involving laying one material on the surface of another material.

Deuterium: An isotope of hydrogen with a nucleus containing one proton and one neutron. The hydrogen nucleus only contains one proton.

Dielectric materials: Materials that do not conduct direct electrical current.

Diffusion bonding: A process of coating one material with thin layers of another material.

Diurnal: Pertaining to, or occurring in, the day or each day (daily).

Dose (chemical): The amount of a substance administered to, taken up by, or assimilated by an organism. It is often expressed in terms of the amount of substance per unit mass of the organism, tissue, or organ of concern.

Dose (radiological): A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, and committed equivalent dose.

Dosimetry: The theory and application of the principles and techniques involved in measuring and recording radiation doses.

Drainage area: An aboveground land area that supplies water to a particular stream or river.

Drawdown: The lowering of the water table (upper aquifer surface) in response to water withdrawal from the aquifer.

Drinking water standards: The prescribed level of constituents or characteristics in a drinking water supply that cannot be exceeded legally.

– E –

Ecosystem: A community of organisms and their physical environment interacting as an ecological unit.

Effluent: Treated or untreated air emissions or liquid discharges.

Eligible cultural resource: A cultural resource that has been evaluated and reviewed by an agency and the State Historic Preservation Officer and determined eligible for inclusion in the National Register of Historic Places, based on the criteria of significance and eligibility.

Emergency response planning guideline level 2 (ERPG-2): The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

Emission standards: Requirements established by a state, local government, or the U.S. Environmental Protection Agency (EPA) Administrator that limits the quantity, rate, or concentration of emissions of air pollutants on a continuous basis.

Emissions: Pollution discharged into the atmosphere from smoke stacks, other vents, and surface areas of commercial or industrial facilities, residential chimneys, and vehicle exhausts.

Encapsulate: Enclose by a protective coating or membrane.

Endangered species: Plants or animals that are in danger of extinction throughout all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the *Endangered Species Act* and its implementing regulations.

| **Environmental assessment (EA):** A public document that a Federal agency prepares under the *National Environmental Policy Act* (NEPA) to provide sufficient evidence and analysis to determine whether a proposed agency action would require preparation of an environmental impact statement (EIS) or finding of no significant impact (FONSI).

Environmental impact statement (EIS): The detailed written statement that is required by section 102(2) of the *National Environmental Policy Act* (NEPA) for a proposed major Federal action significantly affecting the quality of the human environment. A U.S. Department of Energy (DOE) EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality NEPA regulations in 40 CFR Parts 1500-1508, and DOE NEPA regulations in 10 CFR Part 1021.

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 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.

Ephemeral: Lasting for a brief period of time, as in a temporary stream.

Epidemiology: The science concerned with the study of events that determine and influence the frequency, distribution, and causes of disease, injury, and other health-related events in a defined human population.

Erosion: The wearing away of land surfaces by the action of wind or water.

Exotic species: Species of plants and animals that are not native to a region. They often displace native species and may become pests.

Explosion (conventional): A chemical reaction or change of state that occurs in a exceedingly short time with the generation of high temperatures and large quantities of gaseous reaction products.

Explosion (nuclear): An explosion for which the energy is produced by a nuclear transformation, either fission of fusion. The term typically implies the release of enormous amounts (kilotons) of energy.

Exposure pathways: The course a chemical or physical agent takes from the source to the exposed organism. An exposure pathway describes a mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from the site.

– F –

Fast-burst reactor: An operational mode of a reactor that releases fast energy in a short period of time.

Fault: A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred.

Finding of No Significant Impact (FONSI): A document prepared by a Federal agency, briefly presenting the reasons that a proposed action will not have a significant effect on the human environment; and, therefore, will not require an environmental impact statement.

Firing: The release of energy by an accelerator.

Fissile Material: Any material fissionable by low-energy neutrons consisting of or containing one or more of the fissile (capable of being split or divided) radionuclides: plutonium-239 and -241 and uranium-233 and -235. Neither natural nor depleted uranium is a fissile material. Fissile materials are classified according to the controls needed to provide nuclear criticality safety during storage and transportation.

Fissionable: A synonym for fissile material; the meaning of this term has been extended to include material that can be fissioned by fast neutrons such as uranium-238.

Flight dynamics: The study of aerodynamics and/or conditions of flight associated with airplanes, jets, or missiles.

Floodplain: The lowlands and relatively flat areas adjoining inland and coastal waters and the flood-prone areas of offshore islands including, at a minimum, that area inundated by a 1-percent or greater chance flood in any given year. The base floodplain is defined as the 100-year (1-percent) floodplain. The critical action floodplain is defined as the 500-year (0.2- percent) floodplain.

Fuel throughput: The amount of fuel used in a process over a period of time (for example, annual).

Fume hood: An enclosed ventilation system used to protect workers from inhaling fumes or vapors.

Fusion: A nuclear reaction during which light nuclei are fused together to form a heavier nucleus, accompanied by the release of immense amounts of energy and fast neutrons.

Fuzing: Mechanical or electrical means used to deteriorate an explosive charge.

– G –

Gamma rays: High-energy, short-wavelength, electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating and can be stopped only by dense materials (such as lead) or a thick layer of shielding materials.

Geologic disposal: A system that is intended to be used for, or may be used for, the disposal of radioactive wastes.

Geology: The science of the earth: the materials, processes, environments, and history of the planet, including the rocks and their formation and structure.

Geophysics: The science of the earth with respect to its structure, composition, and development.

Geoscience: A term encompassing all the sciences dealing with the materials, processes, environments, and history of the earth and planets, including geology, geophysics, geochemistry, and paleontology.

Glove box: An enclosure that provides a barrier for remote handling of hazardous materials. The term glove box refers to the gloves that extend inward into the box such that the technicians can handle tools and materials without dermal (skin) contact.

Graphite converter: An electronic device that converts energy frequencies.

Groundwater: Subsurface water supply in the saturated zone below the level of the water table.

– H –

Habitat: The place or area where populations of plants, animals, and other organisms normally live.

Half-life: The time required for one-half of a specified substance to degrade or become inert.

Hazardous air pollutants: Air pollutants that are not covered by ambient air quality standards, but that may present a threat of adverse human health effects or adverse environmental effects.

Hazardous chemical: Under 29 CFR §1910.1200(c), a hazardous chemical is 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, that poses an unreasonable risk to health, safety, and property when transported or handled.

Hazardous/toxic waste: Any solid waste (can also be semisolid or liquid or contain gaseous material) having one or more characteristics of ignitability, corrosivity, toxicity, or reactivity, or any other waste specifically regulated as a hazardous waste defined by the *Resource Conservation and Recovery Act* (RCRA) or by the *Toxic Substances Control Act* (TSCA).

Heat exchanger: A device used to transfer heat from one material or process to another material or process. Examples include a car radiator, heat pump, and solar panels used to heat water. Industrial uses are extensive.

Heat response: The science or study of material properties involving heat.

Henry's Law: At a given temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas above the liquid.

High bay: A specially designed room with a high ceiling. The U.S. Department of Energy (DOE) typically designs these rooms for industrial work that involves explosives, radioactive materials, and material processing.

High efficiency particulate air (HEPA) filter: A device used to remove particles from the air with a specified minimum efficiency.

High explosives: A type of explosive that detonates under the influence of a high-pressure shock or by the explosion of a suitable primary explosive (for example, trinitrotoluene [TNT] and nitroglycerin).

High voltage technology: The science or study of the technology associated with the design, fabrication, theory, and application of high potential (voltage) electrical energy. At Sandia National Laboratories/New Mexico (SNL/NM), research and development activities involve protecting materials, components, and systems from failure.

Highly enriched uranium: Uranium in which the abundance of the uranium-235 isotope is increased well above normal (naturally occurring) levels.

High neutron fluence: A high flow of neutrons.

Historic sites (resources): Cultural resources produced after the arrival of the Spanish into the middle Rio Grande valley, but earlier than 50 years ago. For the Site-Wide Environmental Impact Statement (SWEIS), this would be a site dating from A.D. 1540 to 1948. Historic sites may also include resources dating after 1948 if they are considered to be exceptionally significant.

Hydraulic conductivity: The ability of soil or other material to transmit water.

Hydrogeologic region: A sequence of hydrostratigraphic units, bounded by faults, with distinctive hydrogeologic characteristics such as depth to groundwater or hydraulic conductivity.

Hydrologic surface connection: A connection between two hydrologic regimes, for example, between the groundwater and an arroyo or spring.

Hydrology: The science dealing with the properties, distribution, and circulation of natural water systems.

– I –

Inductive voltage technology: The science or study of the technology associated with the design, fabrication, theory, and application of indirectly changing (inducing) voltage from one system to another.

Inertial confinement: The science or study of the technology associated with the design, fabrication, theory, and application of confining energy associated with acceleration.

Inertial confinement fusion: A laser-initiated nuclear fusion, using the inertial properties of the reactants as a confinement mechanism.

Infrastructure: The basic facilities, services, and installations needed for the functioning of a city, plant, or other facility (such as transportation and communication systems).

Inorganic: Materials that generally do not contain carbon atoms and are not associated with living plants and animals and metals are typical examples of inorganic substances.

Ion: An atom or molecule with a positive or negative electrical charge.

Ion-exchange: The process by which atoms or molecules are exchanged based on differences in electrical potential (voltage) or charge (for example, batteries, photo processing, and water treatment).

Irradiation: The process of exposing a substance to radiation.

Isotope: Any of two or more variations of an element in which the nuclei have the same number of protons but a different number of neutrons so that their atomic masses differ.

– J –

Joining: A process that combines materials, such as bonding.

– K –

Ketones: A type of organic compound with a carbonyl group attached to two carbon atoms, typically aromatic.

– L –

Laminates: Several thin layers of material united by an adhesive or other means.

Landforms: A land feature, such as a plain, mountain, or valley.

Lapping: Polishing or smoothing a surface.

Legacy chemical: A chemical with an expired shelf life (a waste).

Light water: Ordinary water (H_2O), as distinguished from heavy water (D_2O) that contains deuterium (an isotope of hydrogen).

Low bay: A specially designed room with a normal ceiling height (approximately 10 ft). Also see definition of High bay.

Low-level waste (LLW): Radioactive waste that is not high-level waste, transuranic waste, spent nuclear fuel, or byproduct tailings from the processing of uranium or thorium.

– M –

Magnetic fusion: The science or study of the technology associated with the design, fabrication, theory, and application of combining atoms through magnetic forces.

Major source: Any stationary source or group of stationary sources in which all of the pollutant-emitting activities at such source emit, or have the potential to emit, 100 or more tons per year of any air pollutants.

Maximally exposed individual: A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

Maximum contaminant level: The maximum permissible level of a contaminant in water delivered to any user of a public water system.

Medical isotope: A radioactive element (atom) used for medical purposes.

Metalizing: A process by which a material's metallic properties are improved.

Meteorology: The science dealing with the dynamics of the atmosphere and its phenomena, especially relating to weather.

Microelectronics: Integrated circuits and electronic devices constructed of individual circuit elements with dimensions of micrometers (10^{-6} meters [m]) on a carrier with dimensions of a centimeter (10^{-2} m).

Microtechnology: The science or study of the technology associated with the design, fabrication, theory, and application involving very small structures, circuits, and materials.

Mission: An objective. The U.S. Department of Energy (DOE) has four missions (or business lines): national security, energy resources, environmental quality, and science and technology.

Mitigation: 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 environmental.

Mixed waste: Waste that contains both "hazardous waste" and "radioactive waste" as defined in this glossary.

– N –

National Ambient Air Quality Standards (NAAQS): Standards defining the highest allowable levels of certain pollutants in the ambient air. Because the U.S. Environmental Protection Agency (EPA) must establish the criteria for setting these standards, the regulated pollutants are called criteria pollutants.

National Emission Standards for Hazardous Air Pollutants (NESHAP): Emissions standards set by the U.S. Environmental Protection Agency (EPA) for air pollutants that are not covered by National Ambient Air Quality Standards (NAAQS) and that may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness.

National Pollutant Discharge Elimination System (NPDES): A provision of the *Clean Water Act* that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the U.S. Environmental Protection Agency (EPA); a state; or, where delegated, a tribal government on an Indian reservation. The NPDES permit lists either permissible discharge, 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 considered 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, archeology, culture, or engineering. Properties included on the National Register range from large-scale, monumentally proportioned buildings to smaller scale, regionally distinctive buildings.

Near-fission: A close simulation of fission (or splitting of an atom) without actually splitting atoms.

Near-fission spectrum radiation: Radiation used during testing that simulates radiation generated through fission.

Neotropical migrants: Birds that seasonally migrate to nesting or wintering areas in the neotropical region extending from the northern edge of the tropical forest in Mexico south to Cape Horn in South America.

Neutron: An uncharged elementary particle with a mass slightly greater than that of the proton, found in the nucleus of every atom heavier than hydrogen-1.

Neutron generator: A device that initiates nuclear fission by providing a flux of neutrons at the proper time. A neutron generator consists of a neutron tube, miniature accelerator, power supply, and timer.

Neutron science: The science or study of technology associated with equipment design, equipment fabrication, theory, and application of neutrons.

Neutron tube: A component (part) of a neutron generator.

Nonattainment area: An area that the U.S. Environmental Protection Agency (EPA) has designated as not meeting (that is, not being in attainment of) one or more of the National Ambient Air Quality Standards (NAAQS) for criteria pollutants. An area may be in attainment for some pollutants, but not others.

Nonhazardous chemical waste: Chemical waste not defined as a *Resource Conservation and Recovery Act* (RCRA) hazardous waste.

Noninvolved worker: A worker who would be near the site of an action but would not participate in the action.

Nonnuclear component: Any one of thousands of parts, not containing radioactive or fissile material (plutonium-239, uranium-233, or uranium-235), that are required in a nuclear weapon.

Nonproliferation: Preventing the spread of nuclear weapons, nuclear weapon materials, and nuclear weapon technology.

Notice of Intent (NOI): A notice published in the *Federal Register* that an environmental impact statement (EIS) would be prepared and considered. An NOI describes the proposed action and alternatives and the Federal agency's scoping process, and states the name and address of the person within the agency who can answer questions about the proposed action and EIS.

Nuclear component: A part of a nuclear weapon that contains fissionable or fusionable material.

Nuclear material: A composite term applied to 1) special nuclear material; 2) source material such as uranium or 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 to the process of producing or using special nuclear material.

Nuclear medicine: The science of medicine specializing in nuclear materials, including medical isotopes.

Nuclear Nonproliferation Treaty: A treaty with the aim of controlling the spread of nuclear weapons technologies, limiting the number of nuclear weapons states, and pursuing, in good faith, effective measures relating to the cessation of the nuclear arms race. The treaty does not invoke stockpile reductions by nuclear states, and it does not address actions of nuclear states in maintaining their stockpiles.

Nuclear weapon: Any weapon in which the explosion results from the energy released by reactions involving atomic nuclei (fission, fusion, or both).

Nuclear weapons complex: The U.S. Department of Energy (DOE) sites supporting the research, development, design, manufacture, testing, assessment, certification, and maintenance of the Nation's nuclear weapons and the subsequent dismantling of retired weapons.

– O –

Occupational Safety and Health Administration (OSHA): The Federal agency that oversees and regulates workplace health and safety, created by *Occupational Safety and Health Act* of 1970.

Opticals: Light-sensitive devices.

Ordnance: Material, including explosives, ammunition, and related equipment.

Organic chemicals: Chemicals that are based on bonds with the carbon atom. Organics can have certain properties, such as volatility, that are not typically associated with inorganics.

Outgassing: Occurs when a solid material loses embedded gas. This can be accelerated by heating a material or reducing pressure.

Ozone: The triatomic form of oxygen. In the stratosphere, ozone protects the earth from the sun's ultraviolet rays; but in lower levels of the atmosphere, ozone is considered an air pollutant.

– P-Q –

Packaging: One or more receptacles and wrappers and their contents including absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The assembly of one or more containers and any other components necessary to ensure compliance.

Paleozoic era: Geologic time dating from 570 million to 245 million years ago when seed-bearing plants, amphibians, and reptiles first appeared.

Palynology: The study of spores and pollen. Such studies are useful in archaeological contexts to reconstruct past environments or to determine plant use by past cultures.

Particle beam: A beam of atoms or subatomic particles that have been accelerated by a particle accelerating device.

Particulate matter: Any finely divided solid or liquid material, other than uncombined water.

Person-rem: A unit of collective radiation dose applied to populations or groups of individuals; that is, a unit for expressing the dose when summed across all persons in a specified population or group.

Photolithography: A printing process using plates made according to a photographic image.

Photometrics: The science or study of the technology associated with the design, fabrication, theory, and application involving the measurement of the properties of light.

Photonics: The science or study of the technology associated with the design, fabrication, theory, and application of light energy generally having no mass and no electrical charge.

Plasma radiation: Emissions of electrically neutral, highly ionized gas composed of ions, electrons, and neutron particles.

Plume: Visible or measurable discharges of a contaminant from a given point or area of origin into environmental media.

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. Its most important isotope is fissile plutonium-239.

Potting compounds: Filler material.

Precambrian era: The oldest division of geologic time characterized by the appearance of primitive forms of life. This era began about 3.5 billion years ago and ended about 500 million years ago.

Prehistoric site (resources): For the Site-Wide Environmental Impact Statement (SWEIS), cultural resources produced before the arrival of the Spanish into the middle Rio Grande valley in A.D. 1540.

Primary explosive: A type of explosive that can explode or detonate when subjected to an energy-input stimulus such as heat, friction, spark, shock, or low-velocity impact. It does not burn. Primary explosives include mercury fulminate and lead oxide.

Programmatic environmental impact statement: A broad-scope environmental impact statement that identifies and assesses the environmental impacts of a U.S. Department of Energy (DOE) program.

Proliferation: The spread of nuclear weapons and the materials and technologies used to produce them.

Propellant: Fuels and oxidizers physically or chemically combined that undergo combustion to provide propulsion.

Proposed species: Any species of fish, wildlife, or plant that is proposed in the *Federal Register* to be listed under Section 4 of the *Endangered Species Act*.

Prototypical stack: A model stack (or exhaust location) used in air quality modeling.

Pulsed-power technologies: The science or study of the technology associated with the design, fabrication, theory, and application of accelerators and reactors that generate bursts of energy.

Pulsed-power accelerator: A single-shot device that accelerates large numbers of particles (energy) in a very short period.

Pulsed-power: Electrical energy that is delivered in short, high-energy bursts.

Pyrotechnics: The art of manufacturing or setting off explosives.

– R –

Radiant Heat Facility: A Sandia National Laboratories/ New Mexico (SNL/NM) facility located in Technical Area-III where items are exposed to heat typically found in fires.

Radiation absorbed dose (rad): A unit of radiation absorbed dose. One rad is equal to an absorbed dose of 0.01 joules per kilogram.

Radiation: The particles (alpha, beta, neutrons, and other subatomic particles) or photons (such as gamma rays and X-rays) emitted from the nucleus of unstable atoms as a result of radioactive decay.

Radioactive waste: In general, waste that is managed because of its radioactive content. Waste material that contains special nuclear or byproduct material is subject to regulation as radioactive waste under the *Atomic Energy Act.*

Radioactivity: The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

Radiograph: An image produced by X-rays passing through an object.

Radioisotope or Radionuclide: An unstable isotope that undergoes spontaneous transformations, emitting radiation.

Recharge: The process by which water is added to a zone of saturation, usually by percolation from the soil surface.

Record of Decision (ROD): A public document that records a Federal agency's decision on a proposed action for which the agency has prepared an environmental impact statement. A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced by the U.S. Department of Energy (DOE) in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

Region of influence: A geographic area within which project activities may affect a particular resource.

Rem: See "Roentgen equivalent, man."

Remediation: The process, or a phase in the process, of rendering areas contaminated by radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Renewable energy: Energy that does not consume a fuel. Examples include solar, geothermal, and hydroelectric.

Resource area: Analyses in the Site-Wide Environmental Impact Statement (SWEIS) are grouped into two categories: resource areas (for example, infrastructure, geology and soils, and water resources) and topic areas (for example, transportation, waste generation, and accidents).

***Resource Conservation and Recovery Act* (RCRA) hazardous waste:** A hazardous waste, as defined by RCRA, is a solid waste, or combination of solid wastes, which, because of its quantity, concentration, physical, chemical, or infectious characteristics may 1) cause or significantly contribute to an increasing mortality or increase in serious irreversible, or incapacitating irreversible, illness; or 2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Riparian: Areas adjacent to rivers and streams that have a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

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 the event. However, separate presentation of probability and consequences is often more informative.

Robotics: The science or study of the technology associated with the design, fabrication, theory, and application of robots.

Roentgen: A unit of exposure to ionizing X- or gamma radiation equal to or producing 1 electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad (a standard unit of absorbed dose of radiation).

Roentgen equivalent, man: A unit of dose equivalent. The dose equivalent in rems equals the absorbed dose in rads in tissue multiplied by the appropriate quality factor and possibly other modifying factors.

Runoff: The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

– S –

Scoping: An early and open process for determining the scope of issues to be addressed in an environmental impact statement and for identifying the significant issues related to a proposed action.

Section 106 process: A *National Historic Preservation Act* (16 U.S.C. §470 *et seq.*) review process used to identify, evaluate, and protect cultural resources eligible for nomination to the National Register of Historic Places that may be affected by Federal actions or undertakings.

Sedimentary fill: Subsurface loosely arranged rock made up of gravels, sands, silts, and clays.

Seismic: Pertaining to any earth vibration, especially related to an earthquake.

Semiconductors: Any of various solid crystalline substances having electrical conductivity greater than insulators but less than good conductors.

Sensitive species: Species within New Mexico that deserve special consideration in management and planning, but are not listed as threatened or endangered. Also, a species designated by the U.S. Forest Service whose population viability is a concern based on current or predicted numbers, density, distribution, or habitat capability.

Silica: A white or colorless crystalline compound.

Silicon chip: A nonmetallic semiconductor.

Silt: A sedimentary material consisting of fine mineral particles, intermediate in size between sand and clay.

Site-Wide Environmental Impact Statement (SWEIS): A type of programmatic environmental impact statement (EIS) that analyzes the environmental impacts of all or selected functions at a U.S. Department of Energy (DOE) site. As part of its regulations for implementation of the *National Environmental Policy Act* (NEPA), the DOE prepares site-wide EISs for certain large, multiple-program DOE sites; it may prepare EISs or environmental assessments (EAs) for the other sites to assess the impacts of all or selected functions at those sites (10 CFR §1021.330 [c]).

Socioeconomics: The science or study of social and economic effects.

Source parameters: Quantitative descriptions of properties of a substance that is entering the natural environment. An example of a source parameter is the mass of material available to enter the environment.

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 that the Nuclear Regulatory Commission determines to be special nuclear material; or 2) any material artificially enriched by any of the foregoing.

Specialty transmission line: Advanced technology electrical transmission lines.

Species of Concern: Species for which further biological research and field studies are needed to resolve their conservation status.

Spent nuclear fuel: Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

Stack monitors: Air quality monitors placed in or near a ventilation discharge system.

START I and II: Terms that refer to negotiations between the U.S. and Russia (the former Soviet Union during START I negotiations) aimed at limiting and reducing nuclear arms. START I discussions began in 1982 and eventually led to a ratified treaty in 1988. The START II protocol, which has not been fully ratified, will attempt to further reduce the acceptable levels of nuclear weapons ratified in START I.

State Historic Preservation Officer (SHPO): A position in each U.S. state that coordinates state participation in the *National Historic Preservation Act* (16 U.S.C. §470 *et seq.*). The SHPO is a key participant in the Section 106 process, assistingin identifying eligible resources, evaluating effects of undertakings, and developing mitigation measures or management plans to reduce any adverse effects to eligible cultural resources.

Steel containment box: One of several large steel cubicles that comprise the "hot cell" used to perform work involving highly radioactive material. The steel boxes are located behind thick concrete shield walls with special shielded windows to view inside. Personnel located behind the shield walls perform work inside the boxes using manipulator arm devices.

Steppe: A semi-arid, grass-covered, and generally treeless plain.

Superconductors: Materials that efficiently transmit large quantities of electricity with minimal losses.

Surface water: Water on the earth's surface, as distinguished from water in the ground (groundwater).

– T –

Target: Item to be tested or radiated.

Telemetry: The science and technology of automatic measurement and transmission of data by wire, radio, or other means from remote sources.

Thermal batteries: Devices that provide heat without mechanical means.

Threatened species: Any plants or animals that are likely to become an endangered species within the foreseeable future throughout all or a significant portion of their ranges and that have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

Threshold limit values: The recommended concentrations of contaminants workers may be exposed to according to the American Council of Governmental Industrial Hygienists.

Throughput: The number of items undergoing a process, or the amount of material consumed by a process.

Total effective dose equivalent: The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Traditional cultural property: A significant place or object that is associated with historic or cultural practices or beliefs of a living community, is rooted in that community's history, and is important in maintaining the continuing cultural identity of the community.

Transient signals: A phenomenon or property of electrical current, which decays with time.

Transport pathways: The environmental media, such as groundwater, soil, or air, by which a contaminant is moved (for example, chemicals carried in the air or dissolved in groundwater and moved along by wind or groundwater).

Transuranic (TRU): An atom with an atomic number greater than uranium (92). Examples include plutonium and californium.

Transuranic (TRU) waste: Without regard to source or form, waste contaminated with alpha-emitting TRU radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries/gram at the time of assay.

Traveling pressure waves: Moving sound waves are actually compressed and decompressed air. The movement (or wave) is similar to water waves formed by an object dropped into water.

***Toxic Substances Control Act* (TSCA) hazardous waste:** TSCA hazardous waste is waste generated from TSCA materials exceeding identified limits in the Act and supporting regulations. Sandia National Laboratories/New Mexico (SNL/NM) manages two TSCA-regulated materials: polychlorinated biphenyls (PCBs) and asbestos. The bulk of TSCA wastes generated at SNL/NM come from decontamination and decommissioning activities.

Turbidity: A cloudy condition in water due to suspended silt or organic matter.

– U –

Unmoderated cylindrical assembly: A cylinder shaped reactor that does not require water (or other material) to manage the speed of the reaction.

Unsaturated zone: A subsurface porous region of the earth in which the pore space is not filled with water.

Utility chase: A structure (may be enclosed) in which groups of utility lines make long straight horizontal or vertical runs.

– V –

Vacuum processing: Material processing under vacuum (very low-pressure) conditions.

Vapor honing: Smoothing surfaces with vapors.

Vapor phase transport: A chemical that is present as a gas and is moving (being transported) in the environment in the gaseous (or vapor) phase.

| **Volatile organic compounds (VOCs):** A broad range of organic compounds, often halogenated, that vaporize at typical background or relatively low temperatures, such as benzene, chloroform, and methyl alcohol, and other solvents.

Volumetric moisture content: The fraction of soil volume, usually in the vadose (or unsaturated) zone, that is water (or moisture). In the saturated zone, all pore spaces are filled with water so that the volumetric moisture content is equal to the fraction of soil that is pore space (that is, the porosity).

– W –

Wafer: Another word for a computer chip.

Waste characterization: The identification of waste composition and properties by reviewing process knowledge, nondestructive examination, non-destructive assay, or sampling and analysis. Characterization provides the basis for determining appropriate storage, treatment, handling, transportation, and disposal requirements.

Water makeup system: An automatic system that adds water to a process as needed to maintain the desired conditions.

Water table: The boundary between the two zones below the surface of the earth, the upper unsaturated zone and the deeper saturated zone.

Weapons component degradation: The aging, corroding, or weakening of a component or material.

Wetland: An area that is inundated by surface or groundwater with a frequency sufficient to support and, under normal circumstances, does or would support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wildlife corridor: Passageways used by animals to move between various parts of their home range or, during migration, to move from summer (breeding) to winter ranges.

Withdrawn Area: The eastern portion of Kirtland Air Force Base (KAFB), totaling 20,486 acres and consisting of land within the Cibola National Forest, which has been withdrawn from public access for use by the U.S. Air Force (15,891 acres) and the U.S. Department of Energy (DOE) (4,595 acres). |

– X-Y-Z

X-ray: A high-energy photon.

Z-pinch mode: A type of high-energy accelerator.

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that the Task Force meet as soon as possible to meet the priority objectives of the Secretary of Defense and to ensure that findings and recommendations are cognizant of and coordinated with the Quadrennial Review process and the proceedings of the National Defense Panel.

Dated: May 23, 1997.

L.M. Bynum,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 97-14114 Filed 5-29-97; 8:45 am]

BILLING CODE 5000-04-M

DEPARTMENT OF EDUCATION

Notice of Proposed Information Collection Requests

AGENCY: Department of Education.

ACTION: Proposed collection; comment request.

SUMMARY: The Director, Information Resources Management Group, invites comments on the proposed information collection requests as required by the Paperwork Reduction Act of 1995.

DATES: Interested persons are invited to submit comments on or before July 29, 1997.

ADDRESSES: Written comments and requests for copies of the proposed information collection requests should be addressed to Patrick J. Sherrill, Department of Education, 600 Independence Avenue, S.W., Room 5624, Regional Office Building 3, Washington, DC 20202-4651.

FOR FURTHER INFORMATION CONTACT: Patrick J. Sherrill (202) 708-8196. Individuals who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1-800-877-8339 between 8 a.m. and 8 p.m., Eastern time, Monday through Friday.

SUPPLEMENTARY INFORMATION: Section 3506 of the Paperwork Reduction Act of 1995 (44 U. S. C. Chapter 35) requires that the Office of Management and Budget (OMB) provide interested Federal agencies and the public an early opportunity to comment on information collection requests. OMB may amend or waive the requirement for public consultation to the extent that public participation in the approval process would defeat the purpose of the information collection, violate State or Federal law, or substantially interfere with any agency's ability to perform its statutory obligations. The Director, Information Resources Management Group publishes this notice containing proposed information collection requests prior to submission of these requests to OMB. Each proposed information collection, grouped by office, contains the following: (1) Type of review requested, e.g., new, revision, extension, existing or reinstatement; (2) Title; (3) Summary of the collection; (4) Description of the need for, and proposed use of, the information; (5) Respondents and frequency of collection; and (6) Reporting and/or Recordkeeping burden. OMB invites public comment at the address specified above. Copies of the requests are available from Patrick J. Sherrill at the address specified above.

The Department of Education is especially interested in public comment addressing the following issues: (1) Is this collection necessary to the proper functions of the Department, (2) will this information be processed and used in a timely manner, (3) is the estimate of burden accurate, (4) how might the Department enhance the quality, utility, and clarity of the information to be collected, and (5) how might the Department minimize the burden of this collection on the respondents, including through the use of information technology.

Dated: May 23, 1997.

Gloria Parker,

Director, Information Resources Management Group.

Office of Special Education and Rehabilitative Services

Type of Review: Reinstatement.

Title: U.S. Department of Education Reporting Form for Projects With Industry (PWI) Compliance Indicators and Annual Evaluation Plan.

Frequency: Annually.

Affected Public: Business or other for-profit; Non-profit institutions; State, local or Tribal Gov't, SEAs or LEAs.

Annual Reporting and Recordkeeping Hour Burden:

Responses: 105.

Burden Hours: 4,200.

Abstract: This form collects data to evaluate the performance of PWI grant recipients with respect to their compliance with evaluation standards mandated by Congress, to enable the Rehabilitation Services Administration (RSA) to meet annual statutory reporting requirements, and to enable RSA to make determinations regarding continued eligibility.

[FR Doc. 97-14138 Filed 5-29-97; 8:45 am]

BILLING CODE 4000-01-P

DEPARTMENT OF ENERGY

Site-Wide Environmental Impact Statement; Sandia National Laboratories/New Mexico

AGENCY: Department of Energy.

ACTION: Notice of intent.

SUMMARY: The Department of Energy (DOE) announces its intent to prepare a Site-Wide Environmental Impact Statement (SWEIS) for its Sandia National Laboratories/New Mexico (SNL/NM), a DOE research and development laboratory located on Kirtland Air Force Base (KAFB) in Albuquerque, New Mexico. The SWEIS will address operations and activities that DOE foresees at SNL/NM for approximately the next 10 years. The U.S. Air Force will participate as a cooperating agency. The purpose of this Notice is to invite public participation in the process and to encourage public dialogue on alternatives that should be considered.

DATES: The DOE invites other Federal agencies, Native American tribes, State and local governments, and the general public to comment on the scope of this SWEIS. The public scoping period starts with the publication of this Notice in the **Federal Register** and will continue until July 14, 1997. DOE will consider all comments received or postmarked by that date in defining the scope of this SWEIS. Comments received or postmarked after that date will be considered to the extent practicable. Public scoping meetings are scheduled to be held as follows:

June 23, 1997, 1:00 p.m.-4:00pm and 6:00 p.m.-9:00pm, UNM Continuing Education Conference Center, 1634 University Blvd. NE; Albuquerque, NM

The purpose of these meetings is to receive oral and written comments from the public. The meetings will use a format to facilitate dialogue between DOE and the public and will provide an opportunity for individuals to provide written or oral statements. The DOE will publish additional notices on the date, times, and location of the scoping meetings in local newspapers in advance of the scheduled meetings. Any necessary changes will be announced in the local media.

In addition to providing oral comments at the public scoping meetings, all interested parties are invited to record their comments, ask questions concerning the SNL/NM SWEIS, or request to be placed on the SNL/NM SWEIS mailing or document distribution list by leaving a message on the SNL/NM SWEIS Hotline at (toll free)

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1-888-635-7305. The Hotline will have instructions on how to record your comments and requests.

ADDRESSES: Written comments or suggestions concerning the scope of the SNL/NM SWEIS should be directed to: Ms. Donna A. Bergman, U.S. Department of Energy, Albuquerque Operations Office, P.O. Box 5400, Albuquerque, New Mexico, 87185-5444, or by facsimile at (505) 845-6392. For express delivery services, the appropriate address is Pennsylvania and H Streets, Kirtland Air Force Base, Albuquerque, NM 87116.

FOR FURTHER INFORMATION CONTACT: For further information on the SWEIS and the public scoping process, contact Donna Bergman at the address and facsimile number listed above.

For information on DOE's NEPA process, please contact: Carol Borgstrom, Director, Office of NEPA Policy and Assistance (EH-42), U.S. Department of Energy, 1000 Independence Avenue SW., Washington, DC 20585. Ms. Borgstrom can be reached at (202) 586-4600, by facsimile at (202) 586-7031, or by leaving a message at 1-800-472-2756.

SUPPLEMENTARY INFORMATION:

Invitation to Comment

The public is invited to participate in the scoping process and is encouraged to comment on the preliminary alternatives and issues identified for the SNL/NM SWEIS.

Availability of Scoping Documents

Copies of all written comments and transcripts of all oral comments will be available at the following location: Albuquerque Technical-Vocational Institute (TVI), Montoya Campus Library, 4700 Morris NE, Albuquerque, New Mexico 87111.

SNL/NM's Mission

DOE is responsible for the Federal Government's nuclear weapons program, research and development of energy technologies, and basic science research. SNL/NM is one of DOE's primary research, development, and test laboratories. It was established in 1947 to support the U.S. weapons development program. Its purpose was to organize and perform engineering activities for development of nuclear and nonnuclear weapons; testing of new designs; and surveillance tests. Today, it remains one of the three national laboratories in DOE's nuclear weapons complex. Responsibilities in support of nuclear weapons activities include design, certification, and assessment of non-nuclear subsystems of nuclear weapons; systems integration; safety, security, reliability, and use control; direction and support to production plants regarding issues associated with production and dismantlement of nuclear weapons; production and/or acquisition of weapons components; surveillance and support of weapons in the stockpile; and work in nuclear intelligence, nonproliferation, and treaty verification technologies. Nonweapons research and science services are provided in areas including waste management, environmental restoration, hazardous and radioactive material transportation, energy efficiency and renewable energy, nuclear energy, fossil energy, magnetic fusion, basic energy sciences, and biological and environmental research. Additional activities include energy and environment technologies; other engineering research; and work-for-others.

SNL/NM operations are located primarily in five technical areas (TA) and the Coyote Test Facility, all of which are surrounded by KAFB. Activities/operations in specific areas are as follows:

TA I—Manufacturing/production activities, such as the microelectronics development laboratory and the neutron generator facility; environmental testing; facilities engineering; laboratory space; office space.

TA II—Light laboratory activities; environmental restoration.

TA III—Field test facilities; explosives testing operations; destructive testing operations; high energy testing operations.

TA IV—Radiation effects experimentation; accelerator operations [high-energy radiation megavolt electron source (HERMES), x-ray source (Saturn)]; electromagnetic analysis.

TA V—Nuclear safety and system analysis; Annular Core Research Reactor; Gamma Irradiation Facility; radioisotope production (molybdenum-99).

Coyote Test Facility—Explosives testing; thermal testing; shock/blast testing; and large scale impact testing.

SNL/NM has an annual budget of approximately $1 billion and employs approximately 8,700 people. SNL/NM is surrounded by KAFB, and occupies 2,842 acres owned by the DOE and an additional 15,003 acres that have been made available through a series of land use agreements or permits.

Missions of Other DOE-funded Operations on KAFB

In addition to SNL/NM, there are several other DOE-funded facilities located on KAFB. There are no planned changes in the level or type of activities at these facilities. The environmental impacts of these operations will be included in the discussion of cumulative impacts in the EIS. DOE welcomes comments on this approach. A summary of each facility follows.

Lovelace Respiratory Research Institute, formerly the Inhalation Toxicology Research Institute, began in the 1960s as a research team for determining the long-term health impacts of inhaling radioactive particles, and has since become a recognized center for inhalation toxicology and related fields.

Central Training Academy ensures the efficient and effective training of safeguards and security personnel from throughout the DOE who are, or may become, involved in the protection of materials and facilities vital to the nation's defense.

Transportation Safeguards Division (TSD) coordinates, implements, and operates the DOE Safeguards Program for strategic quantities of government-owned special nuclear material. TSD coordinates and plans weapons distribution with the Department of Defense and coordinates special nuclear material shipments for all DOE field offices.

Allied-Signal Kirtland Operations is an applied science and engineering organization engaged in research, analysis, testing, and field operations. A major portion of this work is in the design, fabrication, and testing of electro-optic and recording systems for capturing fast transient signals.

Ross Aviation is the DOE's support contractor providing air cargo and passenger service. Ross transports cargo between production plants, national laboratories, test sites, and military facilities and provides special passenger and cargo flights on request.

The DOE/Albuquerque complex is a series of office buildings with approximately 1,200 Federal and contractor employees.

The Energy Training Center is a small office complex that includes classrooms for DOE training.

The Role of the SWEIS in the DOE NEPA Compliance Strategy

The SWEIS will be prepared pursuant to the National Environmental Policy Act (NEPA) of 1969, (42 U.S.C. 4321 *et seq.*), the Council on Environmental Quality's NEPA regulations (40 CFR Parts 1500-1508) and the DOE NEPA regulations (10 CFR Part 1021). The DOE has a policy (10 CFR 1021.330) to prepare SWEISs for certain large, multiple-facility sites, such as SNL/NM. The purpose of a SWEIS is to provide

DOE and its stakeholders with an analysis of the environmental impacts caused by ongoing and reasonably foreseeable new operations and facilities and reasonable alternatives at a DOE site, to provide a basis for site-wide decision making, and to improve and coordinate agency plans, functions, programs, and resource utilization. The SWEIS provides an overall NEPA baseline so that the environmental effects of proposed future changes in programs and activities can be compared with the baseline. A SWEIS also enables DOE to "tier" its NEPA documents at a site so as to eliminate repetitive discussion of the same issues in future project-specific NEPA studies, and to focus on the actual issues ready for decisions at each level of environmental review. The NEPA process allows for Federal, Native American, state and local government, and public participation in the environmental review process. The Environmental Impact Assessment, Sandia Laboratories, Albuquerque, New Mexico [EIA/MA 77-1], May 1977, is the existing site-wide environmental document for SNL/NM. Since that time, several additional NEPA documents have been prepared for specific projects, including one EIS, and various environment assessments.

Related NEPA Reviews

The following is a list of recent NEPA documentation that affects the scope of this SWEIS. The summaries below are intended to familiarize the reader with the purpose of these other NEPA reviews and how SNL/NM is considered in them.

Programmatic NEPA Reviews

The Draft Waste Management Programmatic Environmental Impact Statement (PEIS) (DOE/EIS-0200) analyzes the DOE plan to formulate and implement a national integrated waste management program. SNL/NM is being considered as a possible regional site for the disposal of low-level waste and low-level mixed waste. The Final PEIS is expected to be available to the public in June.

Nonnuclear Consolidation Environmental Assessment [DOE/EA-0792]. A Finding of No Significant Impact on the Consolidation of the Nonnuclear Component within the Nuclear Weapons Complex was signed on September 8, 1993. The following decisions regarding SNL/NM were made at that time and have since been implemented:

—Neutron Generators and Thermal Batteries: The existing technology base for neutron generators will be maintained at SNL/NM. Existing research, development and technology and prototyping capability at SNL/NM will be augmented to provide a limited manufacturing capability for future advanced design neutron generators. The technology base for the manufacture of thermal batteries will be transferred to existing facilities at SNL/NM.

—Detonators: The existing research, development, and technology base for low-power explosives components will be maintained at SNL/NM.

Stockpile Stewardship and Management PEIS [DOE/EIS-0236]. A Record of Decision was signed by the Secretary of Energy on December 19, 1996. Inherent in the many decisions made in the ROD was to continue the operations of the three national weapons laboratories, SNL/NM being one of the three. The Record of Decision emphasized that stockpile stewardship is an essential program to maintain the safety and reliability of the stockpile in the absence of underground nuclear testing, therefore requiring enhanced experimental capabilities in the future.

Project NEPA Reviews

Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement [DOE/EIS-0249F]. The Record of Decision for this EIS was signed on September 11, 1996. The decision made was to produce Mo-99 and related isotopes at the Annular Core Research Reactor and Hot Cell Facility at SNL/NM.

Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico [DOE/EA-1140]. A Finding of No Significant Impact was signed on March 25, 1996. This EA analyzed the environmental restoration site characterization and waste cleanup activities for an estimated 157 solid waste management units or SWMUs at SNL/NM.

Preliminary Alternatives

The scoping process is an opportunity for the public to assist the DOE in determining the alternatives and issues for analysis. DOE welcomes specific comments or suggestions on the content of these alternatives, or on other alternatives that could be considered.

DOE is proposing to continue current operations at SNL/NM. Two preliminary alternatives were identified during internal scoping: the No Action alternative and the Expanded Operations alternative. DOE also considered a Reduced Operations alternative. However, current activities at SNL/NM are at the minimum level of operations needed to protect the technical capability and competency to support the site's assigned missions. Therefore, the Department plans to include the Reduced Operations alternative in the EIS as an alternative considered but eliminated from further analysis.

No Action. NEPA regulations require analysis of the *No Action* alternative to provide a benchmark for comparison with environmental effects of the other alternatives. The *No Action* alternative would continue current facility operations throughout SNL/NM in support of assigned missions, and for this SWEIS, it is also the proposed action. With respect to the Defense Programs mission, the future role of SNL/NM was defined at the programmatic level by the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS) Record of Decision (ROD) (61 FR 68014) (December 26, 1996). In the SSM PEIS, SNL/NM had been considered as an alternative location for the National Ignition Facility (NIF) and for relocation of non-nuclear fabrication functions from the Department's Kansas City Plant. Additionally, the SSM PEIS noted that a pre-decisional facility, the Advanced Radiation Source (X-1), might, at some time in the future, be considered for location at SNL/NM or other sites. The ROD located neither the NIF nor the Kansas City Plant functions at SNL/NM, and stated that if DOE were to propose to construct and operate such next-generation facilities as the X-1 in the future, appropriate NEPA review would be performed. Therefore, the programmatic mission defined by the SSM ROD for SNL/NM is continued operation with the current mission and functions. There are no planned programmatic mission changes in the non-Defense Programs mission areas.

Expanded Operations. This alternative would reflect an increase in facility operations to the highest levels that can be supported by current facilities. This could require construction projects to address safety, security and environmental compliance as well as to support reconfiguration of facility equipment and operations to optimize use of current facilities' capabilities. This alternative will set the bounding conditions for assessing the environmental impacts.

Preliminary Issues Identified by Internal Scoping

The issues listed below have been identified for analysis in this SWEIS as being applicable to the operation of SNL/NM. The list is tentative and is

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intended to facilitate public comment on the scope of this SWEIS. It is not intended to be all-inclusive, nor does it imply any predetermination of potential impacts. The SWEIS will describe the potential environmental impacts of the alternatives, using available data where possible and obtaining additional data where necessary. In accordance with the Council on Environmental Quality Regulations (40 CFR 1500.4 and 1502.21), other documents, as appropriate, may be incorporated into the impacts analyses by reference, in whole or in part. DOE specifically welcomes suggestions and comments for the addition or deletion of items on this list.

—Potential effects on the public and workers from exposures to radiological and hazardous materials during normal operations and from reasonably postulated accidents, including aircraft crashes;
—Potential effect on air and groundwater quality from normal operations and potential accidents;
—Potential cumulative effects of past, present, and future operations at SNL/NM (this SWEIS will include effects of current and reasonably foreseeable federal actions on KAFB).
—Effects on waste management practices and activities, including pollution prevention, waste minimization, and waste stream characterization
—Potential impacts of noise levels to the ambient environment and sensitive receptors; and
—Potential impacts on land use plans, policies, and controls.

Classified Material

DOE will review classified material while preparing this SWEIS. Within the limits of classification, DOE will provide to the public as much information as possible. Any classified material DOE needs to use to explain the purpose and need for action, or the uses, materials, or impacts analyzed in this SWEIS, will be segregated into a classified appendix or supplement.

Issued in Washington, D.C., this 23 day of May 1997, for the United States Department of Energy.

Peter N. Brush,

Principal Deputy Assistant Secretary, Environment, Safety and Health.

[FR Doc. 97-14168 Filed 5-29-97; 8:45 am]

BILLING CODE 6450-01-P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. RP97-187-005]

Arkansas Western Pipeline Company; Notice of Proposed Changes in FERC Gas Tariff

May 23, 1997.

Take notice that on May 20, 1997, Arkansas Western Pipeline Company (AWP) tendered for filing as part of its FERC Gas Tariff, tariff sheets to become effective June 1, 1997.

AWP states that the filing sets forth the revisions to AWP's tariff sheets that are necessary to comply with FERC's May 5, 1997 Letter Order in Docket No. RP97-187-003.

Any person desiring to protest this filing should file a protest with the Federal Energy Regulatory Commission, 888 First Street, N.E., Washington, DC 20426, in accordance with Section 385.211 of the Commission's Rules and Regulations. All such protests must be filed in accordance with Section 154.210 of the Commission's Regulations. Protests will be considered by the Commission in determining the appropriate action to be taken, but will not serve to make protestants parties to the proceeding. Copies of this filing are on file with the Commission and available for public inspection.

Linwood A. Watson, Jr.,

Acting Secretary.

[FR Doc. 97-14133 Filed 5-29-97; 8:45 am]

BILLING CODE 6717-01-M

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. CP97-533-000, CP97-534-000, CP97-535-000]

Chevron U.S.A. Inc., Venice Gathering Company, Venice Gathering System, L.L.C., Venice Energy Services Company; Notice of Application

May 23, 1997.

Take notice that on May 20, 1997, Chevron U.S.A. Inc. (Chevron), 1301 McKinney, Houston, Texas 77010; Venice Gathering Company (VGC), 1301 McKinney, Houston, Texas 77010; Venice Gathering System, L.L.C. (VGS), 1000 Louisiana, Houston, Texas 77002-5050, and Venice Energy Services Company (VESCO), 1000 Louisiana, Houston, Texas 77002-5050, jointly filed an application with the Commission in Docket Nos. CP97-533-000, CP97-534-000, and CP97-535-000 pursuant to Sections 7(b) and 7(c) of the Natural Gas Act (NGA) for permission and approval for Chevron, VGC, and VESCO to abandon by transfer certain offshore Louisiana pipeline facilities to VGS; authority for VGS to construct and operate certain new offshore Louisiana pipeline facilities; and authority for VGS to operate and provide service on both the transferred and proposed facilities under open-access rates, terms, and conditions, all as more fully set forth in the application which is open to the public for inspection.

Chevron, VGC, VGS, and VESCO state that the purpose of their joint application is, in part, to comply with the Commission's April 17, 1997, order in Docket No. CP95-202-000 where the Commission denied a petition for a declaratory order for a determination that certain offshore pipeline facilities owned and/or operated by the applicants were not subject to the Commission's jurisdiction under the NGA. Chevron, VGC, VGS, and VESCO request, therefore appropriate certificate, rate, and tariff approvals to conform the subject facilities and services to the requirements applicable under the NGA.

VGS proposes in Docket No. CP97-533-000 to construct and operate 52.4 miles of 24-inch diameter pipe (Timbalier Expansion) from Chevron's South Timbalier Block 151 platform to an existing West Delta Block 79 platform. The proposed Timbalier Expansion would increase the delivery capacity of the Venice System from the current 482,000 Mcf per day of natural gas to approximately 810,000 Mcf per day. VGS states that one or more of its parent corporate affiliates would use internally generated funds to pay the estimated $39.1 million construction cost for the proposed Timbalier Expansion.

VGS requests in Docket No. CP97-534-000 that the Commission grant VGS Part 284, Subpart G blanket transportation authority to perform open-access, self-implementing, non-discriminatory transportation service in interstate commerce with pregranted abandonment and subject to the applicable provisions of Part 284 of the Commission's Regulations. VGS states that it would comply with the applicable conditions set forth in Part 284, Subpart A of the Regulations.

VGS also requests in Docket No. CP97-535-000 that the Commission grant VGS Part 157, Subpart F blanket authority to engage in certain construction and operational activities from time to time as may be required on a self-implementing basis. VGS states that when constructing "eligible

CHAPTER 15

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DOE/EIS-0281

MOL.20020222.0028

SANDIA NATIONAL LABORATORIES/ NEW MEXICO

VOLUME II

APPENDIXES

SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT

OCTOBER 1999

Organization of the Site-Wide Environmental Impact Statement

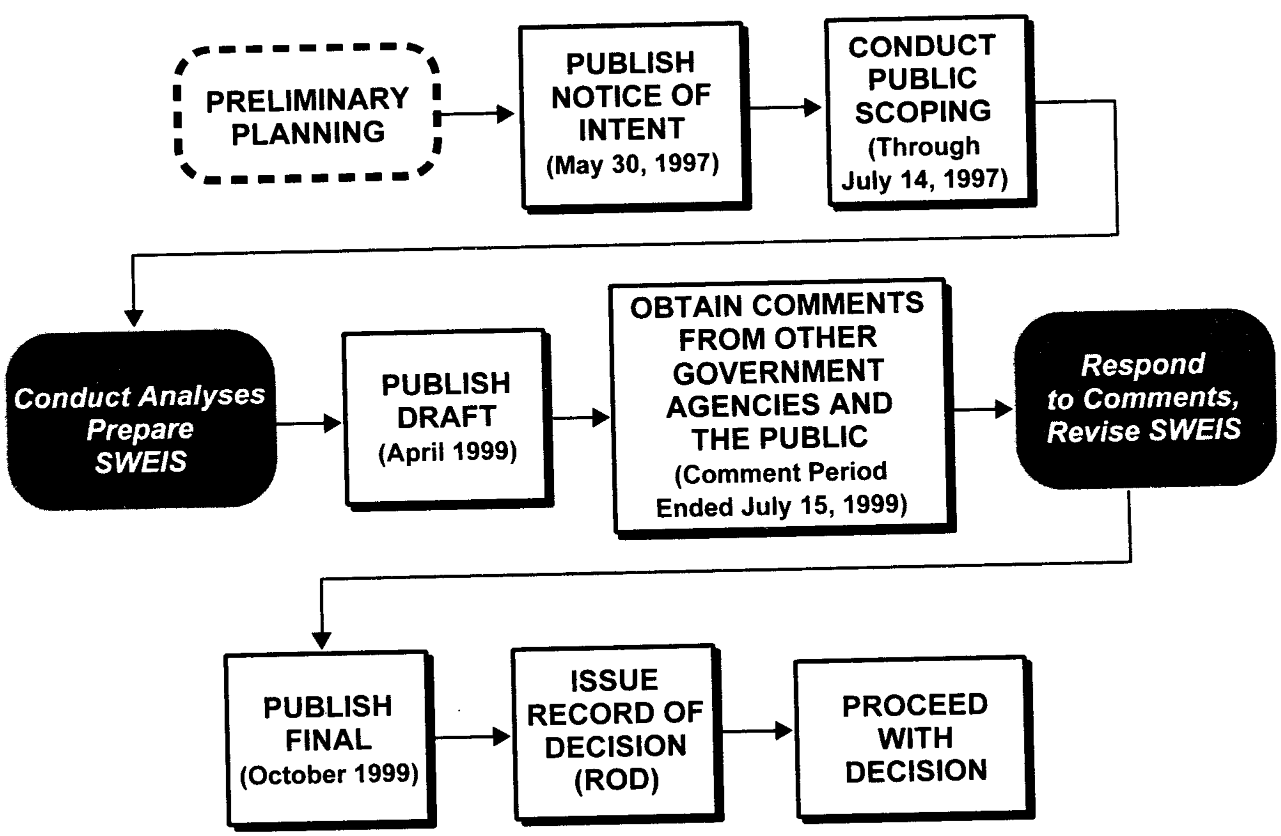
The Site-Wide Environmental Impact Statement (SWEIS) is divided into a Summary and three volumes.

The Summary provides an overview of material presented in the SWEIS, including background, purpose and need, alternatives, existing environment, and environmental impacts.

Volume I analyzes the three alternatives (including the U.S. Department of Energy's [DOE's] preferred alternative, the Expanded Operations Alternative) as they relate to the DOE missions assigned to Sandia National Laboratories/New Mexico (SNL/NM): national security, energy resources, environmental quality, science and technology. Volume I contains 15 chapters. Chapter 1 provides introductory information on background, site missions, purpose and need, decisions to be made, related *National Environmental Policy Act* analyses, and public participation. Chapter 2 describes programs and facility operations at SNL/NM (including selected facilities). Chapter 3 describes the alternatives. Chapter 4 provides a discussion of the affected environment, and Chapter 5 presents an analysis of environmental consequences of each of the proposed alternatives. Chapter 6 describes potential cumulative effects (including effects from other DOE-funded operations and other activities on Kirtland Air Force Base). Chapter 7 contains applicable laws, regulations, and other requirements. Chapters 8 through 15 include references; a list of preparers; conflict of interest statements; list of agencies, organizations, and individuals who received copies of the Final SWEIS; list of agencies and people contacted; glossary; notice of intent; and index.

Volume II contains appendixes of technical details in support of the environmental analyses presented in Volume I. These appendixes contain information on the following issues: material inventory, water quality analysis, cultural resources, air quality analysis, human health analysis, accidents analysis, transportation analysis, and waste generation.

Volume III contains a description of the public comment process, comments and responses, and a description of changes made to the Draft SWEIS. All comments received on the Draft SWEIS were identified and categorized by issue (for example, Socioeconomics) and assigned unique identifiers.



COVER SHEET

RESPONSIBLE AGENCY: U.S. DEPARTMENT OF ENERGY (DOE)

COOPERATING AGENCY: U.S. AIR FORCE

TITLE: Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281)

CONTACT: For further information concerning the Final Site-Wide Environmental Impact Statement (SWEIS), contact

Julianne Levings, NEPA Document Manager
U.S. DOE, Albuquerque Operations Office
P.O. Box 5400, Albuquerque, NM 87185
Telephone: 1-888-635-7305, Fax: 505-845-6392

For further information by way of electronic mail, contact

www.nepanet.com

For general information on the DOE's *National Environmental Policy Act* (NEPA) process, contact

Carol Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
U.S. DOE, 1000 Independence Avenue SW, Washington, DC 20585
Telephone: 202-586-4600 or leave a message at 1-800-472-2756

Abstract: The DOE proposes to continue operating the Sandia National Laboratories/New Mexico (SNL/NM) located in central New Mexico. The DOE has identified and assessed three alternatives for the operation of SNL/NM: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. The Expanded Operations Alternative is the DOE's preferred alternative (exclusive of the Microsystems and Engineering Sciences Applications Complex configuration). Under the No Action Alternative, the DOE would continue the historical mission support activities SNL/NM has conducted at planned operational levels. Under the Expanded Operations Alternative, the DOE would operate SNL/NM at the highest reasonable levels of activity currently foreseeable. Under the Reduced Operations Alternative, the DOE would operate SNL/NM at the minimum levels of activity necessary to maintain the capabilities to support the DOE mission in the near term. Under all of the alternatives, the affected environment is primarily within 50 miles (80 kilometers) of SNL/NM. Analyses indicate little difference in the environmental impacts among alternatives.

Public Comments: The Draft SWEIS was released to the public for review and comment on April 16, 1999. The comment period ended on June 15, 1999, although late comments were accepted to the extent practicable. All comments were considered in preparation of the Final SWEIS[1]. The DOE will use the analysis in this Final SWEIS and prepare a Record of Decision on the level of continued operation of SNL/NM. This decision will be made no sooner than 30 days after the Notice of Availability of the Final SWEIS appears in the *Federal Register*.

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[1] Changes made to this SWEIS since publication of the Draft SWEIS are marked with a vertical bar to the right or left of the text.

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Appendixes
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Appendix A - Material Inventory

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Acronyms

58th SOW	58th Special Operations Wing
A/BC AQCB	Albuquerque/Bernalillo County Air Quality Control Board
ACGIH	American Conference of Governmental Industrial Hygienists
ACPR II	Annular Core Pulsed Reactor II
ACRR	Annular Core Research Reactor
ACS	American Cancer Society
AEA	*Atomic Energy Act*
AEHD	Albuquerque Environmental Health Department
AEI	average exposed individual
AFRL	Air Force Research Laboratory
AFSC	Air Force Safety Center
AL	Albuquerque Operations Office
ALARA	as low as reasonably achievable
ALOHA	*Areal Locations of Hazardous Atmospheres*
AMPL	Advanced Manufacturing Processes Laboratory
ANSI	American National Standards Institute
APCD	Air Pollution Control Division
APPRM	Advanced Pulsed Power Research Module
AQCR	Air Quality Control Region
ARF	airborne release fraction
AT	averaging time
AT&T	American Telephone and Telegraph
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
C&D	construction and demolition
CAA	*Clean Air Act*
CAB	Citizens Advisory Board
CAMP	Capital Assets Management Process
CAMU	Corrective Action Management Unit

Note: Italics are used to denote formal names or titles of acts, published documents, or computer models.

CAP88-PC	*Clean Air Assessment Package*
CAS	Chemical Abstract Service
CDG	Campus Design Guideline
CDI	chronic daily intake
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CHEST	Conventional High Explosives and Simulation Test
CIS	Chemical Information System
COC	chemicals of concern
CPMS	Criteria Pollutant Monitoring Station
CRMP	Cultural Resource Management Plan
CSF	cancer slope factor
CSRL	Compound Semiconductor Research Laboratory
CTA	Central Training Academy
CTTF	Containment Technology Test Facility
CWA	*Clean Water Act*
CWL	Chemical Waste Landfil
CY	calendar year
D&D	decontamination and decommissioning
DARHT	dual-axis radiographic hydrotest
DEAR	Department of Energy Acquisitions Regulations
DF	decontamination factor, dispersion factor
DFG	Deutsche Forschungemeinschaft
DNL	day-night average noise level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DP	Defense Programs
DR	damage ratio
DU	depleted uranium

EA	environmental assessment
EAL	Explosives Applications Laboratory
ECF	Explosive Components Facility
EDE	effective dose equivalent
EF	emission factor
EID	environmental information document
EIS	environmental impact statement
ELCR	excess lifetime cancer risk
EM	Office of Environmental Management
EMP	electromagnetic pulse
EO	*Executive Order*
EOD	explosive ordinance disposal
EPA	U.S. Environmental Protection Agency
EPCRA	*Emergency Planning and Community Right-to-Know Act*
ER	emission rate
ER	Environmental Restoration (Project)
ERPG	emergency response planning guideline
ES&H	Environment, Safety, and Health
ET	exposure time
ETC	Energy Training Center
FAA	Federal Aviation Administration
FCDSWA	Field Command, Defense Special Weapons Agency
FFCA	*Federal Facilities Compliance Act*
FM&T/NM	Federal Manufacturing & Technology/New Mexico
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FSID	*Facilities and Safety Information Document*
FTE	full-time equivalent
FY	fiscal year
GHA	ground hazard area
GIF	Gamma Irradiation Facility
GIS	geographic information system
GRABS	Giant Reusable Air Blast Simulator
GWPMPP	*Groundwater Protection Management Program Plan*

HA	hazards assessment
HAP	hazardous air pollutants
HBWSF	High Bay Waste Storage Facility
HCF	Hot Cell Facility
HCPI	Hazardous Chemical Purchases Inventory
HEAST	Health Effects Assessment Summary Tables
HEPA	high efficiency particulate arrestance
HERMES	High-Energy Radiation Megavolt Electron Source
HERTF	High-Energy Research Test Facility
HI	hazard index
HLW	high-level radioactive waste
HPML	High Power Microwave Laboratory
HQ	hazard quotient
HQ	headquarters
HR	hydrogeologic region
HSWA	*Hazardous and Solid Waste Amendments*
HVAR	high velocity aircraft rocket
HWMF	Hazardous Waste Management Facility
IBMRL	Ion Beam Materials Research Laboratories
ICF	inertial confinement fusion
ICRP	International Commission on Radiological Protection
IDLH	immediately dangerous to life and health
IH	industrial hygiene
IHE	insensitive high explosives
IHIL	Industrial Hygiene Instrumentation Laboratory
IHIR	Industrial Hygiene Investigation Report
IMRL	Integrated Materials Research Laboratory
IPS	Integrated Procurement System
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
ISC	industrial source complex
ISCST3	*Industrial Source Complex Short-Term Model, Version 3*
ISS	interim storage site
JIT	just-in-time

JP	jet propulsion
KAFB	Kirtland Air Force Base
KAO	Kirtland Area Office
KUMMSC	Kirtland Underground Munitions and Maintenance Storage Complex
L90	the A-weighted background sound pressure level that is exceeded 90 percent of the time, based on a maximum of a 1-hour period
LADD	lifetime average daily dose
LANL	Los Alamos National Laboratory
LANMAS	Local Area Network Nuclear Material Accountability System
LBERI	Lovelace Biomedical and Environmental Research Institute, Inc.
LCF	latent cancer fatality
LLMW	low-level mixed waste
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOAEL	lowest observed adverse effect level
LPF	leak path factor
LSA	low specific activity
LSF	Lightning Simulation Facility
LWDS	Liquid Waste Disposal System
M&O	management and operations
M.W.	molecular weight (in grams)
MAC	maximum allowable concentration
MACCS2	*MELCOR Accident Consequence Code System, Version 2*
MAR	material-at-risk
MBTA	*Migratory Bird Treaty Act*
MCL	maximum contaminant level
MDL	Microelectronics Development Laboratory
MEI	maximally exposed individual
MEMF	Mobile Electronic Maintenance Facility
MEPAS	Multimedia Environmental Pollutant Assessment System
MESA	Microsystems and Engineering Sciences Applications
MIPP	Medical Isotopes Production Project
MOBILE 5a	*Mobile Source Emission Factor (model)*
MOU	Memorandum of Understanding

Mo-99	molybdenum-99
MSDS	material safety data sheet
MTRU	mixed transuranic waste
MWL	Mixed Waste Landfill
NA	not applicable
NA	not available
NAAQS	*National Ambient Air Quality Standards*
NAGPRA	*Native American Graves Protection and Repatriation Act*
NASA	National Aeronautics and Space Administration
NCA	*Noise Control Act*
NCEA	National Center for Environment Assessment
NRC	Nuclear Regulatory Commission
NCRP	National Council on Radiation Protection and Measurements
ND	not detected
NEPA	*National Environmental Policy Act*
NESHAP	*National Emissions Standards for Hazardous Air Pollutants*
NEW	net explosive weight
NF	not found
NGF	Neutron Generator Facility
NGIF	New Gamma Irradiation Facility
NHPA	*National Historic Preservation Act*
NRHP	National Register of Historic Places
NIOSH	National Institute of Occupational Safety and Health
NMAAQS	*New Mexico Ambient Air Quality Standards*
NMAC	*New Mexico Administrative Code*
NMED	New Mexico Environment Department
NMEIB	New Mexico Environmental Improvement Board
NMFRCD	New Mexico Forestry and Resource Conservation Division
NMDGF	New Mexico Department of Game and Fish
NMSA	*New Mexico Statutes Annotated*
NMSU	New Mexico State University
NMWQCC	New Mexico Water Quality Control Commission
NNSI	Nonproliferation and National Security Institute
NOAEL	no observed adverse effect level

NOI	Notice of Intent
NOVA	North Vault
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NR	not reported
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTS	Nevada Test Site
OBODM	*Open Burn/Open Detonation Model*
OBS	observations
OEL	occupational exposure limits
OLM	ozone limiting method
ORPD	Occupational Radiation Protection Division
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
PBCA	Particle Bed Critical Assembly
PBFA	Particle Beam Fusion Accelerator
PCB	polychlorinated biphenyl
PDFL	Photovoltiac Device Fabrication Laboratory
PDL	Power Development Laboratory
PEIS	Programmatic Environmental Impact Statement
PEL	permissible exposure limit
PHS	Process Hazard Survey
PL	*Public Law*
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
PM_{10}	particulate matter smaller than 10 microns in diameter
PNM	Public Service Company of New Mexico
PPE	personal protective equipment
PSD	prevention of significant deterioration
PSL	Production Primary Standards Laboratory
PT	product tester
PVC	polyvinyl chloride
R&D	research & development
RCRA	*Resource Conservation and Recovery Act*

REL	recommended exposure limit
REMS	Radiation Exposure Monitoring System
RF	respirable fraction
RfD	reference dose
RHEPP	Repetitive High Energy Pulsed Power
RHI	risk hazard index
RITS	Radiographic Integrated Test Stand
RME	reasonable maximum exposure
RMMA	Radioactive Materials Management Area
RMP	Risk Management Plan
RMSEL	Robotic Manufacturing Science Engineering Laboratory
RMWMF	Radioactive and Mixed Waste Management Facility
ROD	Record of Decision
ROI	region of influence
RV	reentry vehicle
SA	safety assessment
SABRE	Sandia Accelerator & Beam Research Experiment
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
SCAPA	Subcommittee on Consequence Assessment and Protective Actions
SDWA	*Safe Drinking Water Act*
SECOM	Secure Communication Center
SHPO	State Historic Preservation Officer (NM)
SIP	State Implementation Plan
SMERF	Smoke Emission Reduction Facility
SMS	Scenery Management System
SNAP	Systems for Nuclear Auxiliary Power
SNL/CA	Sandia National Laboratories/California
SNL/HI	Sandia National Laboratories/Hawaii
SNL/NM	Sandia National Laboratories/New Mexico
SNL/NV	Sandia National Laboratories/Nevada
SNM	special nuclear material
SPA	sawdust-propellant-acetone
SPHINX	Short-Pulse High Intensity Nanosecond X-Radiator

SPR	Sandia Pulsed Reactor
SRS	Savannah River Site
SSM	stockpile stewardship and management
SST	safe, secure transport
STAR	stability array
START	Strategic Arms Reduction Treaty
STEL	short-term exposure limit
STL	Simulation Technology Laboratory
STP	standard temperature and pressure
SVOC	semivolatile organic compound
SWEIS	Site-Wide Environmental Impact Statement
SWISH	Small Wind Shielded Facility
SWMU	solid waste management unit
SWTF	Solid Waste Transfer Facility
TA	technical area
TAP	toxic air pollutants
TBF	Terminal Ballistics Facility
TCE	trichloroethylene
TCP	traditional cultural property
TEDE	total effective dose equivalent
TEEL	temporary emergency exposure limits
TESLA	Tera-Electron Volt Semiconducting Linear Accelerator
TEV	threshold emission value
TI	transport index
TLV	threshold limit value
TNT	trinitrotoluene
TRU	transuranic
TSCA	*Toxic Substances Control Act*
TSD	Transportation Safety Division
TSP	total suspended particulates
TTF	Thermal Treatment Facility
TtNUS	Tetra Tech NUS, Inc.
TWA	time weighted average
U.S.	United States

U.S.C.	*United States Code*
UBC	Uniform Building Code
UNM	University of New Mexico
UNO	United Nations Organization
UPS	United Parcel Service
USAF	U.S. Air Force
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTM	Universal Transverse Mercator
VDL	vacuum diode load
VHI	vapor hazard index
VHR	vapor hazard ratio
VMF	vehicle maintenance facility
VOC	volatile organic compound
WARE	Worksite Accident Reduction Expert
WFO	work for others
WIPP	Waste Isolation Pilot Plant
WM	Waste Management

UNIT OF MEASURE	ABBREVIATION
acre	ac
billion gallons per year	BGY
centimeters	cm
cubic feet	ft^3
cubic feet per second	ft^3/s
cubic meters	m^3
cubic yards	yd^3
Curie	Ci
decibel	dB
degrees Celsius	°C
degrees Fahrenheit	°F
feet	ft
gallon	gal
gallons per day	gpd
gram	g
grams per second	g/sec
gravity	*g*
hectare	ha
Hertz	Hz
hour	hr
kelvin	K
kilogram	kg
kilojoule	kJ
kilometer	km
kilometer per hour	km/hr
kilovolt	kV
kilovoltampere	kVA
kilowatt	kW
kilowatt hour	kWh
liter	L
megajoule	MJ
megavolt-ampere	MVA

UNIT OF MEASURE	ABBREVIATION
megawatt	MW
megawatt hour	MWh
megawatt-electric	MWe
megawatt-thermal	MWt
meter	m
meters per second	m/sec
microcurie	μCi
microcuries per gram	μCi/g
microgram	μg
micrograms per cubic meter	μg/m^3
micrograms per kilogram	μg/kg
micrograms per liter	μg/L
micron or micrometer	μm
microohms per centimeter	μohms/cm
micropascal	mPa
mile	mi
miles per hour	mph
millicurie	mCi
millicurie per gram	mCi/g
millicurie per millimeter	mCi/ml
milligram	mg
milligram per liter	mg/L
milliliter	ml
millimeters of mercury	mmHg
million	M
million electron volts	MeV
million gallons per day	MGD
million gallons per year	MGY
millirem	mrem
millirem per year	mrem/yr
nanocurie	nCi
nanocuries per gram	nCi/g

[a] Although not used in the SWEIS, the sievert is a ommon unit of measure for dose and equivalent to 100cm.

Metric Conversion Chart

TO CONVERT FROM U.S. CUSTOMARY INTO METRIC			TO CONVERT FROM METRIC INTO U.S. CUSTOMARY		
If you know	**Multiply by**	**To get**	**If you know**	**Multiply by**	**To get**
Length					
inches	2.540	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.03281	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.6214	miles
Area					
square inches	6.452	square centimeters	square centimeters	0.1550	square inches
square feet	0.09290	square meters	square meters	10.76	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.4047	hectares	hectares	2.471	acres
square miles	2.590	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.57	milliliters	milliliters	0.03381	fluid ounces
gallons	3.785	liters	liters	0.2642	gallons
cubic feet	0.02832	cubic meters	cubic meters	35.31	cubic feet
cubic yards	0.7646	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.35	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.205	pounds
short tons	0.9072	metric tons	metric tons	1.102	short tons
Temperature					
Fahrenheit (°F)	subtract 32, then multiply by 5/9	Celsius (°C)	Celsius (°C)	multiply by 9/5, then add 32	Fahrenheit (°F)
kelvin (°k)	subtract 273.15	Celsius (°C)	kelvin (°k)	Multiply by 9/5, then add 306.15	Fahrenheit (°F)
Note: 1 sievert = 100 rems					

Metric Prefixes

PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS	PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS
atto-	10^{-18} = 0. 000,000,000,000,000,001	**dekta-**	10^{1} = 10
femto-	10^{-15} = 0. 000,000,000,000,001	**hecto-**	10^{2} = 100
pico	10^{-12} = 0. 000,000,000,001	**kilo-**	10^{3} = 1,000
nano-	10^{-9} = 0. 000,000,001	**mega-**	10^{6} = 1,000,000
micro-	10^{-6} = 0.000,001	**giga-**	10^{9} = 1,000,000,000
milli	10^{-3} = 0.001	**tetra-**	10^{12} = 1,000,000,000,000
centi	10^{-2} = 0.01	**peta-**	10^{15} = 1,000,000,000,000,000
deci-	10^{-1} = 0.1	**exa-**	10^{18} = 1,000,000,000,000,000,000

Note: 10^{0} = 1

APPENDIX A – MATERIAL INVENTORY

A.1 COLLECTION OF DATA

Data collection consisted of a review of Sandia National Laboratories/New Mexico (SNL/NM) material databases in conjunction with facility projections from selected facilities. The facility projections were aggregated using the SNL/NM Facility Information Manager Database to query each facility by material type. These projections are shown in the tables throughout the appendix. Table A.1–1 contains data sources reviewed in preparation for projections of material inventories under each alternative.

In addition to using the sources listed in the table, the accident analysis team conducted walk-throughs of the selected facilities to review material inventories for potential accident scenarios. Information provided by those data sources was assumed to be correct and complete unless differences in inventories were found during the walk-through. The facility manager resolved any inventory differences between the walk-throughs and databases. If the inventory surveyed during the walk-through was found to be more accurate, it was used for further analysis. For a complete list of chemicals used for accident analysis, see the Accident Analysis, Appendix F.

The data from the Material Inventory appendix were made available for use in the following resource areas:

- Accidents
- Human Health and Worker Safety
- Transportation

A.2 ACTIVITY MULTIPLIERS

The activities proposed under the alternatives would potentially impact the types and quantities of material used at SNL/NM. The activity scenarios from the *SNL/NM Facility Source Documents* (SNL/NM 1998a) are shown in Tables A.2–1, A.2–2, and A.2–3 and were used to project inventories for facilities based on activities at the facilities. The selected existing facilities represent the types of operations that would occur at SNL/NM over the next 10 years. These activities primarily relate to test shots, production levels, and, in some instances, man-hour estimates for these selected facilities. These activities have been converted to unitless numbers that have been normalized so that a site-wide aggregate multiplier for each alternative could be developed. In turn, these multipliers were used to develop projections for the waste management and transportation consequence analysis. Operations at new facilities were not considered for the multiplier because the start-up of these operations reaching their planned production levels would artificially inflate the multiplier and

Table A.1–1. Data Sources Used to Develop SNL/NM Material Inventories

MATERIAL TYPE	DATA SOURCES
Special Nuclear Material	SNL/NM Facility Information Manager Database, April 1998 SNL/NM Preliminary Draft Environmental Information Document, October 1, 1997
Radioactive Material	SNL/NM Facility Information Manager Database, April 1998 SNL/NM Preliminary Draft Environmental Information Document, October 1, 1997
Source Material	SNL/NM Facility Information Manager Database, April 1998 SNL/NM Preliminary Draft Environmental Information Document, October 1, 1997
Spent Fuel	SNL/NM Facility Information Manager Database, April 1998
Chemical	CheMaster Chemical Information System SNL/NM Preliminary Draft Environmental Information Document, October 1, 1997 Hazard Assessments Building Profiles
Explosives	SNL/NM Facility Information Manager Database, April 1998 Explosives Inventory System SNL/NM Preliminary Draft Environmental Information Document, October 1, 1997

Sources: SNL/NM 1997b, 1998a

Table A.2–1. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Tests and Shots

FACILITY NAME	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
ACTIVITY LEVELS REPORTED IN SNL/NM SOURCE DOCUMENTS							
Aerial Cable Facility	Drop/pull-down	tests	21	32	38	100	2
Aerial Cable Facility	Aerial target	tests	6	6	6	30	0
Centrifuge Complex	Centrifuge	tests	32	46	46	120	2
Centrifuge Complex[b]	Impact	tests	0	10	10	100	0
Containment Technology Test Facility - West	Survivability testing	tests	1	1	0	2	1
Drop/Impact Complex	Drop test	tests	18	20	20	50	0
Drop/Impact Complex	Water impact	tests	1	1	1	20	1
Drop/Impact Complex	Submersion	tests	1	1	1	5	0
Drop/Impact Complex[b]	Underwater blast	tests	0	2	2	10	0
Explosive Components Facility[c]	Neutron generator tests	tests	200	500	500	500	500
Explosive Components Facility	Explosive testing	tests	600	750	850	900	300
Explosive Components Facility	Battery tests	tests	50	60	60	100	10
Explosives Applications Laboratory	Explosive testing	tests	240	240	240	360	50
Lurance Canyon Burn Site	Certification testing	tests	12	12	12	55	1
Lurance Canyon Burn Site	Model validation	tests	56	56	56	100	0
Lurance Canyon Burn Site	User testing	tests	37	37	37	50	0

Table A.2–1. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Tests and Shots (continued)

FACILITY NAME	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
Repetitive High Energy Pulsed Power Unit I	Accelerator tests	tests	500	5,000	5,000	10,000	100
Repetitive High Energy Pulsed Power Unit II	Radiation production	tests	80	160	160	800	40
Sandia Pulsed Reactor	Irradiation tests	tests	100	100	100	200	30
Sled Track Complex	Rocket sled test	tests	10	10	15	80	2
Sled Track Complex	Explosive testing	tests	12	12	12	239	0
Sled Track Complex	Rocket launcher	tests	3	4	4	24	0
Sled Track Complex	Free-flight launch	tests	40	40	40	150	0
Terminal Ballistics Complex	Projectile impact testing	tests	50	80	100	350	10
Terminal Ballistics Complex	Propellant testing	tests	25	40	50	100	4
Thunder Range	Ground truthing tests	test series	1	5	8	10	1
Advanced Pulsed Power Research Module	Accelerator shots	shots	500	1,000	1,000	2,000	40
High-Energy Radiation Megavolt Electron Source III	Irradiation of components or materials	shots	262	500	500	1,450	40
Sandia Accelerator & Beam Research Experiment	Irradiation of components or materials	shots	187	225	225	400	0
SATURN	Irradiation of components or materials	shots	65	200	200	500	40

Table A.2–1. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Tests and Shots (continued)

FACILITY NAME	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
Short-Pulse High Intensity Nanosecond X-Radiator	Irradiation of components or materials	shots	1,185	2,500	2,500	6,000	200
Z-Machine	Accelerator shots	shots	150	300	300	350	84
TOTAL[d]		**Tests and shots**	**4,445**	**11,950**	**12,093**	**25,155**	**1,458**
MULTIPLIER FROM BASE YEAR		**Multiplier**	**1.00**	**2.69**	**2.72**	**5.66**	**0.33**
MULTIPLIERS CONTAINED IN SNL/NM SOURCE DOCUMENTS							
Aerial Cable Facility	Drop/pull-down	multiplier	1.00	1.52	1.81	4.76	0.10
Aerial Cable Facility	Aerial target	multiplier	1.00	1.00	1.00	5.00	0.00
Centrifuge Complex	Centrifuge	multiplier	1.00	1.44	1.44	3.75	0.06
Centrifuge Complex[b]	Impact	multiplier	0.00	1.00	1.00	10.00	0.00
Containment Technology Test Facility - West	Survivability testing	multiplier	1.00	1.00	0.00	2.00	1.00
Drop/Impact Complex	Drop test	multiplier	1.00	1.11	1.11	2.78	0.00
Drop/Impact Complex	Water impact	multiplier	1.00	1.00	1.00	20.00	1.00
Drop/Impact Complex	Submersion	multiplier	1.00	1.00	1.00	5.00	0.00
Drop/Impact Complex[b]	Underwater blast	multiplier	0.00	1.00	1.00	5.00	0.00
Explosive Components Facility[c]	Neutron generator tests	multiplier	1.00	2.50	2.50	2.50	2.50
Explosive Components Facility	Explosive testing	multiplier	1.00	1.25	1.42	1.50	0.50
Explosive Components Facility	Battery tests	multiplier	1.00	1.20	1.20	2.00	0.20

Table A.2–1. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Tests and Shots (continued)

FACILITY NAME	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
Explosives Application Laboratory	Explosive testing	multiplier	1.00	1.00	1.00	1.50	0.21
Lurance Canyon Burn Site	Certification testing	multiplier	1.00	1.00	1.00	4.58	0.08
Lurance Canyon Burn Site	Model validation	multiplier	1.00	1.00	1.00	1.79	0.00
Lurance Canyon Burn Site	User testing	multiplier	1.00	1.00	1.00	1.35	0.00
Repetitive High Energy Pulsed Power Unit I	Accelerator tests	multiplier	1.00	10.00	10.00	20.00	0.20
Repetitive High Energy Pulsed Power Unit II	Radiation production	multiplier	1.00	2.00	2.00	10.00	0.50
Sandia Pulsed Reactor	Irradiation tests	multiplier	1.00	1.00	1.00	2.00	0.30
Sled Track Complex	Rocket sled test	multiplier	1.00	1.00	1.50	8.00	0.20
Sled Track Complex	Explosive testing	multiplier	1.00	1.00	1.00	19.92	0.00
Sled Track Complex	Rocket launcher	multiplier	1.00	1.33	1.33	8.00	0.00
Sled Track Complex	Free-flight launch	multiplier	1.00	1.00	1.00	3.75	0.00
Terminal Ballistics Complex	Projectile impact testing	multiplier	1.00	1.60	2.00	7.00	0.20
Terminal Ballistics Complex	Propellant testing	multiplier	1.00	1.60	2.00	4.00	0.16
Thunder Range	Ground truthing tests	multiplier	1.00	5.00	8.00	10.00	1.00
Advanced Pulsed Power Research Module	Accelerator shots	multiplier	1.00	2.00	2.00	4.00	0.08
High-Energy Radiation Megavolt Electron Source III	Irradiation of components or materials	multiplier	1.00	1.91	1.91	5.53	0.15

Table A.2–1. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Tests and Shots (concluded)

FACILITY NAME	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
Sandia Accelerator & Beam Research Experiment	Irradiation of components or materials	multiplier	1.00	1.20	1.20	2.14	0.00
SATURN	Irradiation of components or materials	multiplier	1.00	3.08	3.08	7.69	0.62
Short-Pulse High Intensity Nanosecond X-Radiator	Irradiation of components or materials	multiplier	1.00	2.11	2.11	5.06	0.17
Z-Machine	Accelerator shots	multiplier	1.00	2.00	2.00	2.33	0.56
TOTAL[d]			**30.00**	**56.85**	**60.61**	**192.94**	**9.79**
AVERAGE[d]			**0.94**	**1.78**	**1.89**	**6.03**	**0.31**

Sources: SNL/NM 1997b, 1998a

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Because of the lead time required to set up operations for these facilities, the base year was assumed to be 2003 for calculations, in accordance with information in the FSID.

[c] Indicates a change from the original source documents rollup based on additional information provided by SNL/NM

[d] Numbers are rounded and may differ slightly from calculated values.

Table A.2–2. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Other Operations

FACILITY NAME	ACTIVITY CATEGORIES	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
					5-YEAR	10-YEAR		
ACTIVITY LEVELS REPORTED IN SNL/NM SOURCE DOCUMENTS								
Microelectronics Development Laboratory	Development or production of devices, processes, and systems	Microelectronic devices and systems	wafers	4,000	5,000	7,000	7,500[b]	2,666
Aerial Cable Facility[c]	Test activities	Scoring system tests	series	0	1	1	2	0
Advanced Manufacturing Processes Laboratory	Development or production of devices, processes, and systems	Materials, ceramics/glass, electronics, processes, and systems	operational hours	248,000	310,000	310,000	347,000	248,000
Neutron Generator Facility	Development or production of devices, processes, and systems	Neutron generators	neutron generators	600	2,000	2,000	2,000	2,000
Gamma Irradiation Facility[d]	Test activities	Tests	hours	1,000	0	0	8,000	0
New Gamma Irradiation Facility[d]	Test activities	Tests	hours	0	13,000	13,000	24,000	0

Table A.2–2. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Other Operations (continued)

FACILITY NAME	ACTIVITY CATEGORIES	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
					5-YEAR	10-YEAR		
Thunder Range	Other	Equipment disassembly and evaluation	days/year	60	82	82	144	42
Explosive Components Facility	Test activities	Chemical analysis	analyses	900	950	1,000	1,250	500
Integrated Materials Research Laboratory	Other	Research and development of materials	operational hours	395,454	395,454	395,454	395,454	363,817
MULTIPLIERS CONTAINED IN SNL/NM SOURCE DOCUMENTS								
Microelectronics Development Laboratory	Development or production of devices, processes, and systems	Microelectronic devices and systems	multiplier	1.00	1.25	1.75	1.88[b]	0.67
Aerial Cable Facility[c]	Test activities	Scoring system tests	multiplier	0.00	1.00	1.00	2.00	0.00
Advanced Manufacturing Processes Laboratory	Development or production of devices, processes, and systems	Materials, ceramics/glass, electronics, processes, and systems	multiplier	1.00	1.25	1.25	1.40	1.00

Table A.2–2. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for Other Operations (concluded)

FACILITY NAME	ACTIVITY CATEGORIES	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
					5-YEAR	10-YEAR		
Neutron Generator Facility	Development or production of devices, processes, and systems	Neutron generators	multiplier	1.00	3.33	3.33	3.33	3.33
Gamma Irradiation Facility[c]	Test activities	Tests	multiplier	1.00	0.00	0.00	8.00	0.00
New Gamma Irradiation Facility[d]	Test activities	Tests	multiplier	0.00	1.00	1.00	1.85	0.00
Thunder Range	Other	Equipment disassembly and evaluation	multiplier	1.00	1.37	1.37	2.40	0.70
Explosive Components Facility	Test activities	Chemical analysis	multiplier	1.00	1.06	1.11	1.39	0.56
Integrated Materials Research Laboratory	Other	Research and development of materials	multiplier	1.00	1.00	1.00	1.00	0.92
TOTAL[e]			**multiplier**	**7.00**	**11.26**	**11.81**	**23.24**	**7.18**
AVERAGE[e]			**multiplier**	**0.78**	**1.25**	**1.31**	**2.58**	**0.80**

Sources: SNL/NM 1997b, 1998a

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration under the Expanded Operations Alternative would not change the number of wafers produced. Whether MESA is implemented or not, SNL/NM's maximum production capacity is 7,500 wafers per year with three shifts. Therefore, no changes in activity multipliers would occur.

[c] The operation at this facility is considered to be a constant operation that has a low activity level; however, for calculations, the base year is 2003.

[d] The operations at this facility are considered to be a continuation of the current Gamma Irradiation Facility operations; however, for calculations, the base year is 2003.

[e] Numbers are rounded and may differ slightly from calculated values.

Table A.2–3. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for New Operations

FACILITY NAME	ACTIVITY CATEGORIES	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
					5-YEAR	10-YEAR		
ACTIVITY LEVELS REPORTED IN SNL/NM SOURCE DOCUMENTS								
Annular Core Research Reactor (medical isotopes production configuration)	Test activities	Irradiation of production targets	targets	8	375	375	1,300	40
Annular Core Research Reactor (DP configuration)[b]	Test activities	Irradiation tests	tests	0	0	1	3	0
Hot Cell Facility	Development or production of devices, processes, and systems	Processing of production targets	targets	8	375	375	1,300	40
TESLA[c]	Test activities	Accelerator shots	shots	40	1,000	1,000	1,300	40
Radiographic Integrated Test Stand[f]	Test activities	Accelerator shots	shots per year	0	400	600	800	100
TOTAL[d]			**activities**	**56**	**2,150**	**2,351**	**4,703**	**220**
NORMALIZED TO THE BASE YEAR								
Annular Core Research Reactor (medical isotopes production configuration)	Test activities	Irradiation of production targets	multiplier	1.00	46.88	46.88	162.50	5.00
Annular Core Research Reactor (DP configuration)[c]	Test activities	Irradiation tests	multiplier	0.00	0.00	1.00	3.00	0.00
Hot Cell Facility	Development or production of devices, processes, and systems	Processing of production targets	multiplier	1.00	46.88	46.88	162.50	5.00

Table A.2–3. Activity Multipliers by SNL/NM Facility, Activity, and Alternative for New Operations (concluded)

FACILITY NAME	ACTIVITY CATEGORIES	ACTIVITY TYPES	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
					5-YEAR	10-YEAR		
TESLA	Test activities	Accelerator shots	multiplier	1.00	25.00	25.00	32.50	1.00
Radiographic Integrated Test Stand	Test activities	Accelerator shots	multiplier	0.00	1.00	1.50	2.00	0.25
TOTAL[d]			**multiplier**	**3.00**	**119.75**	**121.25**	**362.50**	**11.25**
AVERAGE[d]			**multiplier**	**0.60**	**23.95**	**24.25**	**72.50**	**2.25**
NORMALIZED TO THE 5- OR 10-YEAR, NO ACTION ALTERNATIVE								
Annular Core Research Reactor (medical isotopes production configuration)	Test activities	Irradiation of production targets	multiplier	0.02	1.00	1.00	3.47	0.11
Annular Core Research Reactor (DP configuration)	Test activities	Irradiation tests	multiplier	0.00	0.00	1.00	3.00	0.00
Hot Cell Facility	Development or production of devices, processes, and systems	Processing of production targets	multiplier	0.02	1.00	1.00	3.47	0.11
TESLA[c]	Test activities	Accelerator shots	multiplier	0.04	1.00	1.00	1.30	0.04
Radiographic Integrated Test Stand[c]	Test activities	Accelerator shots	multiplier	0.00	1.00	1.50	2.00	0.25
TOTAL[d]			**multiplier**	**0.08**	**4.00**	**5.50**	**13.23**	**0.50**
AVERAGE[d]			**multiplier**	**0.02**	**0.80**	**1.10**	**2.65**	**0.10**

Sources: SNL/NM 1997b, 1998a
TESLA: Tera-Electron Volt Semiconducting Linear Accelerator
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Because of the lead time required to set up operations for these facilities, the base year was assumed to be 2003 for calculations, in accordance with information in the FSID.
[c] Indicates a change from the original source documents rollup based on additional provided information from SNL/NM
[d] Numbers are rounded and may differ slightly from calculated values.

Table A.2–4. Summary of Activity Multipliers

ACTIVITY		BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
			5-YEAR	10-YEAR		
Tests & Shots	Unit Total	30	56.85	60.61	192.94	9.79
	Average	0.94	1.78	1.89	6.03	0.31
Nontest or Shot Activities	Unit Total	7.00	11.26	11.81	23.24	7.18
	Average	0.78	1.25	1.31	2.58	0.80
Multiplier to Use (No New Operations)		0.902	1.661	1.766	5.273	0.414
Normalized to Base Year for Multiplication		1.00	1.841	1.957	5.843	0.458
New Operations (Using 1998 as a Base year)	TOTAL (Unitless)	3.00	119.75	121.25	362.50	11.25
	Average	0.60	23.95	24.25	72.50	2.25
	Count	5	5	5	5	5

Sources: SNL/NM 1997b, 1998a

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

not truly reflect the anticipated activity levels. Table A.2–4 summarizes the multipliers used to reflect activity levels.

If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration under the Expanded Operations Alternative would not change the activity projections. Whether MESA Complex configuration is implemented or not, SNL/NM's maximum production capacity is 7,500 wafers per year with three shifts. Therefore, no changes in activity multipliers would occur.

A.3 MATERIAL INVENTORY PROJECTIONS

The following material inventory projections are divided into two sections for each type of material at SNL/NM. These sections, existing operations and new operations, comprise all of the selected representative facilities at SNL/NM. There is also the potential for special programs that could arise in the future and that would be categorized separately from new and existing operations.

The material inventory projections for existing operations are limited to those facilities that maintain material under existing operations and are required to maintain current production at SNL/NM.

New operations are defined as programmatically planned projects with defined implementation schedules that will take place beyond the base year. These projects are currently under development, but will reach their intended operational capacity within the next 10 years under each alternative. Material levels projected for these facilities were omitted from the existing operations assessments and are outlined separately. The following existing facilities are included in the new operations section for each material category: Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA), Radiographic Integrated Test Stand (RITS), Hot Cell Facility (HCF), and Annular Core Research Reactor (ACRR) (medical isotope production configuration).

A.3.1 Nuclear Material

A.3.1.1 Existing Operations

Nuclear material inventories at SNL/NM are presented in Table A.3–1. The table shows inventories for existing operations under each alternative.

No Action Alternative

An increase at the Integrated Materials Research Laboratory (IMRL) would be due to the addition of a

Table A.3–1. Nuclear Materials Inventories Under Each Alternative

FACILITY NAMES	MATERIALS	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
EXISTING OPERATIONS							
Annular Core Research Reactor (DP configuration)	Enriched Uranium	kg	12	37	37	85	12
Annular Core Research Reactor (DP configuration)	Plutonium-239	g	148	148	148	8,800	148
Hot Cell Facility	Enriched Uranium	g	25	25	25	125	25
NEW OPERATIONS							
Annular Core Research Reactor (medical isotopes production mode)	Enriched Uranium	kg	25.8	56.7	56.7	56.7	18.3
Explosive Components Facility	Tritium	Ci	49	49	49	49	49
Gamma Irradiation Facility	Depleted Uranium	kg	13,600	13,600	13,600	13,600	13,600
Integrated Materials Research Laboratory	Depleted Uranium	mCi	0.93	1	1	1	0
Neutron Generator Facility	Tritium	Ci	682	682	682	836	511
Repetitive High Energy Pulsed Power Unit I	Depleted Uranium	µg	0	10	10	100	0
Sandia Pulsed Reactor	Enriched Uranium	kg	550	900	550	1,000	550
Sandia Pulsed Reactor	Plutonium-239	g	53	10,000	10,000	10,000	53
Thunder Range	Americium-241	Ci	≤0.52	≤0.52	≤0.52	0.52	0

Table A.3–1. Nuclear Materials Inventories Under Each Alternative (concluded)

FACILITY NAMES	MATERIALS	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
Thunder Range	Americium-243	Ci	≤0.52	≤0.52	≤0.52	0.52	0
Thunder Range	Normal Uranium	Ci	≤4.2	≤4.2	≤4.2	4.2	0
Thunder Range	Plutonium-238	Ci	≤0.62	≤0.62	≤0.62	0.62	0
Thunder Range	Plutonium-239	Ci	≤0.52	≤0.52	≤0.52	0.52	0
Z-Machine	Depleted Uranium	mg	0	200	200	200	0
Z-Machine	Deuterium[b]	L	0	1,000	1,000	5,000	0
Z-Machine	Plutonium-239	mg	0	200	200	200	0
Z-Machine	Tritium	Ci	0	1,000	1,000	50,000	0

Sources: SNL/NM 1997b, 1998m
μg: microgram
Ci: curies
DP: Defense Programs
g: gram
kg: kilogram
L: liter
mCi: millicurie
mg: milligram
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Deuterium is not radioactive; however, it is considered an accountable nuclear material.

small calibration source that would not require any additional storage capacity. Increases at the Sandia Pulsed Reactor (SPR) facility would be due to increased test activities, but the inventory levels would continue to be within the facility storage capacity. Furthermore, due to recent major reductions in overall nuclear material stored onsite, excess storage capacity currently exists to accommodate any increases under this alternative. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed. The Z-Machine and Repetitive High Energy Pulsed Power Unit (RHEPP) I show increases from the base year to year 5 under the No Action Alternative. However, these facilities would increase to normal production capacity by 2003, which would then become the base year and, therefore, not a reflected increase.

Expanded Operations Alternative

Under the Expanded Operations Alternative, the nuclear material inventory would generally remain consistent with current facility levels, with the exception of four facilities: SPR, Neutron Generator Facility (NGF), RHEPP I, and the Z-Machine (formerly the Particle Beam Fusion Accelerator [PBFA] II). The increases at the SPR facility would be due to increased test activities, but the inventory levels would continue to be within the facility storage capacity. Furthermore, due to recent major reductions in overall nuclear material stored onsite, excess storage capacity currently exists to accommodate any increases under this alternative. Therefore, no additional storage and handling capacity or regulatory requirements would be needed. However, the Z-Machine would have to be upgraded to Hazard Classification 3, which would require additional safety documentation.

Reduced Operations Alternative

Under the Reduced Operations Alternative, the nuclear material inventory at existing facilities would decrease or remain consistent with current facility levels. Furthermore, due to recent major reductions in overall nuclear material stored onsite, excess storage capacity currently exists to accommodate any material needs under this alternative. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

A.3.1.2 New Operations

No Action Alternative

Operating levels at the ACRR would increase to full production capacity. These increases were anticipated during the facility design and would, therefore, not be considered to be increases over the normal design inventory. Furthermore, the U. S. Department of Energy (DOE) issued a record of decision (ROD) for the *Medical Isotopes Production Project* (MIPP) (DOE 1996b), published in the September 17, 1996, *Federal Register* (61 FR 48921-48929), in which material inventories associated with this program were reviewed. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

Expanded Operations Alternative

Under the Expanded Operations Alternative, the nuclear material inventory at two new facilities, the ACRR and the HCF, would increase as the facilities become operational. The projected inventory increases are identified in Table A.3–1. Currently, operating levels at the ACRR are increasing to full production capacity. These increases were anticipated during the facility design and would, therefore, not be considered to be increases under this alternative. Furthermore, the DOE issued a ROD for the MIPP, published in the September 17, 1996, *Federal Register* (61 FR 48921-48929), in which material inventories associated with this program were reviewed. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

Reduced Operations Alternative

Operating levels at new facilities would increase to minimum production capacity. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

A.3.2 Radioactive Material

A.3.2.1 Existing Operations

Radioactive material inventories at SNL/NM are presented in Table A.3–2. The table shows inventories by existing operations for each alternative.

SNL/NM has significantly reduced radioactive and chemical inventories. Since 1995, SNL/NM has reduced source nuclear material holdings by 22.4 metric tons,

Table A.3–2. Radioactive Material Inventories Under Each Alternative

FACILITY NAMES	MATERIAL	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
EXISTING OPERATIONS							
Integrated Materials Research Laboratory	Carbon-14	μCi	220	220	220	220	220
Z-Machine	Activated hardware	kg	50,000	10,000	10,000	10,000	2,000
NEW OPERATIONS							
Annular Core Research Reactor (DP configuration)	Cobalt-60	Ci	33.6	19	10	33.6	33.6
Hot Cell Facility	Mixed fission products	Ci	3,000	10,800	10,800	54,100	10,800
Radiographic Integrated Test Stand	Activated hardware	kg	500	500	500	500	500

Sources: SNL/NM 1997b, 1998m
μCi: microcuries
Ci: Curies
DP: Defense Program
kg: kilograms
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

nearly 39 percent of the former inventory. Surplus source nuclear material holdings were reduced by 79 percent. Further, SNL/NM has reduced its inventory of surplus other nuclear material by 40 percent. Planning for these reductions began in 1993 with an extensive inventory assessment. Disposition options were identified, including returning materials to vendors, better inventory and purchasing controls, and disposal of unneeded materials at the Nevada Test Site. SNL/NM has plans for additional inventory reduction activities through 2002. A detailed discussion is provided in Chapter 11 of Volume II of the Environmental Information Document (SNL/NM 1998f). That chapter also includes material storage facility information.

No Action Alternative

Under the No Action Alternative, the overall radioactive material inventory at all existing and new facilities would remain consistent with current levels or decrease, except for the new operation at the HCF, which would increase to full operational capacity. Furthermore, due to recent major reductions in the total quantities of radioactive material stored onsite, excess storage capacity currently exists to accommodate any increases. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

Expanded Operations Alternative

Under the Expanded Operations Alternative, the overall radioactive material inventory at all existing and new facilities would remain consistent with current levels, except for the new operation at the HCF, which would increase to full operational capacity. Furthermore, due to recent major reductions in the total quantities of radioactive material stored onsite, excess storage capacity currently exists to accommodate any increases. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

Reduced Operations Alternative

Under the Reduced Operations Alternative, the site-wide radioactive material inventory would decrease or remain at current levels except for the new operation at the HCF, which would increase to full operational capacity. Furthermore, due to recent major reductions in overall radioactive material stored onsite, excess storage capacity currently exists to accommodate any increases under this alternative. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

A.3.2.2 New Operations

No Action Alternative

As the new facilities increase operations to full production capacity, the radioactive material inventory levels would increase. However, these increases were anticipated during the design phase of the facilities, and there will be sufficient capacity to accommodate them. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

Expanded Operations Alternative

As the new facilities increase operations to full production capacity, the radioactive material inventory levels would increase. However, these increases were anticipated during the design phase of the facilities, and there will be sufficient capacity to accommodate them. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

Reduced Operations Alternative

Operating levels at new facilities would decrease to minimum production capacity. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

A.3.3 Source Material

Radioactive sealed source material inventories are presented in Table A.3–3. The table shows inventories by existing and new operations for each alternative.

A.3.3.1 Existing Operations

No Action Alternative

Under the No Action Alternative, the source material inventory would generally remain consistent with current levels, with the exception of the SPR. The source material inventory at this facility would potentially increase, as indicated in Table A.3–3. The increases at the SPR facility would be due to increased test activities, but these levels would continue to fall within the facility storage capacity. Furthermore, due to recent major reductions in overall source material stored onsite, excess storage capacity currently exists to accommodate increases under this alternative. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

Expanded Operations Alternative

Under the Expanded Operations Alternative, the source material inventory at existing facilities would generally remain consistent with current levels, with the exception of two facilities, the SPR and Gamma Irradiation Facility (GIF). The source material inventory at these facilities would potentially increase as indicated in Table A.3–3. These increases would be due to increased test activities, but these levels would not exceed the facility storage capacity. Furthermore, due to recent major reductions in overall source material stored onsite, excess storage capacity currently exists to accommodate any increases under this alternative. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

Reduced Operations Alternative

Under the Reduced Operations Alternative, the source material inventory at existing facilities would decrease or remain consistent with current levels. Furthermore, due to recent major reductions in overall nuclear material stored onsite, excess storage capacity currently exists to accommodate any increases under this alternative. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

A.3.3.2 New Operations

No Action Alternative

As the new facilities increase operations to full production capacity, the source material inventory levels would increase. However, these increases were anticipated during the design phase of the facilities, and there will be sufficient capacity to accommodate them. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

Table A.3–3. Source Material Inventory Under Each Alternative

FACILITY NAMES	MATERIALS	UNITS	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
Annular Core Research Reactor (DP configuration)	Enriched Uranium	kg	12	37	37	85	12
Annular Core Research Reactor (DP configuration)	Plutonium-239	g	148	148	148	8,800	148
Annular Core Research Reactor (medical isotopes production configuration)	Enriched Uranium	kg	25.8	56.7	56.7	56.7	18.3
Explosive Components Facility	Tritium	Ci	49	49	49	49	49
Gamma Irradiation Facility	Depleted Uranium	kg	13,600	13,600	13,600	13,600	13,600
Hot Cell Facility	Enriched Uranium	g	25	25	25	125	25
Integrated Materials Research Laboratory	Depleted Uranium	mCi	0.93	1	1	1	0
Neutron Generator Facility	Tritium	Ci	682	682	682	836	511
Repetitive High Energy Pulsed Power Unit I	Depleted Uranium	µg	0	10	10	100	0
Sandia Pulsed Reactor	Enriched Uranium	kg	550	900	550	1,000	550
Sandia Pulsed Reactor	Plutonium-239	g	53	10,000	10,000	10,000	53
Z-Machine	Depleted Uranium	mg	0	200	200	- 200	0
Z-Machine	Deuterium	L	0	1,000	1,000	5,000	0
Z-Machine	Plutonium-239	mg	0	200	200	200	0
Z-Machine	Tritium	Ci	0	1,000	1,000	50,000	0

Sources: SNL/NM 1997b, 1998a
µg: micrograms
Ci: Curies
DP: Defense Program
g: grams
kg: kilograms
L: liters
mCi: millicuries
mg: milligrams
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Expanded Operations Alternative

As the new facilities increase operations to full production capacity, the source material inventory levels would increase. However, these increases were anticipated during the design phase of the facilities, and there will be sufficient capacity to accommodate them. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be needed.

Reduced Operations Alternative

Operating levels at new facilities would decrease to minimum production capacity. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

A.3.4 Spent Fuel

A.3.4.1 New Operations

The only projected source of spent fuel identified by SNL/NM under the each alternative is the ACRR, a new operation associated with the MIPP. The MIPP operations were analyzed in detail in the MIPP Environmental Impact Statement (DOE 1996b). Furthermore, the DOE issued a ROD for the MIPP published in the September 17, 1996, *Federal Register* (61 FR 48921–48929), in which spent fuel associated with this program was reviewed. Therefore, no additional MIPP consequence analysis has been conducted in this Site-Wide Environmental Impact Statement. Table A.3–4 presents the spent fuel inventory for each alternative.

A.3.5 Chemicals

In 1997, SNL/NM received more than 25,000 chemical containers in approximately 2,750 shipments. The majority of these receipts were small quantity purchases made through the just-in-time (JIT) vendors. The remainder of the receipts were large quantity purchases received as bulk loads, including compressed hydrogen tube trailers and acids received from tanker trucks. The top 20 Chemical Information System vendors who provided chemicals to SNL/NM in 1997 accounted for 67 percent of the JIT shipments and 86 percent of the number of containers shipped (Table A.3–5).

For a representative inventory of chemicals used at SNL/NM, see the Accident Analysis, Appendix F.

A.3.5.1 No Action Alternative

The baseline site-wide chemical inventory contains 1,725 different chemical products for a total of 25,000 individual units. Applying the chemical multiplier derived under the No Action Alternative, approximately 2.0 (1.84 in 2003 and 1.96 in 2008), the site-wide chemical inventory would increase to 50,000 units. Thus, the 2008 site-wide chemical inventory would equal 200 percent of the current inventory level, for a site-wide increase of 100 percent overall. This assumes the maximum anticipated operable level for each selected facility. However, the SNL/NM JIT chemical procurement procedures could accommodate the increased demand by increasing the volume of material shipped on the JIT shipments without increasing the number of JIT shipments or the amount of the material present onsite at any one time. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

A.3.5.2 Expanded Operations Alternative

The baseline site-wide chemical inventory contains 1,725 different chemical products for a total of 25,000 individual units. Applying the chemical multiplier derived under the Expanded Operations Alternative, approximately 6.0, the site-wide chemical inventory would increase to 150,000 units. Thus, the site-wide chemical

Table A.3–4. Spent Fuel Inventory Under Each Alternative

FACILITY NAME	MATERIAL	UNIT	BASE YEAR (1996)	NO-ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				5-YEAR	10-YEAR		
Annular Core Research Reactor (medical isotopes production configuration)	Spent fuel from fuel elements	kg	0	0	189	399	42

Source: SNL/NM 1998a
kg: kilograms

Table A.3–5. Top 20 Chemical Inventory System Chemical Vendors by Annual Shipments in 1997

VENDOR	ANNUAL SHIPMENTS	VENDOR	ANNUAL SHIPMENTS
1. Fisher Scientific	226	11. J T Baker Chemical Co.	32
2. Tri-Gas, Inc.	222	12. Johnson Matthey Aesar	31
3. Aldrich Chemical Co.	176	13. W A Hammond Drierite	25
4. Matheson Gas Products	118	14. Dow-Corning Corp.	24
5. Arcos Organics/Janssen	89	15. Hoecsht Celanese Corp.	24
6. Chemtronics, Inc.	81	16. 3M Co.	23
7. Ashland Chemical Co.	80	17. SPEX Industries, Inc.	23
8. Sigma Chemical Co.	51	18. Air Products & Chemicals, Inc.	20
9. Nalco Chemical Co.	39	19. Gelest, Inc.	19
10. Shipley Co, Inc.	39	20. Transene Co, Inc.	18

Source: FWENC 1998a

inventory would equal 500 percent of the current inventory level, for a site-wide increase of 400 percent overall. This assumes the maximum anticipated operable level for each selected facility. However, the SNL/NM JIT chemical procurement procedures could accommodate the increased demand by increasing the volume of material shipped on the JIT shipments without increasing the number of JIT shipments or the amount of the material present onsite at any one time. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

A.3.5.3 Reduced Operations Alternative

The baseline site-wide chemical inventory contains 1,725 different chemical products for a total of 25,000 individual units. Applying the chemical multiplier derived under the Reduced Operations Alternative, approximately 0.5, the site-wide chemical inventory would decrease to 12,500 units. Thus, the 2008 site-wide chemical inventory would only equal 50 percent of the current inventory level, for a site-wide decrease of 50 percent overall. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

A.3.6 Explosives

Table A.3–6 shows explosive material inventories at SNL/NM by alternative.

A.3.6.1 Existing Operations

No Action Alternative

Under the No Action Alternative, the explosives inventory levels maintained at existing facilities would potentially increase at the Explosive Components Facility (ECF), Terminal Ballistics Complex, Thermal Treatment Facility (TTF), Z-Machine (formerly known as the PBFA II), and the GIF, as indicated in the Table A.3–6. These small increases would generally be accommodated by the existing storage capacities at the affected facilities. In the event the increases exceed existing storage capacity for a particular facility, the excess material would be relocated through the explosives inventory system to another facility. Furthermore, during SNL/NM's Propellant, Explosive, and Pyrotechnics Reapplication Project, completed in fiscal year (FY) 1995, SNL/NM substantially reduced its current overall explosives inventory. Therefore, the current site-wide explosives storage and handling capacities would be considered adequate to accommodate any increases under this alternative, and no additional regulatory requirements or security requirements would be necessary.

Expanded Operations Alternative

Under the Expanded Operations Alternative, the explosives inventory levels maintained at existing facilities would potentially increase at the ECF, Explosives Application Laboratory (EAL), and Terminal

Table A.3–6. Projected Changes in Existing Facility Explosives Inventories (kg)

FACILITY NAME	MATERIAL BARE UNO[a]	BASE YEAR[b]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
			5-YEAR	10-YEAR		
Annular Core Research Reactor (DP configuration)	1.2	0	0.5	0.5	0.5	0
Annular Core Research Reactor (medical isotopes production configuration)	1.2	0	0.5	0.5	0.5	0
Explosive Components Facility	1.1	130	150	150	150	100
Explosive Components Facility	1.2	20	30	30	30	15
Explosive Components Facility	1.3	23	30	30	30	20
Explosive Components Facility	1.4	2	3	3	3	1
Explosives Application Laboratory	1.1	327	327	327	490	219
Explosives Application Laboratory	1.2	65.5	65.5	65.5	98.25	44
Explosives Application Laboratory	1.3	2,140	2,140	2,140	3,210	1,430
Explosives Application Laboratory	1.4	2,700	2,700	2,700	4,500	1,800
Gamma Irradiation Facility	1.1	0	0	0	0.5	0
New Gamma Irradiation Facility	1.1	0	0.5	0.5	0.5	0
Radioactive and Mixed Waste Management Facility	1.2	1.57	0	0	0	1.57
Radiographic Integrated Test Stand	1.1	0	150	225	300	45
Sandia Pulsed Reactor	1.1	1	1	1	1	0
Terminal Ballistics Complex	1.1	19	20	20	25	19
Terminal Ballistics Complex	1.2	8	8	8	10	5
Terminal Ballistics Complex	1.3	20	20	20	25	15

Table A.3–6. Projected Changes in Existing Facility Explosives Inventories (kg) (concluded)

FACILITY NAME	MATERIAL BARE UNO[a]	BASE YEAR[b]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
			5-YEAR	10-YEAR		
Terminal Ballistics Complex	1.4	20	20	20	24	15
Terminal Ballistics Complex	1.1	0.01	1.44	1.44	10.37	0
Thermal Treatment Facility	1.3	0	0.1	0.1	165.7	0
Thunder Range	1.1	436	436	436	436	0
Z-Machine	1.1	0	1	1	1.5	0

Source: SNL/NM 1998a
kg: kilogram
[a] United Nations Organization (UNO) classification system used to identify hazard class for explosives
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Ballistics Complex, as indicated in Table A.3–6. These increases would generally be accommodated by the existing storage capacities at the affected facilities. In the event the increases exceed existing storage capacity for a particular facility, the excess material would be relocated through the explosives inventory system to another facility. Furthermore, during SNL/NM's Propellant, Explosive, and Pyrotechnics Reapplication Project, completed in FY 1995, SNL/NM substantially reduced its current overall explosives inventory. Therefore, the current site-wide explosives storage and handling capacities would be considered adequate to accommodate any increases under this alternative, and no additional regulatory requirements or security requirements would be necessary.

Reduced Operations Alternative

Under the Reduced Operations Alternative, the explosives inventory levels maintained at existing facilities would generally decrease or remain consistent with current levels. Furthermore, during SNL/NM's Propellant, Explosive, and Pyrotechnics Reapplication Project, completed in FY 1995, SNL/NM substantially reduced its current overall explosives inventory. Therefore, the current site-wide explosives storage and handling capacities would be considered adequate to accommodate any excess explosives under this alternative, and no additional regulatory requirements or security requirements would be necessary.

A.3.6.2 New Operations

No Action Alternative

Under the No Action Alternative, the explosives inventories at two new facilities, ACRR and RITS, would potentially increase as indicated in Table A.3–6. Currently, operation levels at the ACRR and RITS are increasing to normal production capacity. These increases were anticipated during the facility design and would, therefore, not be considered actual increases over normal inventory. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

Expanded Operations Alternative

Under the Expanded Operations Alternative, the explosives inventories at two new facilities, ACRR and RITS, would potentially increase as indicated in Table A.3–6. Operation levels at these facilities are increasing to full production capacity. These increases were anticipated during the facility design and would, therefore, not be considered actual increases under this alternative. Therefore, the current site-wide storage and handling capacities would be adequate, and no further regulatory requirements or security requirements would be necessary.

Reduced Operations Alternative

Under the Reduced Operations Alternative, operation levels at new facilities would decrease to minimum production capacity. Therefore, no additional storage and handling capacity, regulatory requirements, or security requirements would be necessary.

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APPENDIX B – WATER RESOURCES AND HYDROLOGY

B.1 GROUNDWATER QUALITY

B.1.1 Chemical Waste Landfill Analysis

B.1.1.1 Site History and Monitoring Results

Disposal operations began at the Chemical Waste Landfill (CWL) in 1962 and continued until 1985. An estimate of disposal quantities was derived based on a detailed disposal inventory for the period from 1975 through 1982 and the assumption that landfill use did not change significantly over the period of operation. Based on the disposal quantities, sampling results under the CWL, and the U.S. Environmental Protection Agency (EPA) drinking water standards (maximum contaminant levels [MCLs]), trichloroethylene (TCE) and chromium were identified as the predominant organic and inorganic contaminants of concern (DOE 1992d).

Recent quarterly groundwater sampling results from two monitoring wells upgradient of the CWL and seven monitoring wells downgradient of the CWL showed the presence of TCE in groundwater. In some instances, the measurements were above the TCE MCL of 0.005 mg/L, as shown in Table B.1–1 (SNL 1997d). TCE was not found in the upgradient wells, indicating that its presence is due to the CWL.

Table B.1–2 shows that chromium was also found in two monitoring wells during the third quarterly sampling in 1996. Chromium, measured at levels above the MCL of 0.1 mg/L, was present in both upgradient and downgradient wells. Although the chromium source has been found in the vadose zone down to about 75 ft below ground surface, its presence in saturated groundwater samples is attributed to dissolution of stainless steel in monitoring wells (SNL/NM 1995d). Such dissolution is a well-known phenomenon (Hewitt 1992, Oakley & Korte 1996). Furthermore, if the chromium in the aquifer resulted from vertical transport of the CWL contamination, chromium contamination would be continuously seen in the vadose zone down to the water table. Chromium contamination is not found in the lower 410 ft of the vadose zone. Iron and nickel were also found in the groundwater above MCLs during the same monitoring period. Both metals were present at similar concentrations in upgradient and downgradient wells, indicating that they are background concentrations, although the nickel may also be a result of dissolution of stainless steel in monitoring wells.

Table B.1–1. Trichlorethylene Measured at the Chemical Waste Landfill (1996)

CWL MONITORING WELL	CONCENTRATION RANGE (mg/L)
MW2A	0.010 to 0.026
MW2BU	0.004 to 0.024
MW3A	0.002 to 0.004
MW5L	0.002 to 0.015
MW5U	0.002 to 0.007
MW6L	0.006 to 0.010

Source: SNL 1997d
CWL: Chemical Waste Landfill
mg/L: milligrams per liter

Table B.1–2. Chromium Measured at the Chemical Waste Landfill (1996)

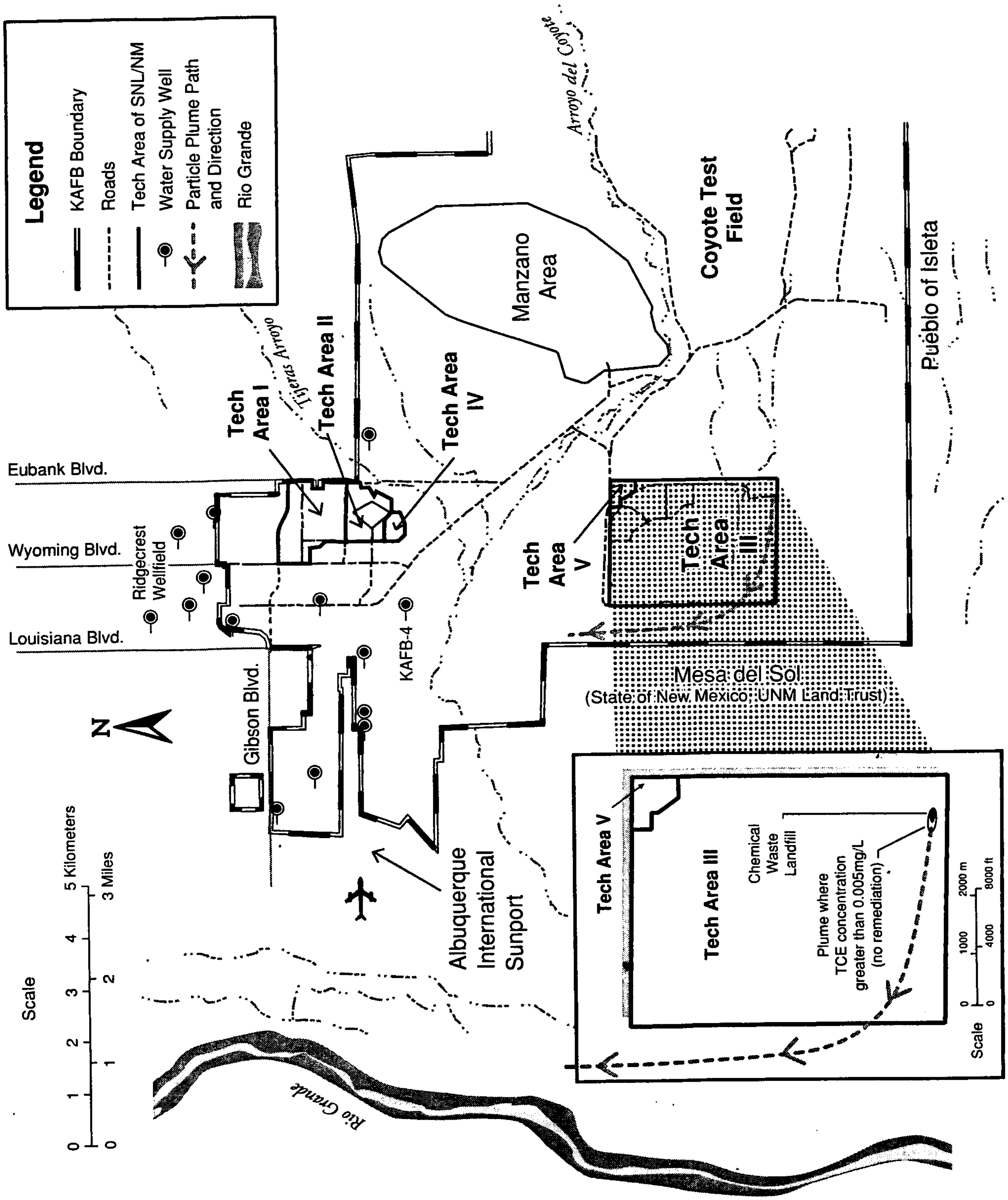
CWL MONITORING WELL	CONCENTRATION (mg/L)
BW3	0.16
MW2A	0.11

Source: SNL 1997d
CWL: Chemical Waste Landfill
mg/L: milligrams per liter

B.1.1.2 Modes of Contaminant Transport

Three modes of TCE transport to the water table were considered: vapor phase, organic phase, and water (aqueous) phase. Vapor phase transport, by way of diffusion of TCE volatilizing in the vadose zone, is responsible for the levels presently measured in the groundwater. This is suggested by three pieces of evidence.

- Application of Henry's law, which governs the partitioning of the TCE between vapor and liquid phases, indicates that the vapor and liquid are near equilibrium, with liquid being slightly less than predicted by Henry's law (DOE 1992d).
- A thin layer of contamination exists at the water table, characteristic of mass transport from vapor to liquid occurring at the water surface (DOE 1992d).



Source: Original

Figure B.1–1. Location and Maximum Extent of Projected Trichloroethylene Contamination in Groundwater at the Chemical Waste Landfill

The maximum calculated extent of trichloroethylene contamination above 0.005 mg/L is 410 ft from the Chemical Waste Landfill.

3 ft after 90 percent remediation (a minimum expected remediation efficiency [Ardito 1998]) and would not exceed the MCL for a remediation efficiency of 95 percent. Table B.1–4 shows the maximum downgradient concentrations along the plume path for the smallest (50 percent) and largest (95 percent) remediation efficiencies considered. Preremediation concentrations (10 years of preremediation releases conservatively followed by 50 percent remediation) are also given.

The liquid organic phase of the TCE currently resides totally in the unsaturated zone. The aquifer is presently not being affected as a result of unsaturated transport of this phase. The inventory of this phase (which was taken as the total disposed, less the inventory in the vapor phase) was estimated as 3.10×10^7 g. The initial percolation of the TCE is to a depth of 33 ft below ground surface (SNL/NM 1995c). The liquid organic phase will tend toward residual liquid levels in the vadose zone and, given a sufficiently small release or sufficiently thick vadose zone, will cease to move as an integral phase (EPA 1991, EPA 1993). Calculations have been performed that indicate that the unsaturated zone is sufficiently thick beneath the CWL so that the organic phase liquid will not reach the aquifer prior to reaching residual concentration levels (at which the liquid is retained in the soil pores by capillary forces) and that the dominant mode of liquid transport will be by way of the aqueous phase (DOE 1992d, SNL/NM 1995d).

Recently, measurements have been taken that indicate degradation of the liquid organic TCE (Ardito 1998). Degradation will result in aqueous phase TCE reaching the water table at levels far below the MCL. This is demonstrated by noting that the saturation concentration of TCE, 1,100 mg/L, would require 17.75 half-lives to degrade to the MCL level of 0.005 mg/L. The lower end of the possible range of travel times of this TCE to the water table is 1,250 years (SNL/NM 1995d). Therefore, a half-life for environmental degradation of less than 70.4 years (1,250 years divided by 17.75 half-lives) would result in TCE reaching the aquifer at levels below the MCL. The longest half-life presented for environmental degradation of TCE in any of various media is 4.5 years for anaerobic degradation (Howard et al. 1991). Even if the degradation rate was a factor of 10 slower than this; that is, a 45-year half-life, the concentration of the TCE as it reaches the water table, prior to dilution with aquifer water, would be 4.8×10^{-6} mg/L, a factor of 1,000 less than the MCL. This indicates that, in addition to the source reduction by remediation and volatilization, degradation would likely result in undetectable TCE concentrations prior to reaching the water table.

Chromium was disposed of in the form of chromic acid; this chromium presently resides totally in the unsaturated zone, to a depth of 75 ft from ground level. Although not presently affecting the saturated zone, this chromium may reach the saturated zone in the future. The EPA has presented studies that show that hexavalent chromium is frequently reduced to trivalent chromium in the environment (Palmer and Puls 1994). The latter has relatively low toxicity and very low mobility. The EPA has also indicated that hexavalent chromium can be expected to adsorb to soil, although not as strongly as trivalent chromium (EPA 1996b). Site documents, however, indicate that the disposed form of the chromium is not retarded by site soils (DOE 1992d). The analysis conservatively assumes that the chromium remains in the hexavalent state in which it was disposed and does not undergo soil adsorption.

The major vertical chromium incursion into the vadose zone has been found under the unlined chromic acid pit (SNL/NM 1992). The dissolved chromium under the pit reaches concentrations greater than 200 mg/L in soil moisture (SNL/NM 1998b). However, remediation is planned that will remove up to 20 ft of soil if the concentrations are greater than three times the background concentrations. In practice, this means that the entire upper 20 ft of soil at the CWL will be removed (Peterson 1998). This remediation will remove all of the areas in which chromium exceeds 200 mg/L (as well as much of the TCE source). The remaining chromium inventory, 9,050 g, was conservatively estimated based on the cross-section of maximum content, approximately 54 ft below ground surface. This cross-section was assumed to represent the vadose zone presence of the chromium between 20 and 75 ft. The moisture levels under the pit have been found to be equivalent to residual moisture levels (SNL/NM 1992). This indicates that although the initial head in the pit carried the chromium to 75 ft deep, remaining chromium movement would be by way of dissolution in percolating precipitation. Indeed, no evidence has been found of recent vertical chromium movement (SNL/NM 1998b).

Based on the expected vertical velocity found at the CWL, 0.05 ft per year., the chromium will take 7,900 years to reach the water table. Given the indicated inventory and vertical velocity and the site information indicated in Table B.1–3, *MEPAS* was used to calculate the chromium concentration 1 m downgradient of the chromium source. It was found that the maximum concentration would only be 0.005 mg/L, a factor of 20 less than the MCL. Even if the maximum vertical velocity calculated for the CWL (see Section B.1.1.2) was assumed, 0.40 ft per year, the chromium would take

Table B.1–4. Maximum Downgradient Trichlorethene Concentrations from Vapor Phase Source

DOWNGRADIENT DISTANCE (ft)	NO REMEDIATION		50% REMEDIATION		95% REMEDIATION	
	CENTERLINE PLUME CONCENTRATION (mg/L)	LATERAL DISTANCE FROM PLUME CENTERLINE TO MCL (0.005 mg/L) (ft)	CENTERLINE PLUME CONCENTRATION (mg/L)	LATERAL DISTANCE FROM PLUME CENTERLINE TO MCL (ft)	CENTERLINE PLUME CONCENTRATION (mg/L)	LATERAL DISTANCE FROM PLUME CENTERLINE TO MCL (ft)
3	0.050	43	0.025	27	0.0025	-
33	0.026	43	0.013	28	0.0013	-
190	0.010	3	0.005	0	0.0005	-
410	0.005	0	0.0025	-	0.00025	-
980	0.002	-	0.001	-	0.0001	-
3,280	0.00086	-	0.00043	-	0.000043	-
7,100	0.0004	-	0.00023	-	0.000023	-
19,700	0.0001	-	0.000057	-	0.0000057	-
32,300	0.00006	-	0.000034	-	0.0000034	-
44,200	0.000045	-	0.000027	-	0.0000027	-
Area exceeding MCL (acres)	**1.7**		**1.2**		**0**	

Source: Calculations derived from PNL 1995
–: Plume does not reach concentration above MCL at this distance.
ft: feet
mg/L: milligrams per liter
MCL: maximum contaminant level

1,000 years to reach the water table and the concentration 1 m downgradient of the source would be 0.03 mg/L, a factor of 3 less than the MCL.

B.2 GROUNDWATER QUANTITY

Because discharge exceeds recharge for this portion of the Albuquerque-Belen Basin (USGS 1993), groundwater withdrawal by water supply wells for the city of Albuquerque and KAFB has resulted in significant changes to the direction of groundwater flow and levels of drawdown in the regional aquifer system over the past 30 years. Groundwater flow at KAFB has been altered from a principally westward direction to northwestward and northward along the western and northern portions of KAFB, chiefly in response to withdrawals by local city (Ridgecrest) and KAFB well fields (SNL/NM 1997a). Water levels in the Albuquerque-Belen Basin have been declining since the 1960s in response to significant increases in groundwater usage. Basin-wide declines range up to 160 ft, with the maximum located just north of KAFB (USGS 1993). Declines in the KAFB vicinity, in response to the local withdrawals, have been measured in the KAFB vicinity since 1985. Cumulative drawdowns are depicted in Figure B.2–1 (SNL/NM 1997a). Levels in the upper unit of the Santa Fe Group have recently declined by as much as 3 ft per year (36 ft over the 12-year period from 1985 through 1996) in the vicinity of the KAFB and Ridgecrest pumping wells, west of the onsite fault zone. Hydrographs of water levels within wells east of the natural flow barrier created by the fault zone show that water levels in these regions are not affected by water supply production from the regional aquifer system.

Projections of near-term (SNL/NM SWEIS operational period of 1998 through 2007) groundwater drawdown can best be estimated by comparison with the recent drawdown. Near-term drawdown is estimated by relating the projected groundwater withdrawals in the KAFB vicinity to the recent withdrawals and assuming a proportional aquifer level response. Table B.2–1 shows the quantity of water recently pumped from onsite KAFB wells and from Ridgecrest, the nearby Albuquerque well field. Groundwater levels in the KAFB vicinity are most dependent on these nearby wells.

Projections of groundwater use through 2007 were based on the city of Albuquerque's goal of 30 percent reduction from 1994 levels in per capita water use by 2004 (COA n.d. [a]). This water conservation goal was

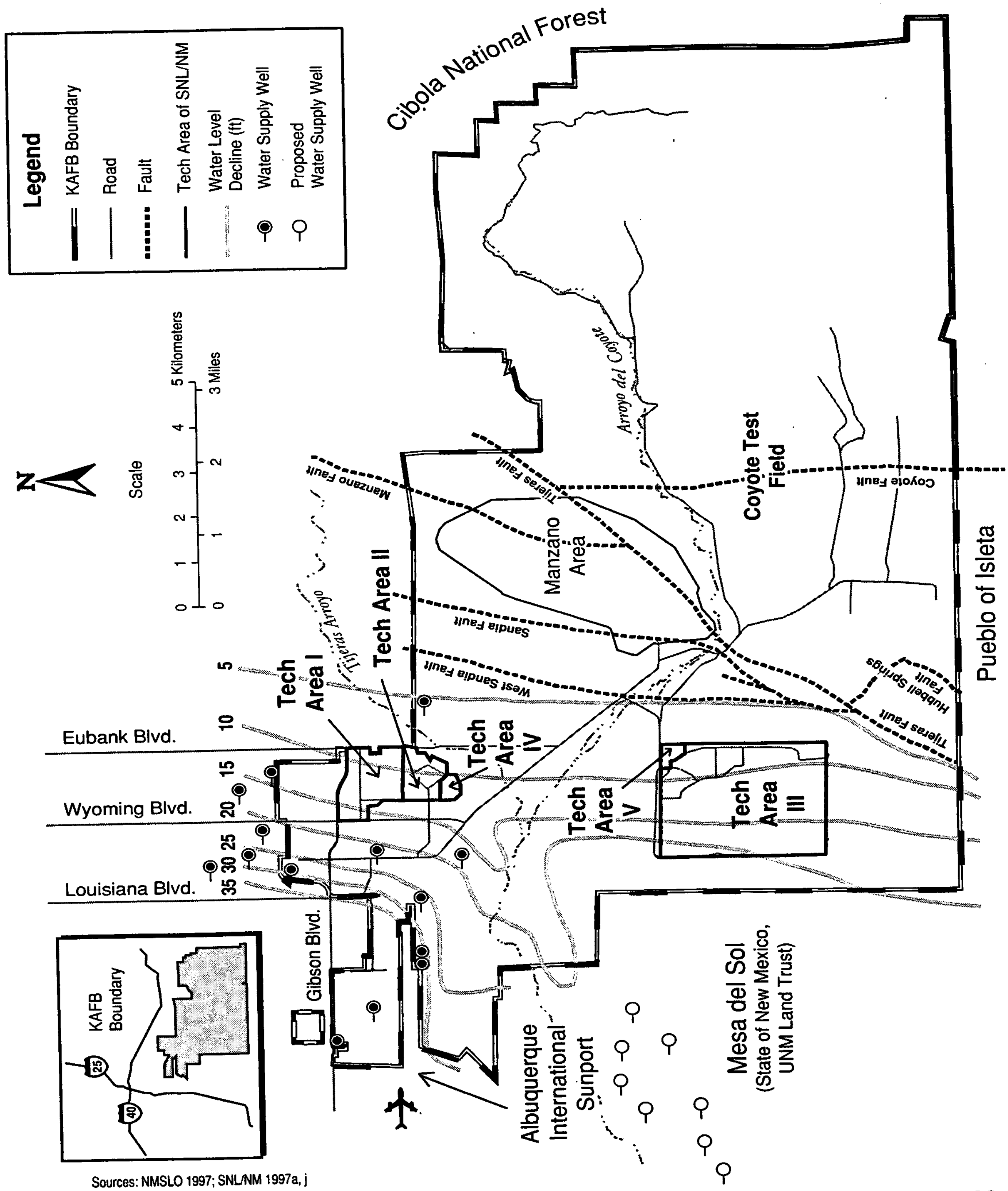
Table B.2–1. 1985 through 1996 Groundwater Withdrawals in the Immediate SNL/NM Vicinity

YEAR	KAFB WITHDRAWAL (10^6 ft^3)	RIDGECREST WITHDRAWAL (10^6 ft^3)
1985	232.3	274.1
1986	237.4	316.4
1987	210.1	374.2
1988	199.0	421.3
1989	258.1	422.8
1990	208.0	390.6
1991	219.7	385.3
1992	235.7	332.2
1993	201.2	454.5
1994	166.7	319.3
1995	151.7[a]	375.5
1996	155.5[a]	356.8
TOTAL (1985-1996)	**2,475**	**4,466**
Number of wells	14	5

Sources: [a] USAF 1998b, USGS 1995
ft^3: cubic feet
KAFB: Kirtland Air Force Base

assumed to be reached linearly over the 10-year period. In addition, a population growth factor of 1.5 percent per year, compounded, was applied to the Ridgecrest field (COA n.d. [b]). Table B.2–2 shows the year-by-year factors used to account for water conservation and population growth. The table indicates that water use will decline until 2004, when the city's goal is assumed to be met, and will begin to increase thereafter.

Table B.2–3 shows the total projected withdrawal for the SWEIS operational period of 1998 through 2007 from the well fields nearest to the site. Ridgecrest water withdrawal was particularly low in 1994; 1995 was used as the base year for this well field. The combined population growth and water conservation factor was applied to the 1995 Ridgecrest withdrawal of 375.5×10^6 ft^3. The KAFB withdrawals include the water used by SNL/NM. Although SNL/NM has committed to the 30 percent water conservation, an explicit projection of SNL/NM water use was conservatively assumed under the No Action



Sources: NMSLO 1997; SNL/NM 1997a, j

Figure B.2–1. Albuquerque-Belen Basin Groundwater Level Declines, 1985 through 1996

During the period of 1985 through 1996, groundwater levels at KAFB declined in some places by more than 35 feet.

Table B.2–2. Annual Factors Applied to 1994 Water Withdrawal for Projecting Future Withdrawals

YEAR	POPULATION GROWTH FACTOR	WATER CONSERVATION FACTOR	COMBINED FACTOR
1994	1	1	1
1995	1.015	.97	.985
1996	1.030	.94	.968
1997	1.046	.91	.952
1998	1.061	.88	.934
1999	1.077	.85	.915
2000	1.093	.82	.896
2001	1.110	.79	.877
2002	1.126	.76	.856
2003	1.143	.73	.834
2004	1.161	.70	.813
2005	1.178	.70	.825
2006	1.196	.70	.837
2007	1.214	.70	.850
TOTAL (1998 through 2007)	**11.4**	**7.63**	**8.64**

Source: Original

Alternative (SNL/NM 1998c). This projection was subtracted from the KAFB withdrawals prior to application of the water conservation factor. Only the water conservation factor was applied to the 1994 KAFB withdrawal of $166.7x10^6$ ft^3. KAFB withdrawals have been and are projected to continue to be significantly below the amount allowed by their water rights, $278.7x10^6$ ft^3 (Bloom 1972).

It is expected that the San Juan/Chama Project (COA 1997b) will be on-line in approximately 2004. The project will allow the city of Albuquerque to meet its normal water demands from Rio Grande water. The river water would be replenished using water from city-owned water rights to the San Juan/Chama Diversion Project. Groundwater withdrawals will be used only to supplement these normal demands. All of the city wells will remain on-line and ready for operation. Which wells will be operated (and how often and how much) has not yet been determined. Although it is safe to say that the Ridgecrest well withdrawal would decrease substantially, the analysis given here conservatively assumes groundwater continues as the chief supplier of water to the region.

The proposed Mesa del Sol Project will be a potential major contributor to groundwater usage in the KAFB vicinity for the period of analysis (NMSLO 1997). For

Table B.2–3. Projected Groundwater Withdrawal (1998 through 2007) in the KAFB Vicinity Under the No Action Alternative

YEAR	WITHDRAWAL (10^6 ft^3)				
	RIDGECREST	KAFB (EXCLUSIVE OF SNL/NM)	SNL/NM	MESA DEL SOL	ANNUAL TOTAL
1998	350.7	95.6	59.4	0	505.7
1999	343.6	92.4	59.6	0	495.6
2000	336.4	89.1	59.9	10.7	496.1
2001	329.3	85.8	60.2	32.0	507.3
2002	321.4	82.6	60.4	53.4	517.8
2003	313.2	79.3	60.7	74.7	527.9
2004	305.3	76.1	60.9	96.1	538.4
2005	309.8	76.1	61.2	117.4	564.5
2006	314.3	76.1	61.4	138.8	590.6
2007	319.2	76.1	61.7	160.1	617.1
TOTAL	**3,243.2**	**829.2**	**605.4**	**683.2**	**5,360.0**

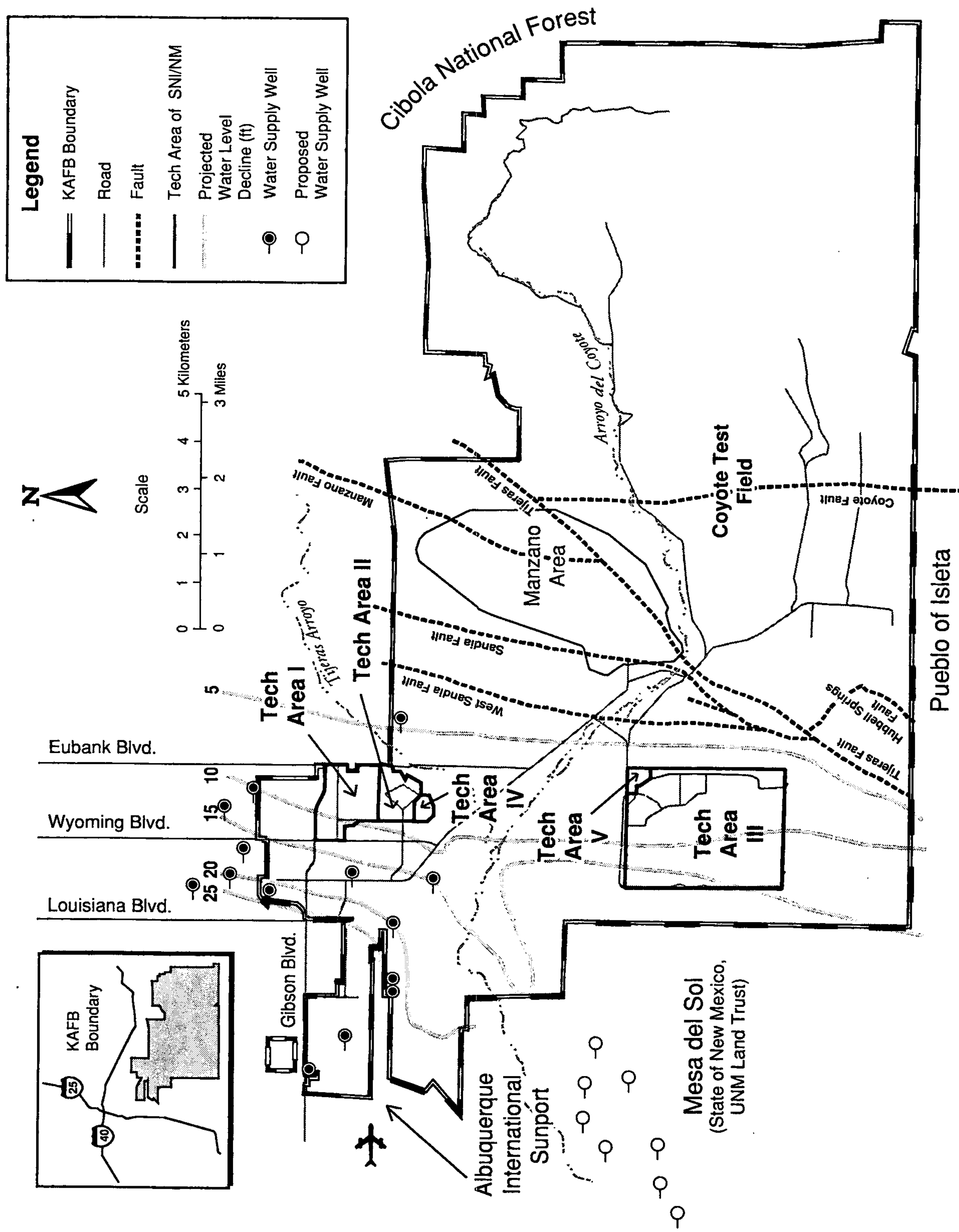
Source: Original
ft^3: cubic feet

KAFB: Kirtland Air Force Base
SNL/NM: Sandia National Laboratories/New Mexico

this projection, it was assumed that 20,000 persons (of the eventual 97,500 total) will be resident in 2007, with the year 2000 being the beginning of residential groundwater usage. The city's post-30 percent reduction goal of 175 gal per day per person was assumed for Mesa del Sol. Projected Mesa del Sol withdrawals for the period 1998 through 2007 are shown in Table B.2–3. As with the city of Albuquerque, it is planned that Rio Grande water will be used to satisfy average Mesa del Sol usage requirements; groundwater wells will supplement this surface water. The withdrawals shown in the table conservatively assume that the entire community usage is from groundwater. Although Mesa del Sol's water usage is similar to SNL/NM's for the period of SWEIS performance, projected continued growth of Mesa del Sol beyond 2007 would result in significant increases in water usage.

Under the No Action Alternative, the total groundwater withdrawal in the KAFB vicinity, projected for the period from 1998 through 2007, is the sum of Kirtland, Ridgecrest, and Mesa del Sol withdrawals, 5,360 M ft^3 (Table B.2–3). This withdrawal is 77.2 percent of the 6,941 M ft^3 withdrawn during the 12-year period, 1985–1996 (Table B.2–1). Assuming a linear relationship between local water use and drawdown, projected drawdowns over the 10-year period, 1998–2007, would be 77.2 percent (5,360 M ft^3/ 6,941 M ft^3) of the drawdowns shown in Figure B.2–1. Figure B.2–2 shows these projected drawdowns across KAFB for the 10-year period, 1998–2007. The maximum drawdown on KAFB during the 1985–1996 period was 36 ft, which would correspond to a maximum projected drawdown over the period, 1998–2007, of 27.8 ft (77.2 percent of 36 ft.)

The projected SNL/NM water use for the period 1998 through 2007 varies 10 percent (12 percent including the Microsystems and Engineering Sciences Applications [MESA] Complex configuration in the Expanded Operations Alternative) or less among the three alternatives, being 605.4, 628 (635 M ft^3 including MESA), and 570.7 M ft^3 under the No Action, Expanded Operations, and Reduced Operations Alternatives, respectively. The SNL/NM water use corresponds, therefore, to approximately 11 percent (12 percent under the Expanded Operations Alternative) of the projected withdrawal in the KAFB vicinity, and 3 ft of water level decline over 10 years.



Sources: NMSLO 1997; SNL/NM 1997a, j

Figure B.2–2. Projected Albuquerque-Belen Basin Groundwater Level Declines Under the No Action Alternative, 1998 through 2007

During the period 1998 through 2007, aquifer levels at KAFB are projected to decline as much as 28 feet.

B.3 SURFACE WATER QUANTITY

The following section describes calculations and assumptions used to estimate the contribution of SNL/NM storm water runoff to surface water quantity in the Rio Grande. This set of calculations estimates excess precipitation runoff from the presence of relatively impermeable surfaces at SNL/NM. The excess precipitation runoff applies to the No Action, Expanded Operations, and Reduced Operations Alternatives, as no significant variation of input parameters is expected under each of the alternatives.

The Montessa Park gaging station, operated by the U.S. Geological Survey (USGS), is located on Tijeras Arroyo, 0.8 mi downstream from where Tijeras Arroyo exits KAFB. The drainage area at this point is 122 mi^2 (USGS 1998). Impervious surfaces covered by SNL/NM include buildings (0.595 mi^2) and parking lots (0.125 mi^2) (SNL/NM 1997j). The total SNL/NM area covered by impervious surfaces is 0.72 mi^2. This number would remain the same under each of the alternatives. A comparison of the runoff potential of this area in its natural state with its developed state is in Table B.3–1.

Comparing the 5.3 percent effective increase in watershed area resulting from the presence of SNL/NM with measured flows at the Montessa Park gaging station allows an estimate of the SNL/NM contribution to runoff within Tijeras Arroyo. Assuming (conservatively) that all flow at the Montessa Park gaging station will reach the Rio Grande (5 mi downstream), the percentage contribution to Rio Grande flow can then be calculated (Table B.3–2).

Note that the volumes in Table B.3–2 are annual totals. Flow at the Montessa Park gaging station was measured

Table B.3–1. Comparison of Natural and Developed Runoff Potential at SNL/NM

PARAMETER KEY	PARAMETER DESCRIPTION	PARAMETER VALUE
A	Natural runoff percentage (conservative estimate)[a]	10%
B	Developed area runoff percentage (conservative estimate)	100%
C	Ratio of developed area runoff percentage to natural runoff percentage (B/A)	10
D	Current developed (impervious) area[b]	0.72 mi^2
E	Size of natural area for equivalent runoff (D x C)	7.2 mi^2
F	Effective increase in drainage area (E - D)	6.48 mi^2
G	Montessa Park drainage area[c]	122 mi^2
H	Effective percentage increase in watershed area (F/G)	5.3%

Sources: [a]SNL/NM 1997a, [b]1997j, [c]USGS 1998
mi^2: square miles

Table B.3–2. Values Used for Calculation of SNL/NM Storm Water Runoff Contributions to Tijeras Arroyo and Rio Grande Flow

YEAR	MONTESSA PARK FLOW VOLUME (ft^3)	SNL/NM CONTRIBUTION (5.3%) TO FLOW (ft^3)	RIO GRANDE FLOW VOLUME (ft^3)	SNL/NM CONTRIBUTION TO RIO GRANDE FLOW (percent)
1993	1.84×10^6	97,520	5.97×10^{10}	0.00016
1994	13.1×10^6	694,300	5.41×10^{10}	0.0013
1995	6.5×10^6	344,500	6.78×10^{10}	0.00051

Source: USGS 1998
ft^3: cubic feet
SNL/NM: Sandia National Laboratories/New Mexico

only on 20 days in the 1993 through 1995 period, all during summer storm events. During these periods, the SNL/NM contribution to Rio Grande flow was likely higher than the percentages calculated above. However, these storm events would also contribute to higher Rio Grande flow because of runoff in surrounding areas, particularly the large paved areas of Albuquerque. For example, on the day during the 1993 through 1995 period when the greatest flow in Tijeras Arroyo was measured at the Montessa Park gaging station, Rio Grande flow increased by nearly 400 percent from the previous day (USGS 1998). Because the major SNL/NM contribution to surface water quantity is discharge to the water reclamation plant (Section 5.3.4), and this discharge amount will remain relatively constant regardless of Rio Grande flow, the total SNL/NM percentage contribution to Rio Grande flow may actually decrease during storm events.

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APPENDIX C – CULTURAL RESOURCES

C.1 INTRODUCTION

This appendix provides supplemental information used in determining potential impacts to cultural resources located within the region of influence (ROI), which includes Kirtland Air Force Base (KAFB) and the U.S. Department of Energy (DOE) Buffer Zone. The information presented here is more detailed than that provided in the main body of the Site-Wide Environmental Impact Statement (SWEIS) and is intended to answer potential questions the reader may have concerning cultural resources. Sections include an overview of previous cultural resource work in the ROI, an explanation of the research methods used to identify cultural resources located in the ROI, a discussion of the cultural history of the ROI, and a description of the cultural resources present in the ROI.

C.2 OVERVIEW OF PREVIOUS CULTURAL RESOURCE STUDIES

Many cultural resource studies of varying scope have been completed for areas within KAFB and the DOE Buffer Zone. While most of these studies were contracted in compliance with Sections 106 and 110 of the *National Historic Preservation Act* (NHPA) as amended (16 United States Code [U.S.C.] Section [§] 470), other studies include regional syntheses and academic papers. Table C.2–1 presents the types and numbers of cultural resource studies conducted in the ROI.

The draft *Cultural Resource Management Plan for Kirtland Air Force Base New Mexico* addresses resources across the entire base (Trierweiler 1998). Previous to this plan, two major compiled works were completed for the ROI. A comprehensive program review was completed in 1988 that evaluated the previous work conducted at KAFB and made suggestions for improvement of the compliance survey process (Lintz et al. 1988). In 1992, a research design was developed for KAFB that provided an integrated framework from which to assess a site's research potential and make determinations of National Register of Historic Places (NRHP) eligibility (Seymour 1992). Much of the material from these two earlier documents was incorporated into the current draft cultural resource management plan for the base (Trierweiler 1998). Due to the paucity of identified cultural resources under DOE jurisdiction in the ROI, the DOE has not prepared a cultural resource management plan.

Table C.2–1. Numbers of Cultural Resource Studies Conducted

TYPE OF STUDY	NUMBER
Plans and Research Designs	2
Archaeological Inventories	139
Architectural Inventories	6
Archaeological Testing	4
Archaeological Excavations	1
Special Purpose Studies	9
TOTAL	161

Source: Trierweiler 1998

Archaeological inventories comprise the majority of the cultural resource studies conducted within the ROI. These studies have been conducted by a variety of agency officials and private sector consultants. Of the 139 inventories conducted, over 80 percent have been conducted in the past 10 years. Since 1989, the inventories appear to have been conducted primarily for NHPA (16 U.S.C. §470) Section 106 compliance for specific undertakings, resulting in more numerous, but smaller surveys. Five hundred eighty-four architectural properties, including most 40 plus-year-old buildings and structures in areas under KAFB jurisdiction, have been assessed in only 6 architectural inventories (Trierweiler 1998).

Little excavation has occurred at sites located in the ROI. This is because archaeological testing has been made obsolete in many instances by the evaluation of NRHP eligibility during the inventory phase. Because much of the ROI has been inventoried for cultural resources, planners are able to design undertakings so that known archaeological sites are not affected, thus removing the need for data recovery to mitigate impacts. Five sites have been tested for eligibility, and one site, Two Dead Junipers (NM 0:3:1:11), has been fully excavated to mitigate ongoing erosional damage to the site. Numerous architectural features and four human burials were revealed during excavation of this site; however, the excavation has not been formally reported. Mitigation of impacts to eligible architectural resources has not been completed for any resources in the ROI. However, the DOE has completed Historic American Buildings Survey Level II quality documentation of three buildings in the old section of Technical Area (TA)-II (901, 904, and 907) (Laskar 1997b) and state of New Mexico building inventory forms for other buildings in that TA. The DOE has determined that these buildings in TA-II comprise a district eligible to be listed on the NHRP and has received concurrence from the State Historic Preservation Officer (SHPO) that the completed documentation mitigates the effects of decontamination and demolition of these buildings. The DOE is seeking concurrence from the Advisory Council on Historic Preservation.

Some of the cultural resource studies that have been conducted do not address the identification or mitigation of archaeological or architectural sites. These special-purpose studies address adjunct issues to archaeology, such as Native American land use (Holmes 1996a), oral history (Holmes 1996b), palynological studies, geophysical studies (Frederick & Williamson 1997), and procedures for complying with the *Native American Graves Protection and Repatriation Act* (NAGPRA) (25 U.S.C. §3001) (Roxlau & White 1998). These works will facilitate future research and compliance with cultural resource laws and regulations.

C.3 RESEARCH METHODS: IDENTIFICATION OF CULTURAL RESOURCES

C.3.1 Prehistoric and Historic Archaeological Resources

Information on the prehistoric and historic archaeological resources in the ROI was obtained from a number of sources. Primary sources include the 377th Air Base Wing/Environmental Management Division at KAFB and the Integrated Risk Management Department of Sandia National Laboratories/New Mexico (SNL/NM). Other sources of information include the New Mexico Office of Cultural Affairs, Historic Preservation Division, Archaeological Records Management Section; the New Mexico State Register of Cultural Properties; and the University of New Mexico, Maxwell Museum of Anthropology. A review of published records and literature was also conducted. Because of the large number of studies that have been completed for cultural resources in the ROI, the literature was plentiful and complete. Finally, detailed information concerning cultural resources located within the ROI is maintained by the SNL/NM Facility Geographic Information System Program office. This database was used for analysis of impacts to cultural resources.

C.3.2 Traditional Cultural Properties

Prior to preparation of the SWEIS, little ethnographic work had been conducted to determine the presence of traditional cultural properties (TCPs) in the ROI, and little published literature existed on the topic. Two studies have been conducted for KAFB regarding historical land use of the area (Holmes 1996a and 1996b). These studies identified Anglo, Hispanic, and Native American uses of the land through interviews with people who had familial connections to homesteaders in the KAFB area. This information, along with written records, provides a rather detailed overview of Hispanic and Anglo use of the area during historic times, which consisted of homesteading, farming, ranching, and mining; however, information on Native American use is overly general. Because of this, more information was sought to identify Native American TCPs.

The primary method for identifying Native American TCPs in the ROI, which might be affected by SNL/NM activities, was direct consultation with the Native American tribes. This consultation was conducted to identify the presence and locations of TCPs, to assess potential impacts from SNL/NM activities, and to provide recommendations for protecting TCPs from any adverse effects of future SNL/NM activities.

Fifteen Native American tribes were identified for consultation, based on information from the New Mexico SHPO and the University of New Mexico's Maxwell Museum of Anthropology (Sebastian 1997, Dorr 1997). The information provided by the SHPO is based on the Indian Land Claims Commission hearings in the 1970s and is derived from the testimony provided by the tribes, not on the decisions made by the commission (Sebastian 1997). The information provided by the Maxwell Museum is used by the museum to consult with tribes under NAGPRA (Dorr 1997). The following 15 tribes were initially contacted:

- Hopi Tribe
- Jicarilla Apache Tribe
- Navajo Nation
- Pueblo de Cochiti
- Pueblo of Acoma

- Pueblo of Isleta
- Pueblo of Jemez
- Pueblo of Laguna
- Pueblo of San Felipe
- Pueblo of Sandia
- Pueblo of Santa Ana
- Pueblo of Santo Domingo
- Pueblo of Ysleta del Sur
- Pueblo of Zia
- Pueblo of Zuni

Ethnographic literature was examined to understand the potential for and types of TCPs that could be located within the ROI for each of the tribes. The consultation process consisted of one to three stages, dependent on the response of the individual tribes.

- *Stage 1: Initial Consultation with Potentially Interested Tribes.* This stage involved identifying the appropriate contact, usually the director of the tribal environmental or cultural resources department, at each of the 15 tribes. A letter was sent to this contact, as well as to the governor/chairman/president of each tribe, describing the SWEIS and the effort underway to identify TCPs, asking if the tribe had concerns for TCPs in the ROI, and offering to provide a project briefing to the tribe at their convenience. This letter also enclosed copies of the SWEIS Public Involvement Plan (DOE 1997d), the Notice of Intent to prepare the SWEIS (62 Federal Register (FR) 104, pp. 29332-29335), and a summary of the comments received during the public scoping period. Telephone calls were then made to each of the tribal contacts. When requested, the tribes were provided with project briefings by the DOE Project Manager, Tetra Tech NUS (TtNUS) Project Manager, and TtNUS Cultural Resource Specialist to introduce the SWEIS and inquire whether or not the tribe wished to continue the consultation process to identify specific TCPs within the ROI.
- *Stage 2: Continued Consultation with Interested Tribes.* Consultation continued for those tribes who expressed a concern for specific TCPs potentially located within the ROI. Each interested tribe designed the methods used to continue the consultation with them. These methods included review of environmental and archaeological information pertaining to the ROI, field visits to the ROI, and interviews with tribal representatives, leaders, elders, and resource specialists. Efforts were made to locate and identify TCPs in the ROI, document concerns of potential impacts to these resources due to SNL/NM activities, and document suggestions for measures to mitigate these potential impacts and protect the TCPs. At this stage, all tribes involved the TtNUS Cultural Resource Specialist in this research, although some tribes conducted interviews with tribal members themselves or prepared reports of their findings for submission to the specialist for the preparation of the SWEIS. All information received from the tribes was protected with strict confidentiality. Official procedures to protect the information were developed and followed throughout the consultation process and development of the SWEIS.
- *Stage 3: Review of Consultation Results.* Upon completion of consultation with each tribe, the tribe was given the opportunity to review the results of the consultation that would be used for preparation of the cultural resource sections of the SWEIS. This was a separate review process that was limited only to the reference materials pertaining to that particular tribe. Review comments were addressed and cultural resource sections of the SWEIS were edited to reflect relevant comments.

C.4 REGION OF INFLUENCE CULTURAL HISTORY

The cultural history of the ROI dates from 10,000 B.C. Archaeologists use different frameworks to classify cultural resources. For the northern Southwest, three major cultural frameworks are generally used: the Oshara Tradition (Irwin-Williams 1973), the Pecos Classification (Kidder 1927), and the Northern Rio Grande Sequence (Wendorf & Reed 1955). The Oshara Tradition, originally identified in an area northwest of Albuquerque, documents the development from Archaic Stage hunting and gathering lifestyles to the beginning of agriculture and sedentism, traits generally attributed to the Ancestral Puebloan way of life. The Northern Rio Grande Sequence emphasizes cultural development specific to the northern Rio Grande during the later Ancestral Pueblo period. The Pecos Classification, though developed for the Four Corners region of the Southwest, is included here because many researchers working in the Albuquerque area have used this framework. However, the Oshara Tradition and Northern Rio Grande Sequence are most applicable to the Albuquerque area and to the ROI in particular

(Trierweiler 1998). Figure C.4–1 illustrates the relationship among these three cultural frameworks.

The characteristics of the various cultural periods represented in the ROI have previously been described many times (Stuart & Gauthier 1984, Cordell 1984). Also, detailed syntheses of the cultural resources located in the ROI within these periods are available (Larson et al. 1998; Trierweiler 1998). Table C.4–1 summarizes the characteristics of the cultural periods and lists the number of NRHP-eligible sites in the ROI that contain artifacts from these periods. Note that some sites were used more than once throughout prehistory and history and have artifacts that date to different periods, resulting in sites that date to more than one period. Also, some sites contain artifacts that are not identifiable to a specific cultural period.

C.4.1 Paleoindian Stage (10,000 to 5500 B.C.)

Evidence of Paleoindian occupation along the Rio Grande begins around 10,000 B.C. Paleoindians practiced a mobile, hunter/gatherer way of life. They relied on hunting now-extinct megafauna such as mastodon, mammoth, horse, American camel, and several bison species, as well as rabbit, deer, and antelope, and on collecting wild plant foods (Trierweiler 1998). Paleoindian sites are largely known from scattered finds of projectile points indicative of the time period and are usually found in heavily eroded contexts. The association between the sites and badly eroded surfaces suggests that many Paleoindian sites remain buried within this region of the Southwest (Stuart & Gauthier 1984). Evidence for Paleoindian occupation in the vicinity of KAFB has been found on the East Mesa near the Manzano Mountain foothills, on Mesa del Sol to the west, and through Tijeras Canyon to the northeast (Larson et al. 1998). Three NRHP-eligible sites containing Paleoindian artifacts and two isolated projectile points have been identified in the ROI.

C.4.2 Archaic Stage (5500 B.C. to A.D. 400)

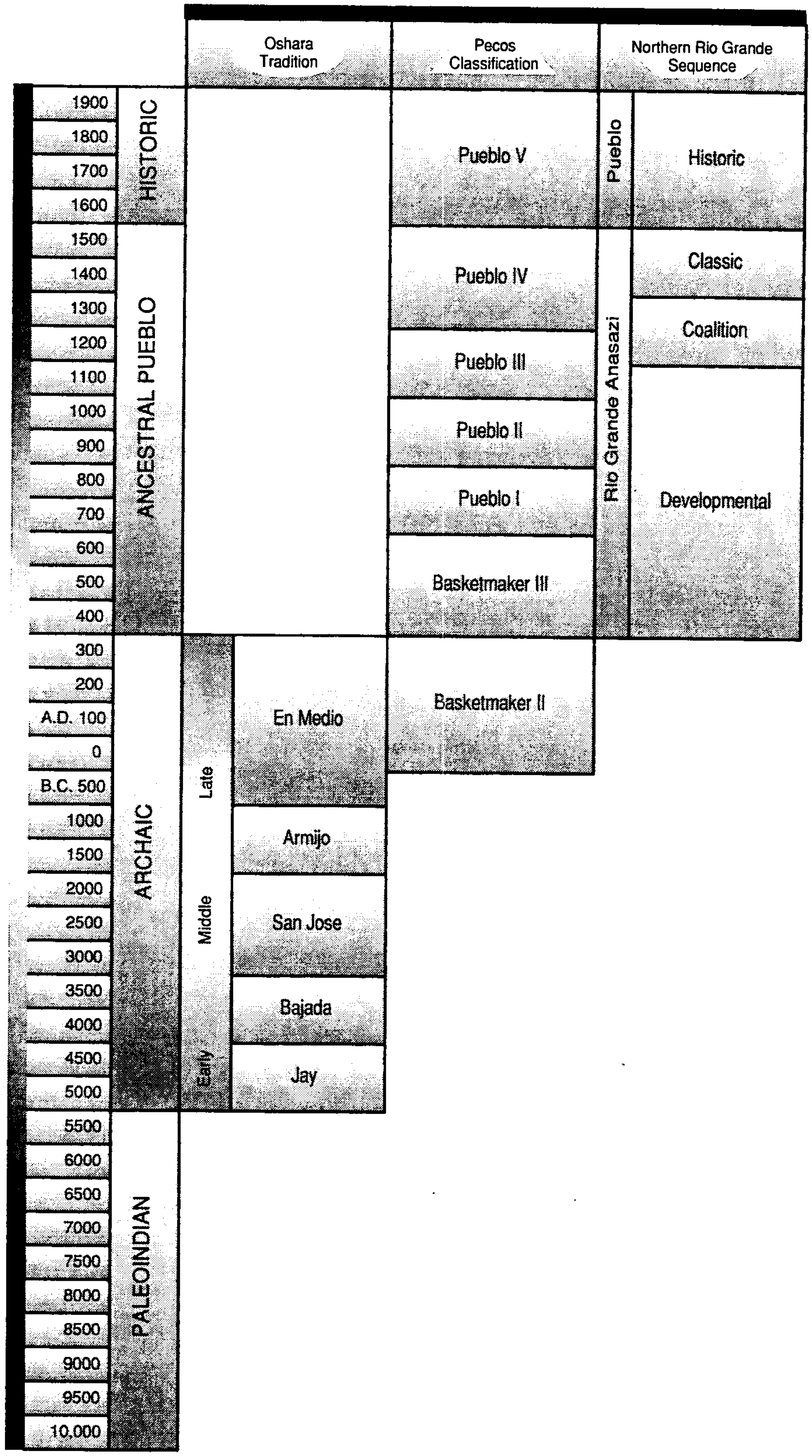
The beginning of the Archaic Stage coincides with a major climatic change and the extinction of the megafauna. The cooler, wetter climate shifted to drier, warmer conditions more common today. The lifestyle of the people changed during this stage. Big game hunting was slowly replaced by a reliance on a more diverse food supply, including a variety of animal species, and the increasing importance of plant collection. Toward the end of the stage, maize and squash plants were introduced into the diet and evidence exists for increasing importance of maize agriculture (USAF 1995c, Trierweiler 1998). The mobile lifestyle remained; however, evidence suggests the repeated use of certain sites. Sites dating to the Archaic Stage are situated in a greater diversity of environments, usually in areas where a great variety of plants and animals are available (USAF 1995c). This trend toward diversity is echoed in the artifacts found at Archaic Stage sites, such as smaller projectile points and the presence of plant grinding tools. The variety of tools indicates a wide range of activities involving hunting, gathering, food processing, butchering, preparing hides, woodworking, and manufacturing stone tools. Numerous Archaic Stage sites are located in the vicinity of the ROI, specifically along Tijeras Canyon, on Mesa del Sol, and in the area of the Albuquerque International Sunport. Thirty-one NRHP-eligible sites in the ROI contain Archaic Stage artifacts and cultural remains.

C.4.3 Ancestral Pueblo Stage (A.D. 400 to 1540)

Sometime around A.D. 400, the introduction of ceramics marks the beginning of the Ancestral Pueblo Stage. Throughout this stage, agriculture became increasingly important, allowing a more sedentary lifestyle to develop, which in turn led to other distinctive changes. The Ancestral Pueblo Stage is divided into three periods: Developmental, Coalition, and Classic. Eighteen NRHP-eligible sites in the ROI have artifacts and remains from this stage that cannot be assigned to a specific period.

C.4.3.1 Developmental Period (A.D. 400 to 1200)

The Developmental Period is one of gradual change from the Late Archaic Stage lifestyle to one defined by increased sedentism and agriculture. Larger scale agriculture permitted increased sedentism, suggested by the introduction of ceramics; the construction of more substantial semi-subterranean houses, called pithouses, that were inhabited for longer periods during the year; and an increase in the amount of trade goods (Larson et al. 1998). Early Developmental Period sites appear to have generally contained four to six pithouses, and sites are dispersed all along the Rio Grande Valley in the area of Albuquerque. Toward the end of the Late Developmental Period, surface adobe structures appear (though pithouses are still used) and site size increases. Developmental Period sites are numerous in the Tijeras Canyon area, though little evidence was found on Mesa



Source: Trierweiler 1998

Figure C.4–1. Relationships Among Three Cultural Frameworks

Three frameworks (Oshara Tradition, Pecos Classification, and Northern Rio Grande Sequence) are used to classify cultural resources in the northern Southwest.

Table C.4–1. Cultural Framework, Characteristics, and Sites on KAFB and the DOE Buffer

TIME PERIOD	DATES	CHARACTERISTICS OF PERIOD	SITES WITH ARTIFACTS[a]
Paleoindian	10,000 to 5500 B.C.	Reliance on big game hunting and plant collection; mobile lifestyle, isolated sites; bones of megafauna such as mastodon, mammoth, and camel; lance-shaped projectile points for spears or darts	3
Archaic	5500 B.C. to A.D. 400	Reliance on smaller animals and increased plant collection; mobile lifestyle, scattered sites, returning to some sites; introduction of agriculture; smaller projectile points for hunting with darts; stone tools, flakes, chips, and hearths at sites	31
ANCESTRAL PUEBLO			
Developmental	A.D. 400 to 1200	Increased reliance on agriculture; more sedentism, multiple rooms (6 to 8) at sites; pithouses and above-ground adobe structures; ceramics are introduced; projectile points are smaller for bow and arrow	34
Coalition	A.D. 1200 to 1325	Increased agriculture, still hunting and gathering; increased sedentism, established communities with 13-30 rooms, population growing; pithouses still used, adobe dwellings increasing in number; ceramics refined, now use organic-based paints	59
Classic	A.D. 1325 to 1540	Increased agriculture, also hunting and gathering; ditch irrigation or seeps/springs to water fields; large, multi-storied pueblos, one- or two-room fieldhouses; introduction of glaze-paint decorated ceramics	24
HISTORIC			
Historic Pueblo	1540 to 1692	Introduction of the Spanish into the area, pueblo life continues; haciendas and other Hispanic architecture appear; historic ceramic styles appear; European artifacts, such as metal, appear; horses and equipment appear	6
Spanish Colonial	1692 to 1846	Spain and then Mexico have ownership; haciendas and rancheros abundant; continued European and some American artifacts; limited mining; lots of ranching and farming	86[b]
U.S. Territorial/ Statehood	1846 to 1942	U.S. gains ownership of Territory; railroad arrives and population booms; mining claims increase; homesteads are established; New Mexico becomes a state; Kirtland Army Airfield established	[b]
World War II	1942 to 1945	Airfield plays limited role in developing and delivering first atomic weapons; airfield used for aircraft maintenance school, convalescent hospital, and storage of old aircraft; "Z" division, forerunner of SNL/NM, established	6 buildings
Cold War	1945 to 1989	SNL/NM designated by Congress; SNL/NM conducts defense, energy, and nuclear research; expansion of facilities leads to acquisition of lands through permits, lease, and withdrawal	TA-II and 3 buildings

Sources: Larson et al. 1998, SNL/NM 1997a, Stuart & Gauthier 1984, Trierweiler 1998
NRHP: National Register of Historic Places
SNL/NM: Sandia National Laboratories/New Mexico
TA: technical area

[a] Only includes sites recommended as eligible or potentially eligible to the NRHP.
[b] Spanish Colonial and U.S. Territorial/Statehood are not treated separately in the available data.
Note: Forty-one sites contain prehistoric artifacts that are not identifiable as to time period. Four sites contain artifacts not identifiable as prehistoric or historic.

de Sol to the west of KAFB (Trierweiler 1998). There are 34 NRHP-eligible sites in the ROI that contain artifacts and cultural remains dating to the Developmental Period.

C.4.3.2 Coalition Period (A.D. 1200 to 1325)

This period is defined by an increase in population, either moving in from outside areas or from internal population growth, which resulted in changes to lifestyle. The number and density of sites increased, with settlement shifting from dispersed habitations to aggregated communities (Larson et al. 1998). Although pithouses still occur, aboveground structures increase in number, and the number of structures per site increases dramatically to an average of 13 to 30 rooms per site. The large increase in population is a function of continuing and developing agricultural practices. Ceramic production during this period is further refined, and a shift is made at the beginning of the period from mineral-based paints to organic-based paints. Tijeras Canyon survey data indicate abundant Coalition Period occupation. There are 59 NRHP-eligible sites in the ROI with Coalition Period artifacts.

C.4.3.3 Classic Period (A.D. 1325 to 1540)

The beginning of the Classic Period is marked by both social and technological change (Trierweiler 1998). Data suggest a dramatic increase in population in the Albuquerque region, with the aggregation of the Rio Grande Valley population into large multi-storied adobe pueblos, some containing over 1,000 rooms (Stuart & Gauthier 1984). Most of these sites focus on river valley locations, with ditch irrigation of agricultural fields. Higher elevation communities seem to be concentrated around seeps and springs, suggesting diverse agricultural practices. A major technological change in ceramic production marks the beginning of this period, with the introduction of glaze paint-decorated pottery. The appearance of glazewares is considered to be evidence of an influx of people or ideas into the Rio Grande Valley from the western part of the state and the Little Colorado area. There are 24 NRHP-eligible sites with Classic Period cultural remains in the ROI.

C.4.4 Historic Stage (A.D. 1540 to present)

C.4.4.1 Historic Pueblo Period (1540 to 1692)

The arrival of Francisco Vasquez de Coronado to the Albuquerque area marks the beginning of the Historic Stage. His explorations were followed by other Spanish expeditions, and, by 1610, missions existed at many of the major pueblos along the middle and upper Rio Grande. Before the Pueblo Revolt in 1680, Hispanic settlers occupied the region between Kuaua and Isleta Pueblos and forced the people in the pueblos to furnish labor. After 1692, when New Mexico was once again under Spanish control, settlers could not legally force the labor of a declining pueblo population. The ROI contains six NRHP-eligible Historic Pueblo sites.

C.4.4.2 Spanish Colonial and U.S. Territorial Periods (1692 to 1942)

During the eighteenth and nineteenth centuries, few economic opportunities were available in the Albuquerque area before the arrival of the railroad. Farming and ranching were the principal activities. Mining never proved to be viable and trade was restricted when the area was under Spanish and Mexican rule. Once the railroad arrived in 1880, mining claims increased and homesteads were established. Coyote Springs was a focus of development in the twentieth century (Holmes 1996b). Native American land use in the project area appears to have been limited to hunting, gathering of plants, woodcutting, grazing, and possibly ritual activity (Holmes 1996a). Historic sites located in the ROI are the product of Pueblo, Hispanic, or Euro-American use or occupation of the area. There are 86 NRHP-eligible sites in the ROI dating to these periods.

During the 1920s, the area that is now KAFB began its history of aviation and military use. In 1928, the city of Albuquerque built its first airfield, Oxnard Field, which consisted of 140 acres near the present National Atomic Museum. In 1930, a new municipal airport was built to the west of Oxnard Field as a Works Progress Administration government program.

C.4.4.3 World War II Period (1942 to 1945)

In 1942, the Secretary of War appropriated 1,100 acres, including the old Oxnard Field, for the U.S. Army Air Corps. In 1943, portions of the current Withdrawn Area were withdrawn to the Department of the Navy for testing associated with the prosecution of World War II. At the end of World War II, Oxnard Field was used for the storage of decommissioned military aircraft. Los Alamos used Kirtland Field, located to the west of the Army airfield, to meet transportation needs associated with developing and delivering the first atomic weapons. In mid-July 1945, jurisdiction over the site that eventually became SNL/NM was transferred to the

Manhattan Engineering District (SNL/NM 1997a). In July of 1945, Los Alamos established the forerunner of SNL/NM, known as "Z" Division, to handle future weapons development, testing, and bomb assembly for the Manhattan Engineering District. The "Z" Division facilities occupied former Army air base facilities consisting of wooden sheds and buildings. The Manhattan Engineering District authorized construction of additional guard, storage, administrative, and laboratory facilities (SNL/NM 1997a). In the ROI, six buildings associated with World War II activities have been assessed as eligible for listing on the NRHP.

C.4.4.4 Cold War Period (1945 to 1989)

Development and expansion of SNL/NM facilities continued throughout the Cold War era and to the present. More acreage of the Cibola National Forest was withdrawn to the USAF and DOE, and the Navy withdrawn area was eventually turned over to the Department of the Army and then the USAF. As more land was needed for testing, construction of facilities, and safety or buffer zones, SNL/NM acquired areas throughout KAFB through the DOE. The DOE owned, leased, and was permitted lands by KAFB, the state of New Mexico, and the Pueblo of Isleta, and acquired withdrawn areas from the U.S. Forest Service. Cold War-era buildings located in TA-II have been determined eligible as a district for listing on the NRHP. In addition, the ROI contains three other Cold War-era buildings determined to be potentially eligible to the NRHP.

C.5 CULTURAL RESOURCES IN THE REGION OF INFLUENCE

C.5.1 Prehistoric and Historic Archaeological Resources

The ROI under consideration in assessing the potential for impacts to cultural resources as a result of SNL/NM activities contains 284 identified prehistoric and historic archaeological sites (TRC 1998). It must be remembered that not all areas of the ROI have been 100 percent inventoried for archaeological sites, and that buried archaeological sites would likely not be identified during inventory. Thus the potential for more sites within the ROI is great.

All of these sites have been evaluated for eligibility for listing on the NRHP (TRC 1998). Of these sites, 132 were designated as eligible, 60 as potentially eligible (eligibility cannot be determined based on current data and further work is needed to make an evaluation; meanwhile, sites are determined to be potentially eligible until a formal evaluation is made), and 92 as not eligible for nomination to the NRHP. As stated in Volume I, Section 4.8, the assessment of impacts to cultural resources in the SWEIS addresses only those archaeological sites that have been determined eligible or potentially eligible, thus only 192 sites are included in the assessment of potential impacts. Table C.5–1 shows the distribution of the archaeological sites by landowner.

Various types of archaeological sites are represented in the ROI. Ninety-eight sites contain evidence only of historic use, of which 46 sites (47 percent) are determined to be eligible or potentially eligible. One hundred twenty-seven sites have evidence of prehistoric use only, 99 of which (78 percent) are eligible or potentially eligible. Fifty-four sites contain evidence of both historic and prehistoric use, of which 42 sites (78 percent) are eligible or potentially eligible. Five sites, which are of undetermined age, are also evaluated as eligible or potentially eligible (TRC 1998).

The archaeological sites present in the ROI are of varied morphological types. Morphology refers to the type of physical remains at a site. Predominant among the prehistoric sites are scatters of artifacts, sometimes with features. Some artifact scatters consist of only stone debitage from tool making and some tools themselves, while others have only ceramic sherds or have both stone and ceramic artifacts. Some sites just have the artifact scatter, while others have features associated with the scatter. These features are often thermal features (such as hearths or ash pits) or structural features (such as remnants of walls or other forms of structures). The historic sites also often consist of artifact scatters, except that the artifacts present are things such as fragments of metal, pieces of ceramic or porcelain dishes, household items such as kitchen utensils, and other items one might find associated with a habitation. These scatters are often associated with features such as historic fences, roads, mining features (for example, placer mining pits), or remnants of habitations.

Sites are often interpreted as to function (such as what it was used for or what was done at the site). Sites often have more than one function, either within the same time period of use or throughout different periods of use. An example is a site that was used prehistorically for processing stone materials and was later used historically for habitation and mining. This one site has three different functions. The different site functions identified for the sites in the ROI are presented in Table C.5–2.

Table C.5–1. Distribution of Prehistoric and Historic Archaeological Sites in the Region of Influence by Land Owner

LAND OWNER		NUMBER OF ARCHAEOLOGICAL SITES	
		ALL SITES	ELIGIBLE OR POTENTIALLY ELIGIBLE SITES
DOE		0	0
USAF		130	86
USFS	*withdrawn to DOE*	41	35
	withdrawn to USAF	110	68
Leased to DOE	*by the state of New Mexico*	3	3
	by the Pueblo of Isleta	0	0
TOTALS		**284**	**192**

Source: TRC 1998
DOE: U. S. Department of Energy
USAF: U. S. Air Force
USFS: U. S. Forest Service

Table C.5–2. Site Functions Represented in the Prehistoric and Historic Archaeological Sites in the Region of Influence

SITE FUNCTIONS	NUMBER OF SITES IN THE ROI WITH THESE FUNCTIONS	NUMBER OF ELIGIBLE OR POTENTIALLY ELIGIBLE SITES IN THE ROI WITH THESE FUNCTIONS
PREHISTORIC FUNCTIONS		
Habitation	53	52
Campsite	80	68
Agriculture	3	3
Limited activity area	36	15
Resource processing	7	3
HISTORIC FUNCTIONS		
Habitation	30	26
Campsite	9	3
Mining	57	26
Fence/road	6	0
Agriculture/ranching	15	12
Trash dump	5	2
Historic Pueblo use	7	5
Schoolhouse	1	1
Military	1	1
Unknown function	23	14

Source: TRC 1998
ROI: region of influence

C.5.2 Architectural Properties

Five hundred seventy-nine buildings and structures and one historic district within the ROI have been recorded, and these are at various stages in the evaluation for eligibility for listing on the NRHP. Most of the buildings and structures owned and used by SNL/NM are less than 50 years old, and thus have not been assessed for eligibility to the NRHP. As the architectural properties in the five TAs attain 50 years in age, the DOE will assess them for eligibility to the NRHP (Merlan 1991).

All of TA-II and 52 DOE properties in TA-I have been assessed. None of the 52 properties assessed in TA-I are considered to be eligible or potentially eligible for inclusion in the NRHP, a determination that has received concurrence from the SHPO (Sebastian 1993, Merlan 1993). TA-II has been determined eligible for the NRHP as a district, with many of the larger buildings in the TA contributing to that status (DOE 1998o).

C.5.3 Traditional Cultural Properties

The DOE initiated consultations with 15 Native American tribes to identify the presence of TCPs within the ROI, determine any potential impacts to these TCPs from SNL/NM activities, and develop mitigation measures to address potential impacts to these TCPs. These tribes were selected for consultation based on information provided by the SHPO (Sebastian 1997) and the Maxwell Museum of Anthropology at the University of New Mexico (Dorr 1997). One tribe, Ysleta del Sur, did not participate in the consultations. The results of the consultations are detailed below.

- *Hopi Tribe*—In response to the request for consultation, the Hopi Tribe's Cultural Preservation Office conducted an initial TCP study to determine concerns for TCPs potentially located at KAFB. The Hopi Tribe considers this study to be an initial step in a continuing consultation effort, not a complete assessment of all TCPs possibly located in the ROI; the study should form the basis for future consultations with the tribe regarding issues of cultural resources.

  The Hopi Tribe asserts cultural affiliation to the cultural sites on KAFB, and is concerned for the well-being and protection of those sites. The tribe wishes to be notified when activities have the potential to disturb cultural sites in the ROI and to be consulted under NAGPRA if and when the need arises. No TCPs were identified on KAFB during this initial study; if any are identified in the future, the Hopi Tribe wishes to have access to them for traditional and/or religious purposes.

- *Jicarilla Apache Tribe*—The Jicarilla Apache Tribe indicated a concern for natural and cultural resources in the ROI. No TCPs were identified.
- *Navajo Nation*—Per the instructions of the Navajo Historic Preservation Department, two chapters of the Navajo Nation, Cañoncito Chapter and Alamo Chapter, were consulted regarding the presence of TCPs in the ROI. Both chapters claimed to have no concerns for TCPs in the ROI. The Historic Preservation Department reported that the Navajo used the ROI in historic times for subsistence activities.
- *Pueblo of Acoma*—The Pueblo of Acoma claims cultural affiliation with the archaeological sites located in the ROI and claims traditional use of the area prior to its becoming restricted access. It may have TCPs in the ROI, but will not continue consultation at this time to identify specific TCPs. The Pueblo has concerns for the treatment of human remains discovered in the area and wishes to be consulted on NAGPRA issues.
- *Pueblo of Cochiti*—Although concerned with the protection of cultural resources in the ROI, this pueblo decided to discontinue consultation at this time.
- *Pueblo of Isleta*—Consultation is ongoing with the Pueblo of Isleta. The pueblo considers itself to be culturally affiliated to the archaeological sites located in the ROI and claims traditional use of the area before restricted access became effective. The pueblo might have TCPs in the ROI, but has not yet identified specific TCPs.
- *Pueblo of Jemez*—This pueblo has no concerns for TCPs in the ROI.
- *Pueblo of Laguna*—The Pueblo of Laguna reports that its aboriginal land claim includes KAFB and that the pueblo used this land for hunting and gathering of resources.
- *Pueblo of Sandia*—Consultation with the Pueblo of Sandia indicated a concern for the protection of cultural resources on KAFB. No TCPs were identified.
- *Pueblo of San Felipe*—This pueblo has no concerns for TCPs in the ROI.

- *Pueblo of Santa Ana*—The Pueblo of Santa Ana reports that the tribe does not have any TCPs in the ROI. They expressed concern for the treatment of human remains discovered in the ROI and requested to be consulted on NAGPRA issues.
- *Pueblo of Santo Domingo*—Although concerned with the protection of cultural resources in the ROI, this pueblo decided to discontinue consultation at this time.
- *Pueblo of Zia*—The Pueblo of Zia claims cultural affiliation with archaeological sites in the ROI; however, the pueblo does not have concerns for TCPs in the ROI.
- *Pueblo of Zuni*—In response to the request for consultation, the Pueblo of Zuni's Heritage and Historic Preservation Office conducted a TCP study for the purposes of the SWEIS. The pueblo considers this report to be an initial step in a continuing consultation effort and not a complete assessment of all TCPs possibly located in the ROI.

Although no specific TCPs were identified, the Pueblo of Zuni considers itself to be culturally affiliated with the prehistoric archaeological remains in the ROI and considers these remains to be of traditional cultural importance due to the spiritual and esoteric relationships between the remains and living Zuni people and culture. The Pueblo of Zuni recommends that all prehistoric archaeological sites be avoided to the extent possible. The pueblo has concerns for the treatment of human remains discovered in the area and wishes to be consulted for all NAGPRA issues. In the event of inadvertent discoveries in the ROI, the Pueblo of Zuni requests to be consulted regarding the treatment of archaeological remains, human remains, associated and unassociated funerary objects, sacred objects, and objects of cultural patrimony.

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APPENDIX D – AIR QUALITY

D.1 NONRADIOLOGICAL AIR QUALITY

This appendix supplements the analytical results presented in the Site-Wide Environmental Impact Statement (SWEIS) main text, Sections 5.3.7, 5.4.7, and 5.5.7. Modeling inputs and assumptions support the results for the nonradiological air quality environmental consequences. Chemical screening and refined analysis results are presented for receptor locations in the vicinity of Sandia National Laboratories/New Mexico (SNL/NM). The maximum chemical concentrations generated by an SNL/NM activity are calculated for selected receptor locations.

Site-specific emissions from SNL/NM are modeled in accordance with the guidelines presented in the U. S. Environmental Protection Agency (EPA) *Guideline on Air Quality Models* (40 *Code of Federal Regulations* [CFR] Part 51, Appendix W), the New Mexico Air Quality Bureau *Dispersion Modeling Guidelines* (NMAPCB 1996), and the Albuquerque Environmental Health Department (AEHD) *Permit Modeling Guidelines* (AEHD 1995).

Impacts were estimated from criteria pollutant emissions, chemical pollutant emissions, mobile (vehicular) source emissions, and open burning by modeling the emissions associated with each alternative during normal operations and comparing the resulting pollutant concentrations to the National Ambient Air Quality Standards (NAAQS), the New Mexico Ambient Air Quality Standards (NMAAQS), the Albuquerque/Bernalillo County Air Quality Control Board (A/BC AQCB) regulations for criteria pollutants, and guidelines for chemical concentrations. These regulations and guidelines represent conditions to which it is believed that nearly all of the general public may be repeatedly exposed, day after day, without adverse health effects.

D.1.1 Air Quality Dispersion Models

The EPA's *Industrial Source Complex Air Quality Dispersion Model* (*ISCST3*) was used to estimate the criteria pollutant concentrations from stationary sources at SNL/NM (EPA 1995a). This model was selected as the most appropriate model to perform the air dispersion modeling analysis from continuous emission sources because it is designed to support the EPA regulatory modeling program and is capable of handling multiple sources, including different source types. This model was also used to estimate chemical concentrations from emissions of chemicals from SNL/NM facilities. It estimates pollutant concentrations from normal operations at SNL/NM from stationary sources.

The *Mobile Source Emission Factor* (*MOBILE5a*) computer model (EPA 1994), which is the EPA-approved model for estimating emission factors from mobile sources, in conjunction with state implementation plans, was used to estimate carbon monoxide emissions from vehicular traffic. Emissions of carbon monoxide from vehicles represent the greatest contribution to overall carbon monoxide emissions in the region of influence (ROI). The model calculates emission factors in grams per mile, from which annual carbon monoxide emissions from mobile sources are calculated.

The *Open Burn/Open Detonation Dispersion Model (OBODM)* was used to evaluate the potential air quality impacts of open-air burning (Bjorklund et al. 1997). *OBODM* predicts the downwind transport and dispersion of pollutants using cloud rise and dispersion model algorithms. The model is used to estimate the pollutant concentrations from open burning at the Fire Testing Facility.

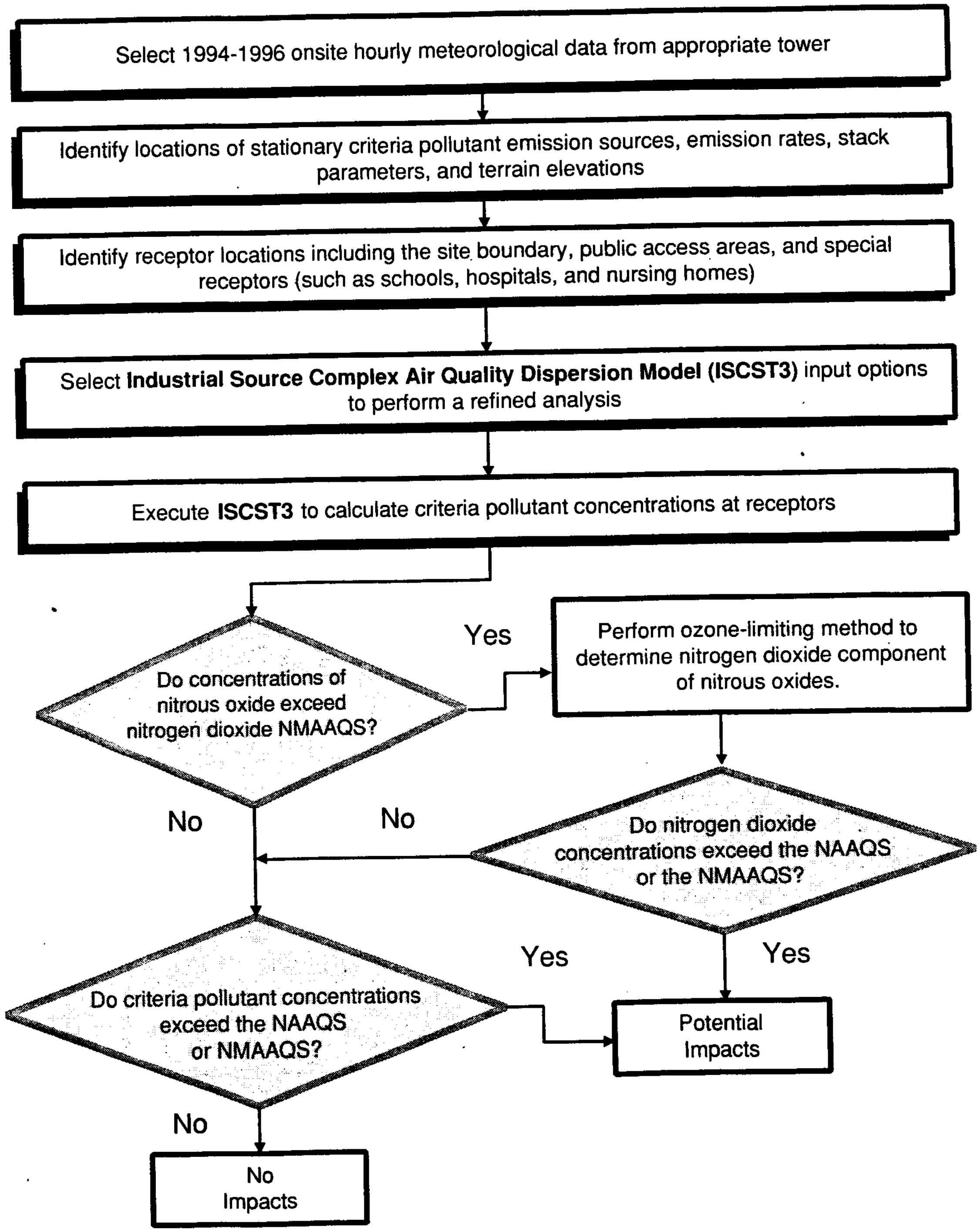
D.1.2 Criteria Pollutants

The criteria pollutants modeled using *ISCST3* include carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates, and particulate matter equal to or less than 10 μm diameter (PM_{10}). Concentrations of lead, ozone, hydrogen sulfide, and total reduced sulfur are provided from monitoring data where available. As of September 16, 1997, in addition to the PM_{10} NAAQS, a new NAAQS became effective for particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$). This new standard will not require imposition of local area controls until 2005, and compliance determinations will not be required until 2008. Additionally, the EPA revised the NAAQS and associated reference method for determining ozone attainment on July 19, 1997. This standard will also be applicable to SNL/NM. Figure D.1–1 presents the process used for evaluating the criteria pollutant emissions from SNL/NM.

The estimated emissions of criteria pollutants under the alternatives are modeled using the EPA-recommended *ISCST3* (dated 97363) model to estimate concentrations of criteria pollutants at or beyond the SNL/NM

Criteria Pollutants

Objective: Determine if concentrations of criteria pollutants from SNL/NM comply with the National Ambient Air Quality Standards (NAAQS) and New Mexico Ambient Air Quality Standards (NMAAQS)



Source: Original

Figure D.1–1. Example Flow Chart For Evaluation of Criteria Pollutants

A multi-step process is used to evaluate criteria pollutants.

boundary, including receptor locations such as public access areas (for example, the National Atomic Museum, hospitals, and schools). For those criteria pollutants for which emission data are not available, onsite monitoring data are presented in lieu of modeling results.

D.1.2.1 Emission Sources

The criteria pollutant emission sources at SNL/NM modeled using *ISCST3* were the following stationary combustion sources located in Technical Area (TA)-I:

- steam plant
- electric power generator plant
- boiler and emergency generator in Building 701
- 600-kW-capacity generator in Building 870b

Sequential hourly emissions, representing actual emissions for 1996 plus estimated emissions for the boiler and emergency generator in Building 701 and the 600-kW-capacity capacity generator in Building 870b, were used as emission source input to *ISCST3* to estimate criteria pollutant concentrations under the No Action Alternative. In addition to actual emission source locations, exhaust parameters (such as height, diameter, temperature, and flow rate) were based on engineering estimates from actual operating data for those existing emission sources. For future emission sources included in the No Action Alternative modeling, engineering estimates of emissions were made using the EPA *Compilation of Air Pollutant Emission Factors, Volume I* (AP-42) (EPA 1995b). Table D.1–1 presents annual average emission rates for criteria pollutant sources at SNL/NM.

D.1.2.2 Stack Parameters

Based upon the daily fuel usage and operating load conditions, the hourly emission rates, gas exit velocities, and exit temperatures for each of the steam plant boilers were determined. These hourly emission parameters were used as input into the *ISCTS3* model. Table D.1–2 presents an example of the source parameters for the steam plant boilers during a 100 percent load condition. Gas exit velocities vary between natural gas and #2 fuel oil usage.

Table D.1–3 presents the source parameters used for modeling purposes for Building 862 generators.

D.1.2.3 Receptors

Receptor locations include special receptors where concentrations of the public, children, and the infirmed are of special interest, such as public access areas, hospitals, and schools located beyond the SNL/NM boundary. Specific special receptors are included in the following locations:

- Child Development Center-East (Special)
- Child Development Center-West (Special)
- Coronado Club (Special)
- Golf Course
- Kirtland Air Force Base (KAFB) Housing
- Kirtland Elementary School (Special)
- Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)
- Lovelace Hospital (Special)
- National Atomic Museum (Special)
- Riding Stables
- Sandia Base Elementary School (Special)
- Shandiin Day Care Center (Special)
- Veterans Affairs Medical Center (Special)
- Wherry Elementary School (Special)

Universal transverse mercator (UTM) coordinates for each of the receptor locations were input into the model to determine the pollutant concentrations at that location. The maximum concentration for each criteria pollutant modeled for each of the averaging periods for five years of meteorological data is presented in Section 5.3.7.

D.1.2.4 Meteorological Data

Sequential hourly meteorological data for 1995 and 1996 from tower A15, and for 1994, 1995, and 1996 from tower A21, were used as model input to determine the maximum pollutant concentrations based on any one year of meteorology. Data from these meteorological towers were used because of their proximity to the emission sources. Figures D.1–2 and D.1–3 present the annual wind roses for meteorological tower A15, for 1995 and 1996, and for meteorological tower A21, for 1994, 1995, and 1996. In addition, mixing height data from the Albuquerque International Sunport were incorporated with the onsite data to provide a single input file containing all of the above data.

Table D.1–1. Annual Average Emission Rates for Criteria Pollutant Emissions from SNL/NM Sources

SOURCE	FUEL	FUEL USAGE (scf/yr)	UNIT CAPACITY (MMbtu/hr)	CARBON MONOXIDE		NITROGEN DIOXIDE		SULFUR DIOXIDE		PARTICULATE MATTER		TSP	
				EF (lb/ 10^6 ft^3)	ER (g/sec)	EF (lb/ 10^6 ft^3)	ER (g/sec)	EF (lb/ 10^6 ft^3)	ER (g/sec)	EF (lb/ 10^6 ft^3)	ER (g/sec)	EF (lb/ 10^6 ft^3)	ER (g/sec)
BOILERS													
Boiler #1	Natural gas	115,932,505	51.550	35.00	0.2273	140.00	0.9093	0.60	0.0039	14.00	0.0909	14.00	0.0909
Boiler #2	Natural gas	83,554,552	39.100	35.00	0.1724	140.00	0.6897	0.60	0.0030	14.00	0.0690	14.00	0.0690
Boiler #3	Natural gas	48,941,341	33.480	35.00	0.1476	140.00	0.5905	0.60	0.0025	14.00	0.0590	14.00	0.0590
Boiler #5	Natural gas	142,776,286	84.63	35.00	0.3732	140.00	1.4929	0.60	0.0064	14.00	0.1493	14.00	0.1493
Boiler #6	Natural gas	349,389,902	142.14	35.00	0.6268	140.00	2.5074	0.60	0.0107	14.00	0.2507	14.00	0.2507
962	Natural gas	118,260,000	13.5	35.00	0.1191	140.00	0.4763	0.60	0.0020	14.00	0.0476	14.00	0.0476

SOURCE	FUEL	FUEL USAGE (gal/yr)	UNIT CAPACITY (MMbtu/hr)	CARBON MONOXIDE		NITROGEN DIOXIDE		SULFUR DIOXIDE		PARTICULATE MATTER		TSP	
				EF (lb/ 10^3 gal)	ER (g/sec)	EF(lb/ 10^3 gal)	ER (g/sec)	EF (lb/ 10^3 gal)	ER (g/sec)	EF (lb/ 10^3 gal)	ER (g/sec)	EF (lb/ 10^3 gal)	ER (g/sec)
Boiler #1	#2 fuel oil	2,700,000	87.256	5.00	0.3883	20.00	1.5534	31.24	2.4264	1.00	0.0777	2.00	0.1553
Boiler #2	#2 fuel oil	2,700,000	87.256	5.00	0.3883	20.00	1.5534	31.24	2.4264	1.00	0.0777	2.00	0.1553
Boiler #3	#2 fuel oil	2,700,000	87.256	5.00	0.3883	20.00	1.5534	31.24	2.4264	1.00	0.0777	2.00	0.1553
Boiler #5	#2 fuel oil	4,023,000	130.09	5.00	0.5786	20.00	2.3146	31.24	3.6153	1.00	0.1157	2.00	0.2315
Boiler #6	#2 fuel oil	7,360,000	237.97	5.00	1.0586	20.00	4.2344	31.24	6.6142	1.00	0.2117	2.00	0.4234

Table D.1–1. Annual Average Emission Rates for Criteria Pollutant Emissions from SNL/NM Sources (concluded)

SOURCE	FUEL	FUEL USAGE (gal/yr)	UNIT CAPACITY (MMbtu/hr)	CARBON MONOXIDE		NITROGEN DIOXIDE		SULFUR DIOXIDE		PARTICULATE MATTER		TSP	
				EF (lb/ MMbtu/ hr)	ER (g/sec)	EF (lb/ MMbtu/ hr)	ER (g/sec)	EF (lb/ MMbtu/ hr)	ER (g/sec)	EF (lb/ MMbtu/ hr)	ER (g/sec)	EF (lb/ MMbtu/ hr)	ER (g/sec)
GENERATORS													
870B	#2 fuel oil	20,076	2.047	0.85	0.6091	3:20	2.2929	0.222	0.1591	0.10	0.0717	0.07	0.0502
862	#2 fuel oil	80,304	8.188	0.85	2.4362	3.20	9.1717	0.222	0.6363	0.10	0.2866	0.07	0.2006
605	#2 fuel oil	13,049	1.331	0.95	0.4425	4.41	2.0539	0.29	0.1351	0.31	0.1444	0.35	0.1630
701	#2 fuel oil	16,730	1.706	0.85	0.5076	3.20	1.9108	0.222	0.1326	0.10	0.0597	0.07	0.0418

Source: SNL/NM 1997a
EF: emission factor
ER: emission rate
g/sec: grams per second
gal: gallon
lb/ft^3: pounds per cubic foot
lb/MMbtu: pounds per Million British Thermal Units
scf: standard cubic feet
TSP: total suspended particulates
Notes: 1) Heating Value: Natural Gas = 1,000 btu/scf; #2 Fuel Oil = 141,636 btu/gal
2) Emission rates for natural gas are based on boilers operating 2,249, 2,137, 1,462, 1,687, and 2,458 hours for boilers 1, 2, 3, 5, and 6, respectively.
3) Emission rates for #2 fuel oil are based on boilers operating 4,380 hours.
4) Emission rates for generators are based on generators operating 500 hours per year.

Table D.1–2. SNL/NM Steam Plant Source Parameters

BOILER NUMBER	STACK HEIGHT (m)	STACK DIAMETER (m)	EXIT VELOCITY (m/sec)	EXIT TEMPERATURE (°K)	UTM-E (m)	UTM-N (m)	BASE ELEVATION (ft)
1	19.8	1.14	13.9[a]/12.8[b]	391	358,672	3,879,647	5,405
2	19.8	1.14	14.4[a]/12.9[b]	408	358,680	3,879,647	5,405
3	19.8	1.14	14.5[a]/13.7[b]	432	358,694	3,879,647	5,405
5	19.8	1.52	13.4[a]/12.4[b]	468	358,708	3,879,647	5,405
6	19.8	1.52	31.5[a]/26.9[b]	555	358,718	3,879,639	5,405

Source: SNL/NM 1997a
°K: degrees Kelvin
ft: feet
m: meter
m/sec: meters per second
UTM-N: Universal Transverse Mercator-N
UTM-E: Universal Transverse Mercator-E
[a] During natural gas usage
[b] During fuel oil usage

Table D.1–3. SNL/NM Building 862 Generators Source Parameters

STACK HEIGHT (m)	STACK DIAMETER (m)	EXIT VELOCITY (m/sec)	EXIT TEMPERATURE (°K)	UTM-E (m)	UTM-N (m)	ELEVATION (ft)
11.9	0.204	85.3	489	359,205	3,879,742	5,397

Source: SNL/NM 1997a
°K: degrees Kelvin
ft: feet
m: meter
m/sec: meters per second
UTM-E: Universal Transverse Mercator-E
UTM-N: Universal Transverse Mercator-N

D.1.2.5 Model Assumptions

Model assumptions include using the regulatory default options that are identified in Appendix A of the *Guideline on Air Quality Models* (Revised) (EPA 1987), and include the following:

- use stack-tip downwash (except for Schulman-Scire downwash),
- use buoyancy-induced dispersion (except for Schulman-Scire downwash),
- do not use gradual plume rise (except for building downwash),
- use the calms processing routines,
- use upper-bound concentration estimates for sources influenced by building downwash from super-squat buildings,
- use default wind speed profile exponents, and
- use default vertical potential temperature gradients.

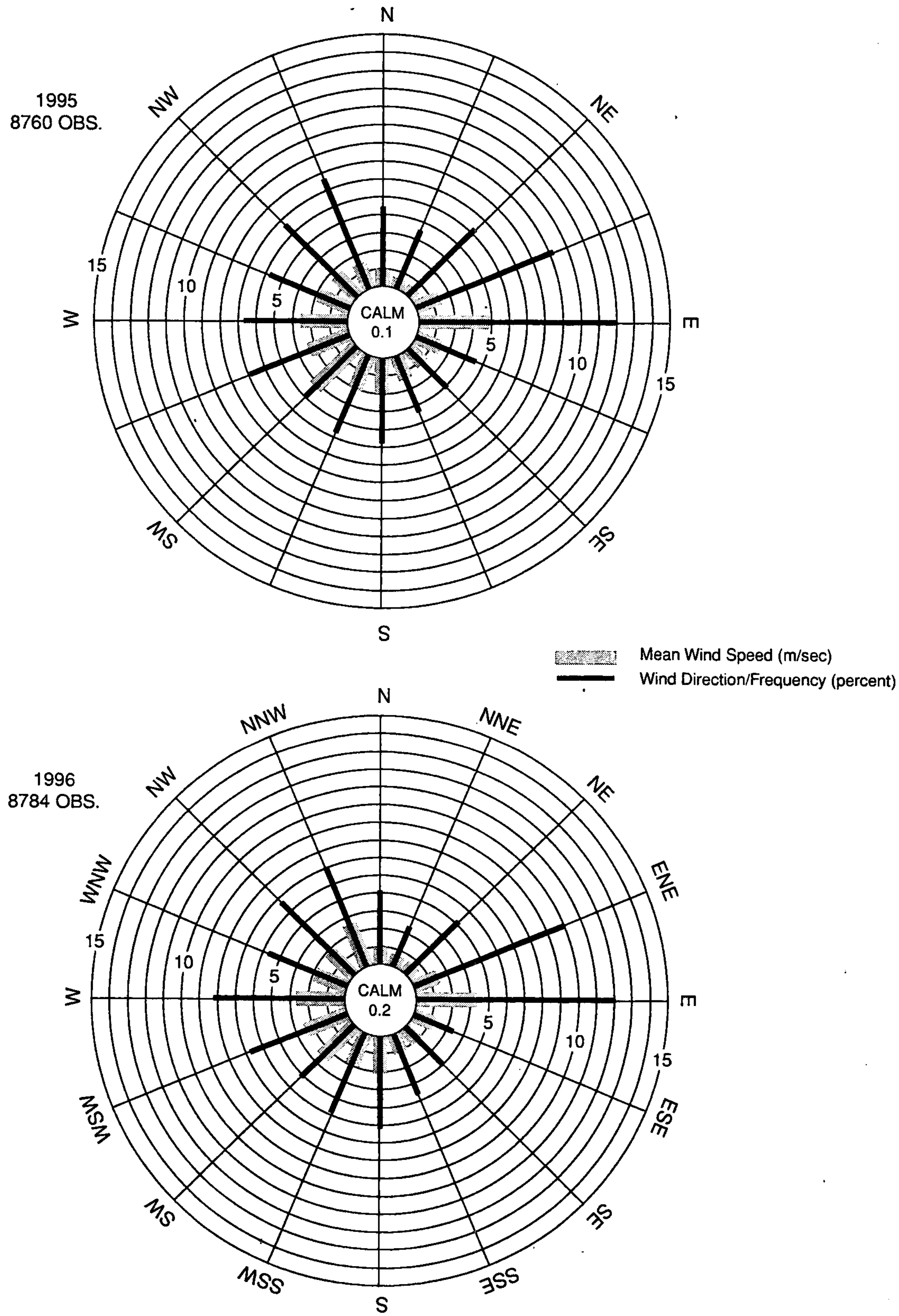
Other assumptions include

- hourly emission rates for natural gas-fired boilers,
- constant emission rates for #2 fuel oil-fired boilers and generators,
- constant emission rates for chemical emissions,
- building downwash option for criteria pollutants, and
- rural dispersion.

D.1.2.6 Methodology

The modeling of nitrogen oxides follows a tiered approach to determine the concentration of nitrogen dioxide as a component of nitrogen oxides. Nitrogen dioxide is one of several forms of nitrogen oxides resulting from the combustion of fossil fuels. Federal and state criteria pollutant standards specify nitrogen dioxide as the form of nitrogen oxides for which the standards apply. The emissions from combustion of fossil fuel provided as input into *ISCST3* are those of nitrogen oxides.

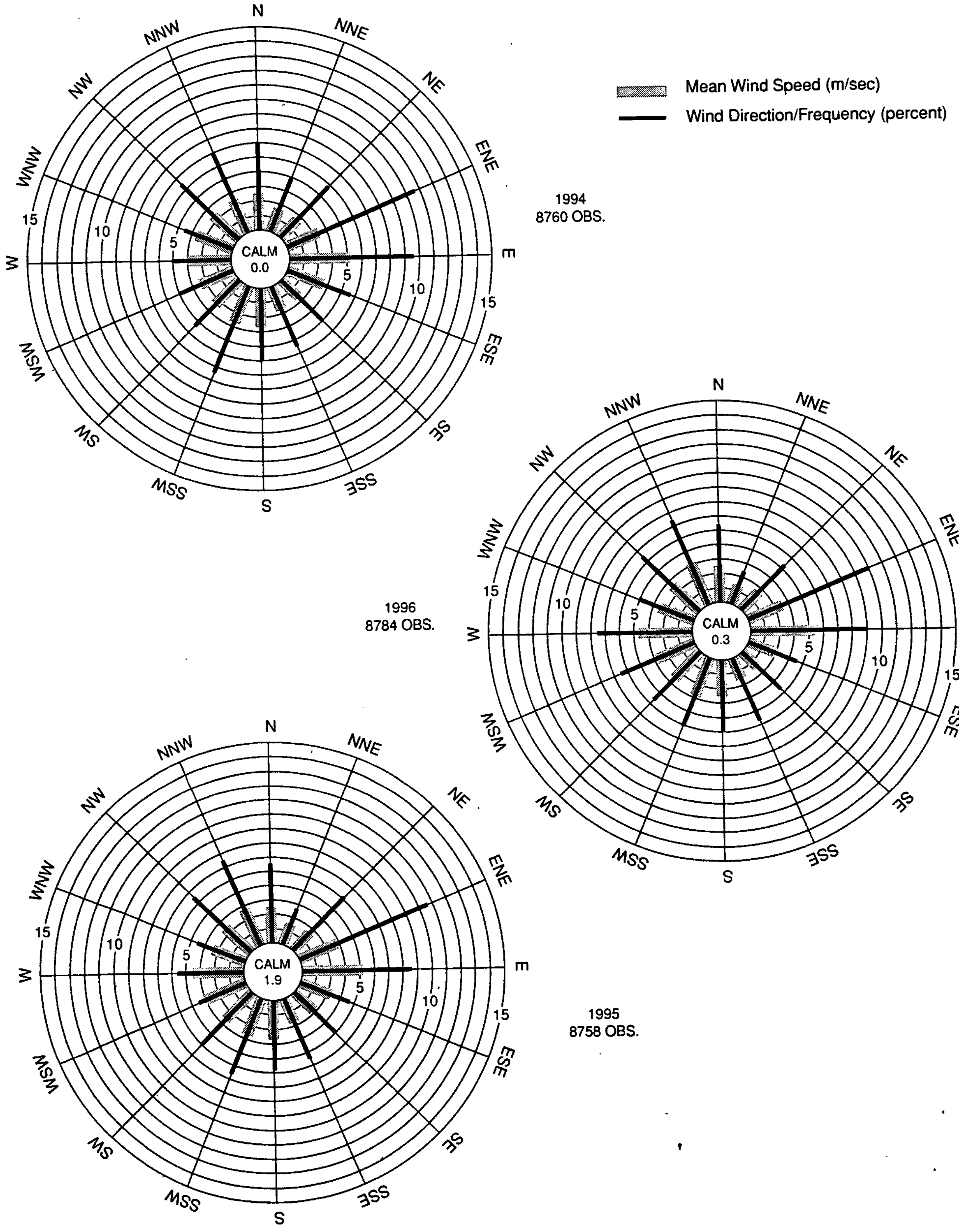
Modeling results for nitrogen oxides, using *ISCST3* for the 24-hour and annual averaging periods, are 0.19 ppm (300 $\mu g/m^3$) and 0.02 ppm (28 $\mu g/m^3$), respectively. The NMAAQS standards for nitrogen dioxide for the 24-hour and annual averaging periods are 0.10 ppm



Source: SNL/NM 1998j

Figure D.1–2. Annual Wind Rose for Tower A15 at 10-m Level, 1995–1996

Two years of meteorological data, including wind speed and direction, from Tower A15 (at the 10-m level), were used to determine the maximum pollutant concentration.



Source: SNL/NM 1998j

Figure D.1–3. Annual Wind Rose for Tower A21 at 10-m Level, 1994–1996

Three years of meteorological data, including wind speed and direction, from Tower A21 (at the 10-m level), were used to determine maximum pollutant concentrations.

(156 μg/m³) and 0.05 ppm (78 μg/m³), respectively. The modeling results indicate that the nitrogen oxides 24-hour concentrations exceed the NMAAQS standard for nitrogen dioxide. If the nitrogen oxides concentration is below the NMAAQS standard for nitrogen dioxide, then no further analysis is necessary to show compliance with the standard. Since the nitrogen oxides concentration is above the standard, a second step must be undertaken to show compliance.

The New Mexico Air Quality Bureau has approved the ozone limiting method (OLM) to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions. The EPA model *ISC3_OLM* (Version 96.113) is used to implement the OLM.

The OLM is employed to calculate the nitrogen dioxide component of the nitrogen oxides concentration. The OLM requires representative hourly ozone concentrations to be input into the model. These data are obtained from monitoring station 2R, located in the south valley of the city of Albuquerque approximately 1 mi west of the Rio Grande and 3 mi south of downtown (Figure 4.9–2). This monitoring location is upwind from the criteria pollutant emission sources at SNL/NM and is, therefore, representative of the background ozone in the area. The OLM also requires that background nitrogen dioxide concentrations be added to the model-calculated nitrogen dioxide concentrations to obtain a representative concentration of nitrogen dioxide. Monitoring station 2R does not measure nitrogen dioxide; therefore, the maximum 24-hour average concentration and the annual average concentration of nitrogen dioxide, measured in 1996 at monitoring station 2ZR, are added to the respective modeled concentrations. Station 2ZR is collocated with monitoring station 2ZQ in the city of Rio Rancho, west of Albuquerque, a rapidly growing area on the city's west side, and provides a reasonable background estimate of nitrogen dioxide not influenced by SNL/NM emissions. Figure 4.9–2 shows the location of this monitoring station.

D.1.3 Chemical Pollutants

The pollutants and laboratory operations that may cause significant air quality and human health impacts at SNL/NM were identified through a progressive series of screening steps, each step involving fewer pollutants that were then screened by methods that involved more rigorous and realistic emission rates than the step before. This approach, consistent with EPA guidance, focused detailed analyses only on those chemicals that had a reasonable chance of being of concern.

The objective was to determine potential impacts from routine emissions (emissions occurring daily from ongoing normal operations at SNL/NM). Databases available at SNL/NM, identifying the thousands of chemical products used at SNL/NM, were screened, and the potential sources of routine chemical air emissions were determined.

First, all site-wide chemical databases available for SNL/NM were identified. The three sources of chemical data for SNL/NM are the Chemical Information System (CIS), Hazardous Chemical Purchases Inventory (HCPI), and CheMaster. Each was developed for a slightly different purpose, has some specific and/or unique information, and has overlapping information. No database was complete enough to use exclusively; therefore, the data are used collectively. CIS is the most current, has annual purchases by building number, is versatile in the formatting of the data, and tracks 90 percent of all chemical purchases by SNL/NM. HCPI provides the chemical product ingredients regulated as hazardous air pollutants (HAPs), and toxic air pollutants (TAPs), as well as volatile organic compound (VOC) ingredients. It also captures the "just in time" (JIT) chemical purchases not tracked in CIS. The CheMaster database contains a 1996 chemical inventory collected from a wall-to-wall survey performed at SNL/NM to determine the maximum inventories of hazardous chemicals. The chemical volumes are maximum potential quantities; CheMaster captures older chemical inventories potentially not documented in CIS as a recent purchase. The CheMaster was also used as the source of information needed for the 1997 study identifying the most significant chemical hazards at SNL/NM for emergency planning/emergency response purposes.

At SNL/NM, each chemical (product) purchased is inventoried in the CIS database. The hazardous ingredients of these chemical products are determined and then categorized as HAPs, TAPs or VOCs, as applicable, and tracked by the HCPI database. Large quantities of HAPs, TAPs, or VOCs used and potentially released to the air from routine operations are regulated under the *Superfund Amendments and Reauthorization Act* (SARA) Title III hazardous substance control and reporting requirements (42 United States Code [U.S.C.] §11001). HCPI is in place to meet these annual tracking and reporting requirements. The HCPI database groups and sums the total quantities of individual HAPs, TAPs,

Ozone Limiting Method

The following is a simplified explanation of the basic chemistry relevant to the ozone limiting method (OLM).

First, the relatively high temperatures typical of most combustion sources promote the formation of nitrogen dioxide by the following thermal reaction:

$2\ NO + O_2 \rightarrow 2\ NO_2$ **In-stack formation of nitrogen dioxide**

The OLM assumes that 10 percent of the oxides of nitrogen emission in the exhaust is converted to nitrogen dioxide by this reaction, and no further conversion by this reaction occurs once the exhaust leaves the stack. This assumption is thought to be conservative, as more typically, only 5 percent of the oxides of nitrogen emission is nitrogen dioxide at the stack exit. The remaining 90 percent of the oxides of nitrogen emission is assumed to be nitric oxide.

As the exhaust leaves the stack and mixes with the ambient air, the nitric oxide reacts with ambient ozone to form nitrogen dioxide and molecular oxygen:

$NO + O_3 \rightarrow NO_2 + O_2$ **Oxidation of nitric oxide by ambient ozone**

The OLM assumes that at any given receptor location, the amount of nitric oxide that is converted to nitrogen dioxide by this reaction is proportional to the ambient ozone concentration. If the ozone concentration is less than the nitric oxide concentration, the amount of nitrogen dioxide formed by this reaction is limited. If the ozone concentration is greater than or equal to the nitric oxide concentration, all of the nitric oxide is assumed to be converted to nitrogen dioxide.

In the presence of radiation from the sun, ambient nitrogen dioxide can be destroyed:

$NO_2 + \text{sunlight} \rightarrow NO + O$ **Photo-dissociation of nitrogen dioxide**

As a conservative assumption, the OLM ignores this reaction.

Another reaction that can form nitrogen dioxide in the atmosphere is the reaction of nitric oxide with reactive hydrocarbons:

$NO + HC \rightarrow NO_2 + HC$ **Oxidation of nitric oxide by reactive hydrocarbons**

The OLM also ignores this reaction. This may be a nonconservative assumption with respect to nitrogen dioxide formation in urban/industrial areas with relatively large amounts of reactive hydrocarbon emissions.

NO: nitric oxide
O: oxygen
NO_2: nitrogen dioxide
HC: reactive hydrocarbon
O_2: oxygen
O_3: ozone
Note: Although not used in the equations above, NO_x is known as nitrogen oxides or oxides of nitrogen.
Source: OLM/ARM 1997

and VOCs by name and total quantities per building. The total pounds of HAPs, TAPs, and VOCs purchased by SNL/NM are reported annually as required by SARA Title III (42 U.S.C. §11001).

To supplement data from CIS and HCPI, a 1997 SNL/NM study for emergency planning/hazards assessment, thoroughly reviewing details of the CheMaster database, was also assessed. The study identified the major chemical hazards at SNL/NM, the sources of the hazard, and the location of the chemical inventory posing the hazard under a 100 percent release accident scenario. Each chemical entered in CheMaster was evaluated for volatility, dispersibility, toxicity, persistence, volume, flammability, and other chemical properties pertinent to assessing the potential for human exposures and health effects through the air pathway. The major chemical hazards identified for emergency response at SNL/NM were identified. Although accidental release of chemicals is not applicable to routine air emissions, results of the study were reviewed as a conservative backup to the information contained in the CIS and HCPI. From a human health impacts standpoint, the objective was to provide a second check of what sources of hazardous chemicals exist at SNL/NM.

Approximately 465 chemicals (out of over 25,000 used at SNL/NM) were identified as the potential sources of routine chemical air emissions from SNL/NM's normal operations. This list was individually reviewed for volume and toxicity. Individual facility managers at SNL/NM verified the volumes of chemicals listed and specified any routinely used highly toxic chemicals, applicable to their operations. With this process, it is very unlikely that any major sources of routine chemical air emissions are overlooked by the SWEIS analysis. The final verified list of chemicals considered the potential sources of routine chemical air emissions is published in the SNL/NM Facility Safety Information Document. These amounts of HAPs, TAPs, VOCs, and 1996 inventory amounts of major chemical hazards identified by the emergency planning study were used in the detailed chemical screening process to estimate maximum emission rates and compare them to health risk based chemical-specific threshold emission values (TEVs).

These hazardous chemicals were categorized into two groups, noncarcinogenic chemicals and carcinogenic chemicals, in order to address the differences in health effects. Fifteen carcinogenic chemicals were associated with five facilities; the remaining chemicals were assessed for noncarcinogenic health effects. Each group was evaluated using a screening technique comparing each chemical's estimated emission rate to a health risk-based TEV. As specified by the *National Environmental Policy Act* (NEPA), current dose-to-risk conversion factors and the "best available technology" were used in assessing impacts to human health (Appendix E). Consistent with the human health impacts assessment methodology, appropriate health risk values were used in the chemical screening process to derive chemical-specific TEVs. Because of the different health effects (noncarcinogenic and carcinogenic), two methods were applied to derive chemical-specific TEVs.

Available data including occupational exposure limits (OELs), and Inhalation Unit Risk values were researched for the entire list of 465 chemicals, as applicable. Where dose-to-risk information was unavailable, a risk assessment model could not be applied to obtain a quantitative TEV for screening purposes. Therefore, some chemicals without OELs, or Inhalation Unit Risk values could not be given a health risk-based screening assessment. This uncertainty in the analysis resulted in a slight underestimation of health risks, but did not affect the overall conclusions of the SWEIS risk analysis. Based on a review of the regulatory literature, there are possible reasons why a chemical would not have a published OEL and/or a dose-response value.

Chemical manufacturers report new chemical information to the EPA according to requirements specified in Section 4 of the *Toxic Substances Control Act* (TSCA) (15 U.S.C. §2601). A 90-day preliminary hazard assessment process determines whether or not further analysis of the chemical will be required and how soon it must be completed. All information implies that a chemical without an OEL or unit risk value is likely to meet one or more of the following conditions:

- it is not used routinely,
- it is not present or used in regulated quantities,
- it will still be controlled according to general Occupational and Safety and Health Administration (OSHA) requirements (personal protective equipment [PPE], labeling, Material Safety Data Sheet [MSDS] recommendations, and so on),
- it is not designated for regulation (based on an interagency regulatory committee determination),
- it is determined not toxic to the environment or human health, or
- it is used for research and development (R&D) or market research only.

A possible condition where a major chemical hazard at SNL/NM could have been overlooked would be a chemical currently in review and not yet given an OEL, reference dose (RfD) or cancer slope factor (CSF), or unit risk value, as appropriate. In that case, the chemical would not yet be in use long enough or in large enough quantities at SNL/NM to be a routine air emission or to allow long-term (chronic) exposures to people. The objective of the SWEIS impact analysis, which is to determine potential health impacts to workers and the public from routine emissions (emissions occurring daily from ongoing normal operations at SNL/NM), is therefore, met. If it were possible, through the SWEIS analysis, to expedite or evaluate a chemical in this situation, it would not introduce enough difference to the analytical results to affect the overall results of the human health risk assessment. Since these are unregulated chemicals, it also would not affect the overall results of the air quality analysis.

D.1.3.1 Noncarcinogenic Chemical Screening

The screening analysis for noncarcinogenic chemicals uses four "industry-recognized" guidelines to determine the most conservative guideline applicable to each chemical. The guidelines are as follows:

- American Conference of Governmental Industrial Hygienists (threshold limit values [TLVs]) (ACGIH 1997)
- OSHA (permissible exposure limits [PELs]) (ACGIH 1997)
- National Institute for Occupational Safety and Health (recommended exposure limits [RELs]) (ACGIH 1997)
- Deutsche Forschungsgemeinschaft (DFG), Federal Republic of Germany, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (ACGIH 1997).

The minimum guideline value from these references divided by 100 was used as the screening guideline for the noncarcinogenic chemicals. Dividing the guideline by 100 ensures a conservative safety factor for identifying those chemicals of potential public concern. The guideline value divided by 100 is henceforth referred to as OEL/100. Figure D.1–4 presents the process used for evaluating the chemical emissions from SNL/NM.

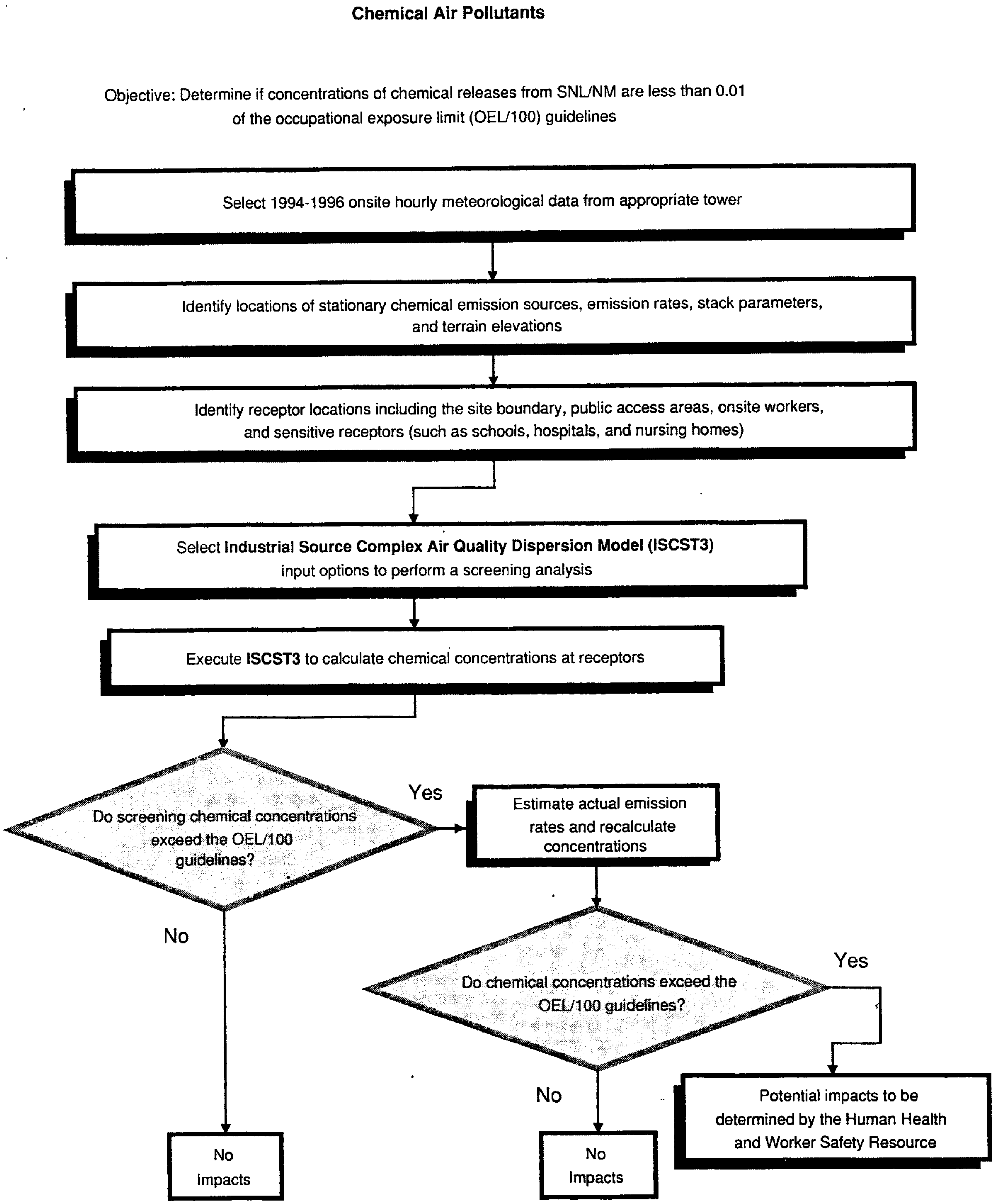
The second chemical screening level after identifying those noncarcinogenic chemicals contained within SNL/NM databases was to calculate the maximum offsite chemical concentration using an emission rate of 1 g per second in the center of 5 major emitters in TA-I. The maximum 8-hour concentration was calculated using the *ISCST3* model and 5 years of hourly winds and stabilities, with a prototypical stack (33 ft high, 1 ft in diameter, 1.6-ft per second exit velocity, 68°F exit temperature, and a 1-g per second emission rate.)

A TEV was calculated by dividing the OEL/100 for each chemical by the calculated maximum 8-hour concentration for a 1-g per second emission rate. The TEV represents the emission rate that would result in an 8-hour chemical concentration equal to the OEL/100 guideline.

The hypothetical emission rate for each noncarcinogenic chemical was calculated by dividing the 1996 purchased amount in grams by 2,000 hours, converted to seconds, to obtain an emission rate in grams per second. The 2,000 hours represents a 40-hour work week times 50 work weeks per year as the number of hours during which the chemicals are emitted. It is conservatively assumed that 100 percent of the purchased chemicals for 1996 for each facility purchasing chemicals are released to the atmosphere from the facility. An exception to this assumption is made for sulfuric acid emissions from Buildings 858 and 878. These buildings are equipped with scrubbers with a greater than 90 percent control efficiency (Kramer 1993). Credit for these scrubbers is applied to emissions of sulfuric acid by reducing the emissions by 90 percent.

Chemicals not having an OEL were not screened using the TEV method (no TEV could be derived). Instead, a review of the chemicals was performed to assess the potential human health effects to prevent screening out any potential health hazards. A general approach was applied. Under OSHA requirements, all chemicals manufactured must be investigated for toxicity (acute and chronic). Manufacturers are required to provided OELs, as appropriate, for the intended use of the chemical and based on its toxic properties. Therefore, where a chemical has no OEL, it is a reasonable assumption that the chemical's toxic properties do not warrant regulation from chronic (long-term) exposures. Many of the chemicals without OELs are acids, which are chemically not persistent in the environment (they change chemical form rapidly), thereby preventing chronic exposures or even exposures at a distance from the source. These chemicals are acute hazards that are monitored and controlled according to PPE requirements identified on the products MSDSs. Because routine air emissions are associated with larger quantities of chemical use, it is also reasonable to say that chemicals without an OEL, but in small quantities (less than 10 lb), were not associated with routine emissions and did not affect human health by way of the air emissions pathway.

The hypothetical emission rate, based upon chemical purchased amounts, was then compared to the TEV. If the hypothetical emission rate was greater than the TEV, then the chemical concentration resulting from the hypothetical emission rate may exceed the OEL/100 guideline, and the chemical required further analysis to determine whether it was a potential chemical of concern.



Source: Original

Figure D.1–4. Flow Chart for Evaluation of Chemical Air Pollutants
Chemical air pollutants are evaluated using the ISCST3 computer model

Tables Key

SOURCES:

Raw Data: SNL/NM 1998a, SNL/NM 1999a
TLVs: ACGIH 1997

ACRONYMS:

CAS: Chemical Abstracts Service
DF: dispersion factor (airborne concentration per unit release)
EF: emissions factor (fraction that is released of a potential source)
ER: emission rate
FALSE: Indicates chemical emissions below TEV
g: gram
g/g: grams of pollutant per gram of JP-8 fuel
g/yr: grams per year
g/sec: grams per second
m^3: cubic meter
NA: not available
OEL: occupational exposure limit
sec: second
TEV: threshold emissions value
TRUE: Indicates chemical emissions above TEV
yr: year
µg: microgram
µg/m^3: micrograms per cubic meter

BUILDING NUMBERS:

605 Steam Plant
858 Microelectronics Development Laboratory (MDL)
870 Neutron Generator Facility (NGF)
878 Advanced Manufacturing Processes Laboratory (AMPL)
893 Compound Semiconductor Research Laboratory (CSRL)
897 Integrated Materials Research Laboratory (IMRL)
905 Explosive Components Facility (ECF)
963 Repetitive High Energy Pulsed Power Unit II (RHEPP II)
981 Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)
986 Repetitive High Energy Pulsed Power Unit I (RHEPP I)
6580 Hot Cell Facility (HCF)
6920 Radioactive and Mixed Waste Management Facility (RMWMF)
MESA Microsystems and Engineering Sciences Applications Complex

Tables D.1–4 through D.1–19 present the results of the noncarcinogenic chemical screening process, comparing the hypothetical emission rate to the TEV. The tables present 1996 purchases, and No Action, Expanded Operations, and Reduced Operations Alternatives results for HAPs, TAPs, VOCs, and additional chemicals from the CheMaster and HCPI databases, respectively. The Expanded Operations Alternative included results from the Microsystems and Engineering Sciences Applications (MESA) Complex configuration, if implemented. The word TRUE in the results column indicates that the hypothetical emission rate exceeds the TEV.

The final screening involves estimating actual emissions from process engineering data for those noncarcinogenic chemicals whose emission rates, based upon purchased quantities, exceeded the TEV. The estimated actual emission rate is again compared with the TEV to determine whether it is a chemical of concern.

Tables D.1–20, D.1–21, and D.1–22 present the No Action, Expanded Operations (with or without MESA Complex configuration), and Reduced Operations Alternatives results of the final screening step for the noncarcinogenic chemicals, comparing emission rates derived from process engineering estimates to the TEV. The process engineering estimates are emission factors based upon facility process knowledge applicable to each of the chemical emissions.

Table D.1–4. 1996 Annual Purchases of Hazardous Air Pollutants (HAPs) Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
605	67-56-1	Methanol	$1.89x10^{3}$	$2.63x10^{-4}$	$2.60x10^{3}$	3.07	FALSE
6580	7647-01-0	Hydrogen chloride	$1.09x10^{3}$	$1.52x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
858	67-56-1	Methanol	$8.38x10^{4}$	$1.16x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
858	78-93-3	Methyl ethyl ketone (2-butanone)	$8.05x10^{2}$	$1.12x10^{-4}$	$5.90x10^{3}$	6.97	FALSE
858	110-54-3	n-Hexane	$1.40x10^{3}$	$1.94x10^{-4}$	$1.76x10^{3}$	2.08	FALSE
858	7647-01-0	Hydrogen chloride	$6.58x10^{4}$	$9.13x10^{-3}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
858	7664-39-3	Hydrogen fluoride	$5.67x10^{4}$	$7.87x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
870	67-56-1	Alcohol, Methyl	$4.98x10^{5}$	$6.92x10^{-2}$	2,600	3.07	FALSE
870	101-77-9	4,4'-Methylene dianiline (37%)	$5.58x10^{4}$	$7.75x10^{-3}$	$2.60x10^{3}$	$9.56x10^{-3}$	FALSE
870	7440-47-3	Chromium	$5.03x10^{3}$	$6.99x10^{-4}$	5	$5.90x10^{-3}$	FALSE
870	1333-82-0	Chromium Trioxide	$3.18x10^{3}$	$4.41x10^{-4}$	0.01	$1.18x10^{-5}$	TRUE
870	7440-48-4	Cobalt (17.4%)	$3.63x10^{3}$	$5.04x10^{-4}$	0.2	$2.36x10^{-4}$	TRUE
870	111-42-2	Diethanolamine (85%)	$1.02x10^{5}$	$1.41x10^{-2}$	20	$2.36x10^{-2}$	FALSE
870	107-21-1	Ethylene Glycol	$2.23x10^{4}$	$3.10x10^{-3}$	260	$3.07x10^{-1}$	FALSE
870	7647-01-0	Hydrochloric Acid	$3.90x10^{4}$	$5.42x10^{-3}$	70	$8.26x10^{-2}$	FALSE
870	7664-39-3	Hydrofluoric Acid	$3.27x10^{4}$	$4.54x10^{-3}$	20	$2.36x10^{-2}$	FALSE
870	7439-96-5	Manganese	$4.13x10^{3}$	$5.73x10^{-4}$	2	$2.36x10^{-3}$	FALSE
870	108-10-1	Methyl iso-butyl ketone	$2.04x10^{4}$	$2.83x10^{-3}$	820	$9.68x10^{-1}$	FALSE
870	7718-54-9	Nickel Chloride	$2.66x10^{5}$	$3.70x10^{-2}$	$1.50x10^{-1}$	$1.77x10^{-4}$	TRUE
870	7786-81-4	Nickel Sulfate	$2.66x10^{5}$	$3.70x10^{-2}$	$1.50x10^{-1}$	$1.77x10^{-4}$	TRUE
878	67-56-1	Methanol	$5.84x10^{4}$	$8.12x10^{-3}$	$2.60x10^{3}$	3.07	FALSE
878	68-12-2	N,N-dimethylformamide	$3.27x10^{1}$	$4.54x10^{-6}$	$3.00x10^{2}$	$3.54x10^{-1}$	FALSE

Table D.1–4. 1996 Annual Purchases of Hazardous Air Pollutants (HAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULT
878	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	$7.78x10^{4}$	$1.08x10^{-2}$	$1.08x10^{4}$	$1.28x10^{1}$	FALSE
878	78-93-3	Methyl ethyl ketone (2-butanone)	$3.40x10^{3}$	$4.72x10^{-4}$	$5.90x10^{3}$	6.97	FALSE
878	79-10-7	Acrylic acid	$2.06x10^{2}$	$2.86x10^{-5}$	$5.90x10^{1}$	$6.97x10^{-2}$	FALSE
878	80-62-6	Methyl methacrylate	$1.12x10^{2}$	$1.56x10^{-5}$	$2.10x10^{3}$	2.48	FALSE
878	84-74-2	Dibutyl phthalate	3.00	$4.17x10^{-7}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	101-68-8	Methylenebis(phenylisocyanate) (MDI)	$9.92x10^{1}$	$1.38x10^{-5}$	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	107-21-1	Ethylene glycol	$3.29x10^{3}$	$4.58x10^{-4}$	$2.60x10^{2}$	$3.07x10^{-1}$	FALSE
878	108-10-1	Methyl isobutyl ketone (hexone)	4.68	$6.50x10^{-7}$	$8.20x10^{2}$	$9.68x10^{-1}$	FALSE
878	108-88-3	Toluene	$9.70x10^{3}$	$1.35x10^{-3}$	$1.88x10^{3}$	2.22	FALSE
878	108-95-2	Phenol	$6.06x10^{3}$	$8.42x10^{-4}$	$1.90x10^{2}$	$2.24x10^{-1}$	FALSE
878	110-54-3	n-Hexane	$9.92x10^{1}$	$1.38x10^{-5}$	$1.76x10^{3}$	2.08	FALSE
878	111-42-2	Diethanolamine	$6.49x10^{3}$	$9.01x10^{-4}$	2.00	$2.36x10^{-2}$	FALSE
878	123-31-9	Hydroquinone	$5.64x10^{-3}$	$7.83x10^{-10}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	131-11-3	Dimethyl phthalate	6.00	$8.33x10^{-7}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	584-84-9	Toluene-2,4-diisocyanate	$2.89x10^{3}$	$4.01x10^{-4}$	$3.60x10^{-1}$	$4.25x10^{-4}$	FALSE
878	1330-20-7	Xylene	$4.47x10^{3}$	$6.21x10^{-4}$	$4.34x10^{3}$	5.12	FALSE
878	7439-92-1	Lead	$5.32x10^{3}$	$7.38x10^{-4}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	7439-96-5	Manganese	$1.06x10^{4}$	$1.47x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-3}$	FALSE
878	7439-97-6	Mercury	$2.72x10^{4}$	$3.78x10^{-3}$	$2.50x10^{-1}$	$2.95x10^{-4}$	TRUE
878	7440-36-0	Antimony	$7.09x10^{2}$	$9.84x10^{-5}$	5.00	$5.90x10^{-3}$	FALSE
878	7440-47-3	Chromium (II) compounds, as chromium	$1.88x10^{4}$	$2.61x10^{-3}$	5.00	$5.90x10^{-3}$	FALSE

Table D.1–4. 1996 Annual Purchases of Hazardous Air Pollutants (HAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	7440-48-4	Cobalt	$2.02x10^{4}$	$2.80x10^{-3}$	$2.00x10^{-1}$	$2.36x10^{-4}$	TRUE
878	7647-01-0	Hydrogen chloride	$3.62x10^{3}$	$5.02x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
878	7664-39-3	Hydrogen fluoride	$8.43x10^{3}$	$1.17x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	7782-49-2	Selenium hexafluoride as selenium	$4.54x10^{1}$	$6.30x10^{-6}$	1.60	$1.89x10^{-3}$	FALSE
878	7784-42-1	Arsine	$3.66x10^{3}$	$5.08x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
878	7803-51-2	Phosphine	$3.66x10^{3}$	$5.08x10^{-4}$	1.40	$1.65x10^{-3}$	FALSE
893	67-56-1	Methanol	$1.14x10^{5}$	$1.58x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
893	107-21-1	Ethylene glycol	$4.90x10^{4}$	$6.81x10^{-3}$	$2.60x10^{2}$	$3.07x10^{-1}$	FALSE
893	108-88-3	Toluene	$9.80x10^{3}$	$1.36x10^{-3}$	$1.88x10^{3}$	2.22	FALSE
893	7647-01-0	Hydrogen chloride	$2.49x10^{4}$	$3.46x10^{-3}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
893	7664-39-3	Hydrogen fluoride	$3.29x10^{4}$	$4.57x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	62-53-3	Aniline	$2.55x10^{2}$	$3.55x10^{-5}$	$7.60x10^{1}$	$8.97x10^{-2}$	FALSE
897	67-56-1	Methanol	$3.16x10^{4}$	$4.39x10^{-3}$	$2.60x10^{3}$	3.07	FALSE
897	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	$1.20x10^{4}$	$1.67x10^{-3}$	$1.08x10^{4}$	$1.28x10^{1}$	FALSE
897	74-88-4	Methyl iodide	$5.00x10^{2}$	$6.94x10^{-5}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
897	75-05-8	Acetonitrile	$6.60x10^{3}$	$9.17x10^{-4}$	$3.40x10^{2}$	$4.01x10^{-1}$	FALSE
897	106-42-3	p-Xylene	$6.86x10^{3}$	$9.53x10^{-4}$	$4.34x10^{3}$	5.12	FALSE
897	107-21-1	Ethylene glycol	$4.40x10^{3}$	$6.11x10^{-4}$	$2.60x10^{2}$	$3.07x10^{-1}$	FALSE
897	108-10-1	Methyl isobutyl ketone (hexone)	$1.14x10^{1}$	$1.58x10^{-6}$	$8.20x10^{2}$	$9.68x10^{-1}$	FALSE
897	108-88-3	Toluene	$3.28x10^{3}$	$4.55x10^{-4}$	$1.88x10^{3}$	2.22	FALSE
897	108-95-2	Phenol	$1.00x10^{2}$	$1.39x10^{-5}$	$1.90x10^{2}$	$2.24x10^{-1}$	FALSE
897	110-54-3	n-Hexane	$1.41x10^{4}$	$1.96x10^{-3}$	$1.76x10^{3}$	2.08	FALSE

Table D.1–4. 1996 Annual Purchases of Hazardous Air Pollutants (HAPs) Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
897	123-31-9	Hydroquinone	6.84×10^{2}	9.50×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	7439-92-1	Lead	5.00	6.94×10^{-7}	5.00×10^{-1}	5.90×10^{-4}	FALSE
897	7647-01-0	Hydrogen chloride	3.19×10^{3}	4.44×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
897	7664-39-3	Hydrogen fluoride	1.64×10^{3}	2.27×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
905	67-56-1	Methanol	5.12×10^{3}	7.11×10^{-4}	2.60×10^{3}	3.07	FALSE
905	75-05-8	Acetonitrile	1.26×10^{4}	1.75×10^{-3}	3.40×10^{2}	4.01×10^{-1}	FALSE
905	108-88-3	Toluene	6.92×10^{2}	9.61×10^{-5}	1.88×10^{3}	2.22	FALSE
981	67-56-1	Methanol	6.06×10^{3}	8.41×10^{-4}	2.60×10^{3}	3.07	FALSE

Table D.1–5. Projected Hazardous Air Pollutant (HAP) Emissions No Action Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
605	67-56-1	Methanol	1.89×10^{3}	2.63×10^{-4}	2.60×10^{3}	3.07	FALSE
6580	7647-01-0	Hydrogen chloride	2.19×10^{3}	3.04×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
858	67-56-1	Methanol	1.47×10^{5}	2.04×10^{-2}	2.60×10^{3}	3.07	FALSE
858	78-93-3	Methyl ethyl ketone (2-butanone)	1.41×10^{3}	1.96×10^{-4}	5.90×10^{3}	6.97	FALSE
858	110-54-3	n-Hexane	2.45×10^{3}	3.40×10^{-4}	1.76×10^{3}	2.08	FALSE
858	7647-01-0	Hydrogen chloride	1.15×10^{5}	1.6×10^{-2}	7.00×10^{1}	8.26×10^{-2}	FALSE
858	7664-39-3	Hydrogen fluoride	9.92×10^{4}	1.38×10^{-2}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	101-77-9	4,4'-Methylene dianiline (37%)	1.68×10^{5}	2.33×10^{-2}	8.10	9.56×10^{-3}	TRUE
870	67-56-1	Alcohol, Methyl	1.66×10^{6}	2.31×10^{-1}	2.60×10^{3}	3.07	FALSE
870	7440-47-3	Chromium	1.51×10^{4}	2.10×10^{-3}	5	5.90×10^{-3}	FALSE
870	1333-82-0	Chromium Trioxide	8.98×10^{3}	1.25×10^{-3}	1.00×10^{-2}	1.18×10^{-5}	TRUE
870	7440-48-4	Cobalt (17.4%)	1.04×10^{4}	1.45×10^{-3}	2.00×10^{-1}	2.36×10^{-4}	TRUE
870	111-42-2	Diethanolamine (85%)	3.05×10^{5}	4.24×10^{-2}	2.00×10^{1}	2.36×10^{-2}	TRUE
870	107-21-1	Ethylene Glycol	2.23×10^{4}	3.10×10^{-3}	2.60×10^{2}	3.07×10^{-1}	FALSE
870	7647-01-0	Hydrochloric Acid	1.19×10^{5}	1.65×10^{-2}	7.00×10^{1}	8.26×10^{-2}	FALSE
870	7664-39-3	Hydrofluoric Acid	9.86×10^{4}	1.37×10^{-2}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	7439-96-5	Manganese	1.31×10^{4}	1.82×10^{-3}	2	2.36×10^{-3}	FALSE
870	108-10-1	Methyl iso-butyl ketone	6.84×10^{4}	9.50×10^{-3}	8.2×10^{2}	9.68×10^{-1}	FALSE
870	7718-54-9	Nickel Chloride	7.98×10^{5}	1.11×10^{-1}	1.50×10^{-1}	1.77×10^{-4}	TRUE
870	7786-81-4	Nickel Sulfate	7.98×10^{5}	1.11×10^{-1}	1.50×10^{-1}	1.77×10^{-4}	TRUE
878	67-56-1	Methanol	8.77×10^{4}	1.22×10^{-2}	2.60×10^{3}	3.07	FALSE
878	68-12-2	N,N-Dimethylformamide	4.90×10^{1}	6.81×10^{-6}	3.00×10^{2}	3.54×10^{-1}	FALSE

Table D.1–5. Projected Hazardous Air Pollutant (HAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	$1.17x10^5$	$1.62x10^{-2}$	$1.08x10^4$	$1.28x10^1$	FALSE
878	78-93-3	Methyl ethyl ketone (2-butanone)	$5.10x10^3$	$7.08x10^{-4}$	$5.90x10^3$	6.97	FALSE
878	79-10-7	Acrylic acid	$3.09x10^2$	$4.30x10^{-5}$	$5.90x10^1$	$6.97x10^{-2}$	FALSE
878	80-62-6	Methyl methacrylate	$1.68x10^2$	$2.34x10^{-5}$	$2.10x10^3$	2.48	FALSE
878	84-74-2	Dibutyl phthalate	4.50	$6.25x10^{-7}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	101-68-8	Methylenebis (phenylisocyanate) (MDI)	$1.49x10^2$	$2.07x10^{-5}$	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	107-21-1	Ethylene glycol	$4.94x10^3$	$6.86x10^{-4}$	$2.60x10^2$	$3.07x10^{-1}$	FALSE
878	108-10-1	Methyl isobutyl ketone (hexone)	7.02	$9.75x10^{-7}$	$8.20x10^2$	$9.68x10^{-1}$	FALSE
878	108-88-3	Toluene	$1.45x10^4$	$2.02x10^{-3}$	$1.88x10^3$	2.22	FALSE
878	108-95-2	Phenol	$9.10x10^3$	$1.26x10^{-3}$	$1.90x10^2$	$2.24x10^{-1}$	FALSE
878	110-54-3	n-Hexane	$1.49x10^2$	$2.07x10^{-5}$	$1.76x10^3$	2.08	FALSE
878	111-42-2	Diethanolamine	$9.73x10^3$	$1.35x10^{-3}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
878	123-31-9	Hydroquinone	$8.46x10^{-3}$	$1.17x10^{-9}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
878	131-11-3	Dimethyl phthalate	9.00	$1.25x10^{-6}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	584-84-9	Toluene-2,4-diisocyanate	$4.33x10^3$	$6.00x10^{-4}$	$3.60x10^{-1}$	$4.25x10^{-4}$	TRUE
878	1330-20-7	Xylene	$6.70x10^3$	$9.31x10^{-4}$	$4.34x10^3$	5.12	FALSE
878	7439-92-1	Lead	$7.97x10^3$	$1.11x10^{-3}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	7439-96-5	Manganese	$1.59x10^4$	$2.20x10^{-3}$	2.00	$2.36x10^{-3}$	FALSE
878	7439-97-6	Mercury	$4.08x10^4$	$5.67x10^{-3}$	$2.50x10^{-1}$	$2.95x10^{-4}$	TRUE
878	7440-36-0	Antimony	$1.06x10^3$	$1.48x10^{-4}$	5.00	$5.90x10^{-3}$	FALSE
878	7440-47-3	Chromium (II) compounds, as chromium	$2.82x10^4$	$3.91x10^{-3}$	5.00	$5.90x10^{-3}$	FALSE
878	7440-48-4	Cobalt	$3.03x10^4$	$4.21x10^{-3}$	$2.00x10^{-1}$	$2.36x10^{-4}$	TRUE

Table D.1–5. Projected Hazardous Air Pollutant (HAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
878	7647-01-0	Hydrogen chloride	5.43×10^{3}	7.54×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
878	7664-39-3	Hydrogen fluoride	1.26×10^{4}	1.76×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	7782-49-2	Selenium hexafluoride as selenium	6.80×10^{1}	9.45×10^{-6}	1.60	1.89×10^{-3}	FALSE
878	7784-42-1	Arsine	5.49×10^{3}	7.62×10^{-4}	1.60	1.89×10^{-3}	FALSE
878	7803-51-2	Phosphine	5.49×10^{3}	7.62×10^{-4}	1.40	1.65×10^{-3}	FALSE
893	67-56-1	Methanol	1.14×10^{5}	1.58×10^{-2}	2.60×10^{3}	3.07	FALSE
893	107-21-1	Ethylene glycol	4.90×10^{4}	6.81×10^{-3}	2.60×10^{2}	3.07×10^{-1}	FALSE
893	108-88-3	Toluene	9.80×10^{3}	1.36×10^{-3}	1.88×10^{3}	2.22	FALSE
893	7647-01-0	Hydrogen chloride	2.49×10^{4}	3.46×10^{-3}	7.00×10^{1}	8.26×10^{-2}	FALSE
893	7664-39-3	Hydrogen fluoride	3.29×10^{4}	4.57×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	62-53-3	Aniline	2.55×10^{2}	3.55×10^{-5}	7.60×10^{1}	8.97×10^{-2}	FALSE
897	67-56-1	Methanol	3.16×10^{4}	4.39×10^{-3}	2.60×10^{3}	3.07	FALSE
897	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	1.20×10^{4}	1.67×10^{-3}	1.08×10^{4}	1.28×10^{1}	FALSE
897	74-88-4	Methyl iodide	5.00×10^{2}	6.94×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	75-05-8	Acetonitrile	6.60×10^{3}	9.17×10^{-4}	3.40×10^{2}	4.01×10^{-1}	FALSE
897	106-42-3	p-Xylene	6.86×10^{3}	9.53×10^{-4}	4.34×10^{3}	5.12	FALSE
897	107-21-1	Ethylene glycol	4.40×10^{3}	6.11×10^{-4}	2.60×10^{2}	3.07×10^{-1}	FALSE
897	108-10-1	Methyl isobutyl ketone (hexone)	1.14×10^{1}	1.58×10^{-6}	8.20×10^{2}	9.68×10^{-1}	FALSE
897	108-88-3	Toluene	3.28×10^{3}	4.55×10^{-4}	1.88×10^{3}	2.22	FALSE
897	108-95-2	Phenol	1.00×10^{2}	1.39×10^{-5}	1.90×10^{2}	2.24×10^{-1}	FALSE
897	110-54-3	n-Hexane	1.41×10^{4}	1.96×10^{-3}	1.76×10^{3}	2.08	FALSE
897	123-31-9	Hydroquinone	6.84×10^{2}	9.50×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE

Table D.1–5. Projected Hazardous Air Pollutant (HAP) Emissions No Action Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULT
897	7439-92-1	Lead	5.00	6.94×10^{-7}	5.00×10^{-1}	5.90×10^{-4}	FALSE
897	7647-01-0	Hydrogen chloride	3.19×10^{3}	4.44×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
897	7664-39-3	Hydrogen fluoride	1.64×10^{3}	2.27×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
905	67-56-1	Methanol	1.02×10^{4}	1.42×10^{-3}	2.60×10^{3}	3.07	FALSE
905	75-05-8	Acetonitrile	2.52×10^{4}	3.49×10^{-3}	3.40×10^{2}	4.01×10^{-1}	FALSE
905	108-88-3	Toluene	1.38×10^{3}	1.92×10^{-4}	1.88×10^{3}	2.22	FALSE
981	67-56-1	Methanol	1.82×10^{4}	2.52×10^{-3}	2.60×10^{3}	3.07	FALSE

Table D.1–6. Projected Hazardous Air Pollutant (HAP) Emissions Expanded Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
605	67-56-1	Methanol	$1.89x10^{3}$	$2.63x10^{-4}$	$2.60x10^{3}$	3.07	FALSE
6580	7647-01-0	Hydrogen chloride	$6.57x10^{3}$	$9.12x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
858	67-56-1	Methanol	$1.57x10^{5}$	$2.18x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
858	78-93-3	Methyl ethyl ketone (2-butanone)	$1.51x10^{3}$	$2.10x10^{-4}$	$5.90x10^{3}$	6.97	FALSE
858	110-54-3	n-Hexane	$2.62x10^{3}$	$3.65x10^{-4}$	$1.76x10^{3}$	2.08	FALSE
858	7647-01-0	Hydrogen chloride	$1.23x10^{5}$	$1.71x10^{-2}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
858	7664-39-3	Hydrogen fluoride	$1.06x10^{5}$	$1.48x10^{-2}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
870	101-77-9	4,4′-Methylene dianiline (37%)	$1.68x10^{5}$	$2.33x10^{-2}$	8.10	$9.56x10^{-3}$	TRUE
870	67-56-1	Alcohol, Methyl	$1.66x10^{6}$	$2.31x10^{-1}$	$2.60x10^{3}$	3.07	FALSE
870	7440-47-3	Chromium	$1.51x10^{4}$	$2.10x10^{-3}$	5	$5.90x10^{-3}$	FALSE
870	1333-82-0	Chromium Trioxide	$8.98x10^{3}$	$1.25x10^{-3}$	$1.00x10^{-2}$	$1.18x10^{-5}$	TRUE
870	7440-48-4	Cobalt (17.4%)	$1.04x10^{4}$	$1.45x10^{-3}$	$2.00x10^{-1}$	$2.36x10^{-4}$	TRUE
870	111-42-2	Diethanolamine (85%)	$3.05x10^{5}$	$4.24x10^{-2}$	$2.00x10^{1}$	$2.36x10^{-2}$	TRUE
870	107-21-1	Ethylene Glycol	$2.23x10^{4}$	$3.10x10^{-3}$	$2.60x10^{2}$	$3.07x10^{-1}$	FALSE
870	7647-01-0	Hydrochloric Acid	$1.19x10^{5}$	$1.65x10^{-2}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
870	7664-39-3	Hydrofluoric Acid	$9.86x10^{4}$	$1.37x10^{-2}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
870	7439-96-5	Manganese	$1.31x10^{4}$	$1.82x10^{-3}$	2	$2.36x10^{-3}$	FALSE
870	108-10-1	Methyl iso-butyl ketone	$6.84x10^{4}$	$9.50x10^{-3}$	$8.2x10^{2}$	$9.68x10^{-1}$	FALSE
870	7718-54-9	Nickel Chloride	$7.98x10^{5}$	$1.11x10^{-1}$	$1.50x10^{-1}$	$1.77x10^{-4}$	TRUE
870	7786-81-4	Nickel Sulfate	$7.98x10^{5}$	$1.11x10^{-1}$	$1.50x10^{-1}$	$1.77x10^{-4}$	TRUE
878	67-56-1	Methanol	$1.17x10^{5}$	$1.62x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
878	68-12-2	N,N-Dimethylformamide	$6.54x10^{1}$	$9.08x10^{-6}$	$3.00x10^{2}$	$3.54x10^{-1}$	FALSE

Table D.1–6. Projected Hazardous Air Pollutant (HAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	1.56×10^{5}	2.16×10^{-2}	1.08×10^{4}	1.28×10^{1}	FALSE
878	78-93-3	Methyl ethyl ketone (2-butanone)	6.80×10^{3}	9.44×10^{-4}	5.90×10^{3}	6.97	FALSE
878	79-10-7	Acrylic acid	4.12×10^{2}	5.73×10^{-5}	5.90×10^{1}	6.97×10^{-2}	FALSE
878	80-62-6	Methyl methacrylate	2.24×10^{2}	3.12×10^{-5}	2.10×10^{3}	2.48	FALSE
878	84-74-2	Dibutyl phthalate	6.00	8.33×10^{-7}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	101-68-8	Methylenebis(phenylisocyanate) (MDI)	1.98×10^{2}	2.76×10^{-5}	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	107-21-1	Ethylene glycol	6.59×10^{3}	9.15×10^{-4}	2.60×10^{2}	3.07×10^{-1}	FALSE
878	108-10-1	Methyl isobutyl ketone (hexone)	9.36	1.30×10^{-6}	8.20×10^{2}	9.68×10^{-1}	FALSE
878	108-88-3	Toluene	1.94×10^{4}	2.69×10^{-3}	1.88×10^{3}	2.22	FALSE
878	108-95-2	Phenol	1.21×10^{4}	1.68×10^{-3}	1.90×10^{2}	2.24×10^{-1}	FALSE
878	110-54-3	n-Hexane	1.98×10^{2}	2.76×10^{-5}	1.76×10^{3}	2.08	FALSE
878	111-42-2	Diethanolamine	1.30×10^{4}	1.80×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	123-31-9	Hydroquinone	1.13×10^{-2}	1.57×10^{-9}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	131-11-3	Dimethyl phthalate	1.20×10^{1}	1.67×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	584-84-9	Toluene-2,4-diisocyanate	5.77×10^{3}	4.01×10^{-4}	3.60×10^{-1}	4.25×10^{-4}	TRUE
878	1330-20-7	Xylene	8.94×10^{3}	1.24×10^{-3}	4.34×10^{3}	5.12	FALSE
878	7439-92-1	Lead	1.06×10^{4}	1.48×10^{-3}	5.00×10^{-1}	5.90×10^{-4}	TRUE
878	7439-96-5	Manganese	2.12×10^{4}	2.94×10^{-3}	2.00	2.36×10^{-3}	TRUE
878	7439-97-6	Mercury	5.44×10^{4}	7.56×10^{-3}	2.50×10^{-1}	2.95×10^{-4}	TRUE
878	7440-36-0	Antimony	1.42×10^{3}	1.97×10^{-4}	5.00	5.90×10^{-3}	FALSE
878	7440-47-3	Chromium (II) compounds, as chromium	3.76×10^{4}	5.22×10^{-3}	5.00	5.90×10^{-3}	FALSE
878	7440-48-4	Cobalt	4.04×10^{4}	5.61×10^{-3}	2.00×10^{-1}	2.36×10^{-4}	TRUE

Table D.1–6. Projected Hazardous Air Pollutant (HAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
878	7647-01-0	Hydrogen chloride	7.23×10^{3}	1.00×10^{-3}	7.00×10^{1}	8.26×10^{-2}	FALSE
878	7664-39-3	Hydrogen fluoride	1.69×10^{4}	2.34×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	7782-49-2	Selenium hexafluoride as selenium	9.07×10^{1}	1.26×10^{-5}	1.60	1.89×10^{-3}	FALSE
878	7784-42-1	Arsine	7.32×10^{3}	1.02×10^{-3}	1.60	1.89×10^{-3}	FALSE
878	7803-51-2	Phosphine	7.32×10^{3}	1.02×10^{-3}	1.40	1.65×10^{-3}	FALSE
893	67-56-1	Methanol[a]	2.28×10^{5}	3.17×10^{-2}	2.60×10^{3}	3.07	FALSE
893	107-21-1	Ethylene glycol[a]	9.80×10^{4}	1.36×10^{-2}	2.60×10^{2}	3.07×10^{-1}	FALSE
893	108-88-3	Toluene[a]	1.96×10^{4}	2.72×10^{-3}	1.88×10^{3}	2.22	FALSE
893	7647-01-0	Hydrogen chloride[a]	4.98×10^{4}	6.91×10^{-3}	7.00×10^{1}	8.26×10^{-2}	FALSE
893	7664-39-3	Hydrogen fluoride[a]	6.58×10^{4}	9.14×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
MESA	84-74-2	Dibutyl_phthalate[b]	9.48×10^{3}	1.32×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
MESA	107-06-2	Ethylene dichloride[b]	6.27×10^{2}	8.71×10^{-5}	4.00×10^{1}	4.72×10^{-2}	FALSE
MESA	107-21-1	Ethylene glycol[b]	6.03×10^{4}	8.37×10^{-3}	2.60×10^{2}	3.07×10^{-1}	FALSE
MESA	7647-01-0	Hydrogen chloride[b]	3.75×10^{4}	5.21×10^{-3}	7.00×10^{1}	8.26×10^{-2}	FALSE
MESA	7664-39-4	Hydrogen fluoride[b]	8.48×10^{3}	1.18×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
MESA	67-56-1	Methanol[b]	2.72×10^{5}	3.78×10^{-2}	2.60×10^{3}	3.07	FALSE
MESA	110-54-3	N-Hexane[b]	1.45×10^{3}	2.02×10^{-4}	1.76×10^{3}	2.08	FALSE
MESA	7803-51-2	Phosphine[b]	5.12×10^{4}	7.11×10^{-3}	1.40	$1 65 \times 10^{-3}$	TRUE
MESA	108-88-3	Toluene[b]	6.96×10^{3}	9.67×10^{-4}	1.88×10^{3}	2.22	FALSE
MESA	1330-20-7	Xylene[b]	2.00×10^{2}	2.78×10^{-5}	4.34×10^{3}	5.12	FALSE
897	62-53-3	Aniline	2.55×10^{2}	3.55×10^{-5}	7.60×10^{1}	8.97×10^{-2}	FALSE
897	67-56-1	Methanol	3.16×10^{4}	4.39×10^{-3}	2.60×10^{3}	3.07	FALSE

Table D.1–6. Projected Hazardous Air Pollutant (HAP) Emissions Expanded Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
897	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	1.20×10^{4}	1.67×10^{-3}	1.08×10^{4}	1.28×10^{1}	FALSE
897	74-88-4	Methyl iodide	5.00×10^{2}	6.94×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	75-05-8	Acetonitrile	6.60×10^{3}	9.17×10^{-4}	3.40×10^{2}	4.01×10^{-1}	FALSE
897	106-42-3	p-Xylene	6.86×10^{3}	9.53×10^{-4}	4.34×10^{3}	5.12	FALSE
897	107-21-1	Ethylene glycol	4.40×10^{3}	6.11×10^{-4}	2.60×10^{2}	3.07×10^{-1}	FALSE
897	108-10-1	Methyl isobutyl ketone (hexone)	1.14×10^{1}	1.58×10^{-6}	8.20×10^{2}	9.68×10^{-1}	FALSE
897	108-88-3	Toluene	3.28×10^{3}	4.55×10^{-4}	1.88×10^{3}	2.22	FALSE
897	108-95-2	Phenol	1.00×10^{2}	1.39×10^{-5}	1.90×10^{2}	2.24×10^{-1}	FALSE
897	110-54-3	n-Hexane	1.41×10^{4}	1.96×10^{-3}	1.76×10^{3}	2.08	FALSE
897	123-31-9	Hydroquinone	6.84×10^{2}	9.50×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	7439-92-1	Lead	5.00	6.94×10^{-7}	5.00×10^{-1}	5.90×10^{-4}	FALSE
897	7647-01-0	Hydrogen chloride	3.19×10^{3}	4.44×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
897	7664-39-3	Hydrogen fluoride	1.64×10^{3}	2.27×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
905	67-56-1	Methanol	1.02×10^{4}	1.42×10^{-3}	2.60×10^{3}	3.07	FALSE
905	75-05-8	Acetonitrile	2.52×10^{4}	3.49×10^{-3}	3.40×10^{2}	4.01×10^{-1}	FALSE
905	108-88-3	Toluene	1.38×10^{3}	1.92×10^{-4}	1.88×10^{3}	2.22	FALSE
981	67-56-1	Methanol	4.66×10^{4}	6.48×10^{-3}	2.60×10^{3}	3.07	FALSE

MESA: Microsystems and Engineering Sciences Applications

[a] If the MESA Complex is built, Building 893 would cease operations (after 2003) and the chemicals listed would no longer contribute emissions under the Expanded Operations Alternative.

[b] If Building 893 is not replaced by the MESA Complex, the chemicals listed would not contribute to chemical emissions under the Expanded Operations Alternative.

Table D.1–7. Projected Hazardous Air Pollutant (HAP) Emissions Reduced Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
605	67-56-1	Methanol	1.89×10^{3}	2.63×10^{-4}	2.60×10^{3}	3.07	FALSE
6580	7647-01-0	Hydrogen chloride	1.09×10^{3}	1.52×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
858	67-56-1	Methanol	5.62×10^{4}	7.80×10^{-3}	2.60×10^{3}	3.07	FALSE
858	78-93-3	Methyl ethyl ketone (2-butanone)	5.39×10^{2}	7.49×10^{-5}	5.90×10^{3}	6.97	FALSE
858	110-54-3	n-Hexane	9.38×10^{2}	1.30×10^{-4}	1.76×10^{3}	2.08	FALSE
858	7647-01-0	Hydrogen chloride	4.41×10^{4}	6.12×10^{-3}	7.00×10^{1}	8.26×10^{-2}	FALSE
858	7664-39-3	Hydrogen fluoride	3.80×10^{4}	5.27×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	101-77-9	4,4'-Methylene dianiline (37%)	1.68×10^{5}	2.33×10^{-2}	8.10	9.56×10^{-3}	TRUE
870	67-56-1	Alcohol, Methyl	1.66×10^{6}	2.31×10^{-1}	2.60×10^{3}	3.07	FALSE
870	7440-47-3	Chromium	1.51×10^{4}	2.10×10^{-3}	5	5.90×10^{-3}	FALSE
870	1333-82-0	Chromium Trioxide	8.98×10^{3}	1.25×10^{-3}	1.00×10^{-2}	1.18×10^{-5}	TRUE
870	7440-48-4	Cobalt (17.4%)	1.04×10^{4}	1.45×10^{-3}	2.00×10^{-1}	2.36×10^{-4}	TRUE
870	111-42-2	Diethanolamine (85%)	3.05×10^{5}	4.24×10^{-2}	2.00×10^{1}	2.36×10^{-2}	TRUE
870	107-21-1	Ethylene Glycol	2.23×10^{4}	3.10×10^{-3}	2.60×10^{2}	3.07×10^{-1}	FALSE
870	7647-01-0	Hydrochloric Acid	1.19×10^{5}	1.65×10^{-2}	7.00×10^{1}	8.26×10^{-2}	FALSE
870	7664-39-3	Hydrofluoric Acid	9.86×10^{4}	1.37×10^{-2}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	7439-96-5	Manganese	1.31×10^{4}	1.82×10^{-3}	2	2.36×10^{-3}	FALSE
870	108-10-1	Methyl iso-butyl ketone	6.84×10^{4}	9.50×10^{-3}	8.20×10^{2}	9.68×10^{-1}	FALSE
870	7718-54-9	Nickel Chloride	7.98×10^{5}	1.11×10^{-1}	1.50×10^{-1}	1.77×10^{-4}	TRUE
870	7786-81-4	Nickel Sulfate	7.98×10^{5}	1.11×10^{-1}	1.50×10^{-1}	1.77×10^{-4}	FALSE
878	67-56-1	Methanol	5.84×10^{4}	8.12×10^{-3}	2.60×10^{3}	3.07	FALSE
878	68-12-2	N,N-Dimethylformamide	3.27×10^{1}	4.54×10^{-6}	3.00×10^{2}	3.54×10^{-1}	FALSE

Table D.1–7. Projected Hazardous Air Pollutant (HAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	7.78×10^{4}	1.08×10^{-2}	1.08×10^{4}	1.28×10^{1}	FALSE
878	78-93-3	Methyl ethyl ketone (2-butanone)	3.40×10^{3}	4.72×10^{-4}	5.90×10^{3}	6.97	FALSE
878	79-10-7	Acrylic acid	2.06×10^{2}	2.86×10^{-5}	5.90×10^{1}	6.97×10^{-2}	FALSE
878	80-62-6	Methyl methacrylate	1.12×10^{2}	1.56×10^{-5}	2.10×10^{3}	2.48	FALSE
878	84-74-2	Dibutyl phthalate	3.00	4.17×10^{-7}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	101-68-8	Methylenebis(phenylisocyanate) (MDI)	9.92×10^{1}	1.38×10^{-5}	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	107-21-1	Ethylene glycol	3.29×10^{3}	4.58×10^{-4}	2.60×10^{2}	3.07×10^{-1}	FALSE
878	108-10-1	Methyl isobutyl ketone (hexone)	4.68	6.50×10^{-7}	8.20×10^{2}	9.68×10^{-1}	FALSE
878	108-88-3	Toluene	9.70×10^{3}	1.35×10^{-3}	1.88×10^{3}	2.22	FALSE
878	108-95-2	Phenol	6.06×10^{3}	8.42×10^{-4}	1.90×10^{2}	2.24×10^{-1}	FALSE
878	110-54-3	n-Hexane	9.92×10^{1}	1.38×10^{-5}	1.76×10^{3}	2.08	FALSE
878	111-42-2	Diethanolamine	6.49×10^{3}	9.01×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	123-31-9	Hydroquinone	5.64×10^{-3}	7.83×10^{-10}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	131-11-3	Dimethyl phthalate	6.00	8.33×10^{-7}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	584-84-9	Toluene-2,4-diisocyanate	2.89×10^{3}	4.01×10^{-4}	3.60×10^{-1}	4.25×10^{-4}	FALSE
878	1330-20-7	Xylene	4.47×10^{3}	6.21×10^{-4}	4.34×10^{3}	5.12	FALSE
878	7439-92-1	Lead	5.32×10^{3}	7.38×10^{-4}	5.00×10^{-1}	5.90×10^{-4}	TRUE
878	7439-96-5	Manganese	1.06×10^{4}	1.47×10^{-3}	2.00	2.36×10^{-3}	FALSE
878	7439-97-6	Mercury	2.72×10^{4}	3.78×10^{-3}	2.50×10^{-1}	2.95×10^{-4}	TRUE
878	7440-36-0	Antimony	7.09×10^{2}	9.84×10^{-5}	5.00	5.90×10^{-3}	FALSE
878	7440-47-3	Chromium (II) compounds, as chromium	1.88×10^{4}	2.61×10^{-3}	5.00	5.90×10^{-3}	FALSE
878	7440-48-4	Cobalt	2.02×10^{4}	2.80×10^{3}	2.00×10^{1}	2.36×10^{-4}	TRUE

Table D.1–7. Projected Hazardous Air Pollutant (HAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
878	7647-01-0	Hydrogen chloride	3.62×10^{3}	5.02×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
878	7664-39-3	Hydrogen fluoride	8.43×10^{3}	1.17×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	7782-49-2	Selenium hexafluoride as selenium	4.54×10^{1}	6.30×10^{-6}	1.60	1.89×10^{-3}	FALSE
878	7784-42-1	Arsine	3.66×10^{3}	5.08×10^{-4}	1.60	1.89×10^{-3}	FALSE
878	7803-51-2	Phosphine	3.66×10^{3}	5.08×10^{-4}	1.40	1.65×10^{-3}	FALSE
893	67-56-1	Methanol	1.14×10^{5}	1.58×10^{-2}	2.60×10^{3}	3.07	FALSE
893	107-21-1	Ethylene glycol	4.90×10^{4}	6.81×10^{-3}	2.60×10^{2}	3.07×10^{-1}	FALSE
893	108-88-3	Toluene	9.80×10^{3}	1.36×10^{-3}	1.88×10^{3}	2.22	FALSE
893	7647-01-0	Hydrogen chloride	2.49×10^{4}	3.46×10^{-3}	7.00×10^{1}	8.26×10^{-2}	FALSE
893	7664-39-3	Hydrogen fluoride	3.29×10^{4}	4.57×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	62-53-3	Aniline	2.35×10^{2}	3.26×10^{-5}	7.60×10^{1}	8.97×10^{-2}	FALSE
897	67-56-1	Methanol	2.91×10^{4}	4.04×10^{-3}	2.60×10^{3}	3.07	FALSE
897	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	1.11×10^{4}	1.54×10^{-3}	1.08×10^{4}	1.28×10^{1}	FALSE
897	74-88-4	Methyl iodide	4.60×10^{2}	6.39×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	75-05-8	Acetonitrile	6.07×10^{3}	8.44×10^{-4}	3.40×10^{2}	4.01×10^{-1}	FALSE
897	106-42-3	p-Xylene	6.31×10^{3}	8.76×10^{-4}	4.34×10^{3}	5.12	FALSE
897	107-21-1	Ethylene glycol	4.05×10^{3}	5.62×10^{-4}	2.60×10^{2}	3.07×10^{-1}	FALSE
897	108-10-1	Methyl isobutyl ketone (hexone)	1.05×10^{1}	1.46×10^{-6}	8.20×10^{2}	9.68×10^{-1}	FALSE
897	108-88-3	Toluene	3.02×10^{3}	4.19×10^{-4}	1.88×10^{3}	2.22	FALSE
897	108-95-2	Phenol	9.20×10^{1}	1.28×10^{-5}	1.90×10^{2}	2.24×10^{-1}	FALSE
897	110-54-3	n-Hexane	1.30×10^{4}	1.80×10^{-3}	1.76×10^{3}	2.08	FALSE
897	123-31-9	Hydroquinone	6.29×10^{2}	8.74×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE

Table D.1–7. Projected Hazardous Air Pollutant (HAP) Emissions Reduced Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
897	7439-92-1	Lead	4.60	6.39×10^{-7}	5.00×10^{-1}	5.90×10^{-4}	FALSE
897	7647-01-0	Hydrogen chloride	2.94×10^{3}	4.08×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
897	7664-39-3	Hydrogen fluoride	1.51×10^{3}	2.09×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
905	67-56-1	Methanol	1.02×10^{3}	1.42×10^{-4}	2.60×10^{3}	3.07	FALSE
905	75-05-8	Acetonitrile	2.52×10^{3}	3.49×10^{-4}	3.40×10^{2}	4.01×10^{-1}	FALSE
905	108-88-3	Toluene	1.38×10^{2}	1.92×10^{-5}	1.88×10^{3}	2.22	FALSE
981	67-56-1	Methanol	4.24×10^{3}	5.89×10^{-4}	2.60×10^{3}	3.07	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
605	79-09-4	Propionic acid	1.03×10^{2}	1.43×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
605	7664-93-9	Sulfuric acid	8.25×10^{1}	1.15×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
6580	141-78-6	Ethyl acetate	3.60×10^{3}	5.00×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
6580	7722-84-1	Hydrogen peroxide (concentration > 52%)	1.66×10^{2}	2.31×10^{-5}	1.40×10^{1}	1.65×10^{-2}	FALSE
6580	7697-37-2	Nitric acid	2.62×10^{3}	3.65×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
6580	1310-73-2	Sodium hydroxide	1.13×10^{4}	1.57×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
6580	7664-93-9	Sulfuric acid	9.20×10^{2}	1.28×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
6920	7697-37-2	Nitric acid	1.87×10^{2}	2.60×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
6920	1310-73-2	Sodium hydroxide	4.54×10^{2}	6.30×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
6920	7440-66-6	Zinc	1.00×10^{3}	1.39×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
858	64-19-7	Acetic acid	3.22×10^{4}	4.48×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	67-64-1	Acetone	1.74×10^{4}	2.41×10^{-3}	5.90×10^{3}	6.97	FALSE
858	7722-84-1	Hydrogen peroxide (concentration > 52%)	1.77×10^{6}	2.46×10^{-1}	1.40×10^{1}	1.65×10^{-2}	TRUE
858	7697-37-2	Nitric acid	2.28×10^{6}	3.16×10^{-1}	5.00×10^{1}	5.90×10^{-2}	TRUE
858	7664-38-2	Phosphoric acid	4.34×10^{4}	6.02×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
858	7803-62-5	Silane (silicon tetrahydride)	1.02×10^{5}	1.41×10^{-2}	6.60×10^{1}	7.79×10^{-2}	FALSE
858	1310-73-2	Sodium hydroxide	3.50×10^{7}	4.86	2.00×10^{1}	2.36×10^{-2}	TRUE
858	7664-93-9	Sulfuric acid	3.30×10^{4}	4.59×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
870	64-19-7	Acetic Acid	3.45×10^{4}	4.79×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	64-19-7	Acetic Acid, Glacial	3.86×10^{4}	5.35×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	67-64-1	Acetone	2.15×10^{6}	2.99×10^{-1}	5.90×10^{3}	6.97	FALSE
870	71-36-3	Alcohol, Butyl	4.08×10^{3}	5.67×10^{-4}	3.00×10^{3}	3.54	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULT
870	67-63-0	Alcohol, Isopropyl	$7.85x10^4$	$1.09x10^{-2}$	$4.90x10^3$	5.79	FALSE
870	7429-90-5	Aluminum	$2.00x10^5$	$2.77x10^{-2}$	50	$5.90x10^{-2}$	FALSE
870	1344-28-1	Aluminum Oxide	$9.98x10^4$	$1.39x10^{-2}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
870	1336-21-6	Ammonium Hydroxide	$4.54x10^3$	$6.30x10^{-4}$	No OEL		
870	1113-50-1	Boric Acid	$3.99x10^4$	$5.54x10^{-3}$	No OEL		
870		Brulin Cleaner	0	0	0	0	FALSE
870	11-15-9	Cellosolve Acetate	$1.81x10^3$	$2.52x10^{-4}$	No OEL		
870		Cerric Ammonium Nitrate	$5.99x10^5$	$8.32x10^{-2}$	No OEL		
870		Citridet Cleaner	$3.82x10^5$	$5.31x10^{-2}$	$1.21x10^3$	1.43	FALSE
870	7440-50-8	Copper	$2.00x10^5$	$2.77x10^{-2}$	1.00	$1.18x10^{-3}$	TRUE
870	7440-50-8	Copper (0.10%)	$1.81x10^1$	$2.52x10^{-6}$	1.00	$1.18x10^{-3}$	FALSE
870		Carboxyl terminated acrylonitrile butadiene Epoxy Resin	$9.98x10^4$	$1.39x10^{-2}$	No OEL		
870		Curing Agent Z (37% methylene dianiline)	$1.51x10^5$	$2.09x10^{-2}$	No OEL		
870		2,6-diethylaniline curing agent	$1.20x10^5$	$1.66x10^{-2}$	No OEL		
870		Diala oil	$1.67x10^5$	$2.32x10^{-2}$	No OEL		
870	106-42-3	Di-p Xylene	$2.73x10^5$	$3.79x10^{-2}$	$4.34x10^3$	5.12	FALSE
870	7440-52-0	Erbium	$4.99x10^3$	$6.93x10^{-4}$	No OEL		
870		Fluorinert	$1.87x10^6$	$2.59x10^{-1}$	No OEL		
870		Glass microballoons filler	$2.49x10^4$	$3.46x10^{-3}$	No OEL		
870		Hexylene glycol	$3.33x10^5$	$4.63x10^{-2}$	$1.21x10^3$	1.43	FALSE
870	1309-37-1	Iron (53%)	$1.04x10^4$	$1.45x10^{-3}$	50	$5.90x10^{-2}$	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
870	123-92-2	Iso Amyl Acetate	$2.65x10^5$	$3.68x10^{-2}$	$5.25x10^3$	6.20	FALSE
870		Isopropyl alcohol	$7.85x10^4$	$1.09x10^{-2}$	$4.90x10^3$	5.79	FALSE
870		Mold Release	$9.34x10^4$	$1.30x10^{-2}$	No OEL		
870	7439-98-7	Molybdenum	$1.81x10^3$	$2.52x10^{-4}$	50	$5.90x10^{-2}$	FALSE
870	7697-37-2	Nitric Acid (70%)	$4.84x10^4$	$6.72x10^{-3}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
870		Oakite Citridet	$3.33x10^5$	$4.63x10^{-2}$	No OEL		
870	127-18-4	Perchloroethylene	$1.01x10^6$	$1.41x10^{-1}$	$1.70x10^3$	2.01	FALSE
870	7664-38-2	Phosphoric Acid	$3.67x10^4$	$5.10x10^{-3}$	10	$1.18x10^{-2}$	FALSE
870	1310-58-3	Potassium Hydroxide	$4.99x10^3$	$6.93x10^{-4}$	20	$2.36x10^{-2}$	FALSE
870	7440-20-2	Scandium	$4.99x10^3$	$6.93x10^{-4}$	No OEL		
870	7631-86-9	Silica	$2.71x10^5$	$3.77x10^{-2}$	$4.00x10^1$	$4.72x10^{-2}$	FALSE
870		Silver Epoxy	$4.99x10^3$	$6.93x10^{-4}$	No OEL		
870	1310-73-2	Sodium Hydroxide	$4.99x10^3$	$6.93x10^{-4}$	20	$2.36x10^{-2}$	FALSE
870	7664-93-9	Sulfuric Acid	$3.67x10^4$	$5.10x10^{-3}$	10	$1.18x10^{-2}$	FALSE
870	7704-98-5	Titanium Hydride	$9.07x10^2$	$1.26x10^{-4}$	No OEL		
870		Ultima Gold-Packard (alkylnapthalene)	$5.27x10^5$	$7.32x10^{-2}$	No OEL		
878	110-80-5	2-Ethoxyethanol	$1.24x10^2$	$1.73x10^{-5}$	$1.80x10^1$	$2.13x10^{-2}$	FALSE
878	111-15-9	2-Ethoxyethyl acetate	$8.53x10^3$	$1.18x10^{-3}$	$2.70x10^1$	$3.19x10^{-2}$	FALSE
878	109-86-4	2-Methoxyethanol	$8.75x10^1$	$1.22x10^{-5}$	3.00	$3.54x10^{-3}$	FALSE
878	64-19-7	Acetic acid	$1.28x10^4$	$1.77x10^{-3}$	$2.50x10^2$	$2.95x10^{-1}$	FALSE
878	67-64-1	Acetone	$3.92x10^5$	$5.44x10^{-2}$	$5.90x10^3$	6.97	FALSE
878	7429-90-5	Aluminum (fume or dust)	$1.07x10^4$	$1.48x10^{-3}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	1344-28-1	Aluminum oxide (fibrous forms)	1.67×10^{6}	2.31×10^{-1}	5.00×10^{1}	5.90×10^{-2}	TRUE
878	12125-02-9	Ammonium chloride	9.99×10^{4}	1.39×10^{-2}	1.00×10^{2}	1.18×10^{-1}	FALSE
878	1303-96-4	Borates, tetra, sodium salts (anhydrous)	1.00×10^{4}	1.39×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	111-76-2	Butyl cellosolve (R)	5.97×10^{3}	8.29×10^{-4}	2.40×10^{2}	2.83×10^{-1}	FALSE
878	1305-62-0	Calcium hydroxide	1.12×10^{4}	1.56×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	76-22-2	Camphor	7.44×10^{1}	1.03×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	1333-86-4	Carbon black	4.46×10^{2}	6.19×10^{-5}	3.50×10^{1}	4.13×10^{-2}	FALSE
878	2921-88-2	Chlorpyrifos	2.27	3.15×10^{-7}	2.00	2.36×10^{-3}	FALSE
878	7440-50-8	Copper dusts and mists, as copper	7.60×10^{4}	1.06×10^{-2}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	110-82-7	Cyclohexane	3.40×10^{2}	4.73×10^{-5}	7.00×10^{3}	8.26	FALSE
878	108-93-0	Cyclohexanol	8.00	1.11×10^{-6}	2.00×10^{3}	2.36	FALSE
878	108-91-8	Cyclohexylamine	1.83×10^{4}	2.54×10^{-3}	4.00×10^{2}	4.72×10^{-1}	FALSE
878	111-40-0	Diethylene triamine	2.07×10^{3}	2.87×10^{-4}	4.00×10^{1}	4.72×10^{-2}	FALSE
878	109-87-5	Dimethyoxymethane (methylal)	3.40	4.72×10^{-7}	3.10×10^{4}	3.66×10^{1}	FALSE
878	141-43-5	Ethanolamine	1.53×10^{2}	2.12×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	141-78-6	Ethyl acetate	4.88×10^{2}	6.77×10^{-5}	1.40×10^{4}	1.65×10^{1}	FALSE
878	78-10-4	Ethyl silicate	4.79×10^{2}	6.65×10^{-5}	8.50×10^{2}	1.00	FALSE
878	64-18-6	Formic acid	5.68×10^{3}	7.89×10^{-4}	9.00×10^{1}	1.06×10^{-1}	FALSE
878	7722-84-1	Hydrogen peroxide (concentration > 52%)	2.94×10^{4}	4.08×10^{-3}	1.40×10^{1}	1.65×10^{-2}	FALSE
878	7783-06-4	Hydrogen sulfide	3.66×10^{3}	5.08×10^{-4}	1.40×10^{2}	1.65×10^{-1}	FALSE
878	61788-32-7	Hydrogenated terphenyls	3.18×10^{3}	4.42×10^{-4}	4.90×10^{1}	5.79×10^{-2}	FALSE
878	7440-74-6	Indium & compounds as indium	8.80×10^{3}	1.22×10^{-3}	1.00	1.18×10^{-3}	TRUE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
878	7553-56-2	Iodine	7.00×10^{2}	9.72×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	1309-37-1	Iron oxide fume (Fe_2O_3) as iron	1.03×10^{4}	1.43×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7439-89-6	Iron salts, soluble, as iron	8.03×10^{3}	1.12×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	26952-21-6	Isoacytl alcohol	6.80	9.45×10^{-7}	2.66×10^{3}	3.14	FALSE
878	110-19-0	Isobutyl acetate	5.10×10^{1}	7.08×10^{-6}	7.00×10^{3}	8.26	FALSE
878	4098-71-9	Isophorone diisocyanate	1.00	1.39×10^{-7}	4.50×10^{-1}	5.31×10^{-4}	FALSE
878	67-63-0	Isopropyl alcohol	2.21×10^{5}	3.07×10^{-2}	4.90×10^{3}	5.79	FALSE
878	1309-48-4	Magnesium oxide	1.18×10^{3}	1.63×10^{-4}	6.00×10^{1}	7.08×10^{-2}	FALSE
878	5124-30-1	Methylene bis(4-cyclohexylisocyanate)	1.66×10^{2}	2.31×10^{-5}	5.40×10^{-1}	6.38×10^{-4}	FALSE
878	7439-98-7	Molybdenum as Molybdenum (insoluble compounds)	1.57×10^{4}	2.18×10^{-3}	1.00×10^{2}	1.18×10^{-1}	FALSE
878	628-63-7	n-Amyl acetate	4.38×10^{2}	6.08×10^{-5}	2.60×10^{3}	3.07	FALSE
878	123-86-4	n-Butyl acetate	1.36×10^{3}	1.89×10^{-4}	7.10×10^{3}	8.38	FALSE
878	71-36-3	n-Butyl alcohol	6.74×10^{3}	9.36×10^{-4}	3.00×10^{3}	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	2.72×10^{2}	3.78×10^{-5}	1.33×10^{3}	1.57	FALSE
878	142-82-5	n-Heptane	6.03×10^{2}	8.37×10^{-5}	3.50×10^{3}	4.13	FALSE
878	7697-37-2	Nitric acid	6.33×10^{4}	8.79×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	109-66-0	Pentane	3.25×10^{2}	4.51×10^{-5}	3.50×10^{3}	4.13	FALSE
878	8002-05-9	Petroleum	4.53×10^{2}	6.30×10^{-5}	3.50×10^{3}	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	1.05×10^{2}	1.46×10^{-5}	8.50×10^{2}	1.00	FALSE
878	7664-38-2	Phosphoric acid	6.69×10^{3}	9.30×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	7440-06-4	Platinum metal	1.02×10^{4}	1.41×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	1310-58-3	Potassium hydroxide	2.90×10^{3}	4.03×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
878	71-23-8	Propyl alcohol	4.06×10^{3}	5.63×10^{-4}	4.92×10^{3}	5.81	FALSE
878	8003-34-7	Pyrethrins	2.36×10^{-1}	3.28×10^{-8}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	110-86-1	Pyridine	1.94×10^{2}	2.69×10^{-5}	1.50×10^{2}	1.77×10^{-1}	FALSE
878	14808-60-7	Quartz	4.02×10^{3}	5.59×10^{-4}	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	78-92-2	sec-Butyl alcohol	1.34×10^{3}	1.86×10^{-4}	3.00×10^{3}	3.54	FALSE
878	7631-86-9	Silica, fused (respirable)	6.46×10^{3}	8.97×10^{-4}	5.00×10^{-1}	5.90×10^{-4}	TRUE
878	7440-22-4	Silver metal	1.40×10^{4}	1.95×10^{-3}	1.00×10^{-1}	1.18×10^{-4}	TRUE
878	7631-90-5	Sodium bisulfite	5.00×10^{2}	6.94×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	1310-73-2	Sodium hydroxide	4.87×10^{2}	6.77×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	8052-41-3	Stoddard solvent	2.27×10^{2}	3.15×10^{-5}	3.50×10^{3}	4.13	FALSE
878	7664-93-9	Sulfuric acid	2.18×10^{2}	3.02×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	75-65-0	t-Butyl alcohol	3.40	4.72×10^{-7}	3.00×10^{3}	3.54	FALSE
878	7440-25-7	Tantalum	1.04×10^{3}	1.44×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	26140-60-3	Terphenyls	4.77×10^{2}	6.62×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	109-99-9	Tetrahydrofuran	4.23×10^{2}	5.87×10^{-5}	1.50×10^{3}	1.77	FALSE
878	7722-88-5	Tetrasodium pyrophosphate	1.50	2.08×10^{-7}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7440-31-5	Tin metal	1.37×10^{4}	1.91×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	91-08-7	Toluene-2,6-diisocyanate	2.04×10^{1}	2.83×10^{-6}	7.00×10^{-1}	8.26×10^{-4}	FALSE
878	7440-33-7	Tungsten as Wolfram insoluble compounds	2.74×10^{4}	3.81×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7440-62-2	Vanadium (fume or dust)	2.18×10^{4}	3.03×10^{-3}	5.00×10^{-1}	5.90×10^{-4}	TRUE
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	2.75×10^{-1}	3.82×10^{-8}	3.50×10^{3}	4.13	FALSE
878	7440-66-6	Zinc	9.64	1.34×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
878	1314-13-2	Zinc oxide	$1.14x10^{2}$	$1.58x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
893	67-64-1	Acetone	$4.68x10^{5}$	$6.50x10^{-2}$	$5.90x10^{3}$	6.97	FALSE
893	7726-95-6	Bromine	$1.55x10^{2}$	$2.16x10^{-5}$	6.60	$7.79x10^{-3}$	FALSE
893	7722-84-1	Hydrogen peroxide (Conc.> 52%)	$1.30x10^{4}$	$1.80x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
893	67-63-0	Isopropyl alcohol	$1.77x10^{5}$	$2.46x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
893	7697-37-2	Nitric acid	$1.36x10^{4}$	$1.89x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
893	1310-58-3	Potassium hydroxide	$2.04x10^{3}$	$2.84x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
893	7664-93-9	Sulfuric acid	$7.07x10^{4}$	$9.82x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	$2.40x10^{3}$	$3.33x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	64-19-7	Acetic acid	$4.95x10^{4}$	$6.88x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
897	67-64-1	Acetone	$6.84x10^{4}$	$9.51x10^{-3}$	$5.90x10^{3}$	6.97	FALSE
897	106-92-3	Allyl glycidyl ether	$1.67x10^{1}$	$2.32x10^{-6}$	$2.20x10^{2}$	$2.60x10^{-1}$	FALSE
897	1344-28-1	Aluminum oxide (fibrous forms)	$1.50x10^{3}$	$2.08x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
897	128-37-0	Butylated hydroxytoluene	$9.90x10^{1}$	$1.37x10^{-5}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
897	420-04-2	Cyanamide	$2.47x10^{1}$	$3.44x10^{-6}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	110-82-7	Cyclohexane	2.99	$4.15x10^{-7}$	$7.00x10^{3}$	8.26	FALSE
897	107-66-4	Dibutyl phosphate	$2.72x10^{2}$	$3.78x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
897	124-40-3	Dimethylamine	$3.98x10^{2}$	$5.53x10^{-5}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
897	141-78-6	Ethyl acetate	$1.78x10^{4}$	$2.47x10^{-3}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	$2.18x10^{4}$	$3.03x10^{-3}$	$1.20x10^{4}$	$1.42x10^{1}$	FALSE
897	78-10-4	Ethyl silicate	$6.27x10^{2}$	$8.72x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
897	7722-84-1	Hydrogen peroxide (concentration > 52%)	$2.36x10^{3}$	$3.28x10^{-4}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
897	67-63-0	Isopropyl alcohol	$7.77x10^{4}$	$1.08x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
897	8008-20-6	Kerosene	$3.01x10^{3}$	$4.18x10^{-4}$	$1.00x10^{3}$	1.18	FALSE
897	126-98-7	Methacrylonitrile	$7.95x10^{1}$	$1.10x10^{-5}$	$2.70x10^{1}$	$3.19x10^{-2}$	FALSE
897	681-84-5	Methyl silicate	$2.24x10^{2}$	$3.12x10^{-5}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE
897	71-36-3	n-Butyl alcohol	$1.57x10^{2}$	$2.19x10^{-5}$	$3.00x10^{3}$	3.54	FALSE
897	142-82-5	n-Heptane	$5.42x10^{3}$	$7.52x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	7697-37-2	Nitric acid	$1.60x10^{1}$	$2.22x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
897	144-62-7	Oxalic acid	$3.92x10^{3}$	$5.44x10^{-4}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
897	109-66-0	Pentane	$1.91x10^{3}$	$2.66x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	9003-53-6	Phenlylethylene (Styrene, monomer)	$8.00x10^{-1}$	$1.11x10^{-7}$	$8.50x10^{2}$	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-Trinitrophenol)	9.95	$1.38x10^{-6}$	1.00	$1.18x10^{-3}$	FALSE
897	1310-58-3	Potassium hydroxide	$9.30x10^{3}$	$1.29x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	71-23-8	Propyl alcohol	$2.98x10^{4}$	$4.14x10^{-3}$	$4.92x10^{3}$	5.81	FALSE
897	7440-22-4	Silver Metal	$1.68x10^{1}$	$2.33x10^{-6}$	$1.00x10^{-1}$	$1.18x10^{-4}$	FALSE
897	1310-73-2	Sodium hydroxide	$5.00x10^{2}$	$6.94x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	7664-93-9	Sulfuric acid	$7.75x10^{3}$	$1.08x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
897	109-99-9	Tetrahydrofuran	$1.17x10^{4}$	$1.62x10^{-3}$	$1.50x10^{3}$	1.77	FALSE
897	7719-09-7	Thionyl chloride	$4.89x10^{3}$	$6.80x10^{-4}$	$4.90x10^{1}$	$5.79x10^{-2}$	FALSE
897	76-03-9	Trichloroacetic acid	$5.00x10^{2}$	$6.94x10^{-5}$	$6.70x10^{1}$	$7.91x10^{-2}$	FALSE
905	67-64-1	Acetone	$1.40x10^{4}$	$1.95x10^{-3}$	$5.90x10^{3}$	6.97	FALSE
905	67-63-0	Isopropyl alcohol	$1.24x10^{4}$	$1.72x10^{-3}$	$4.90x10^{3}$	5.79	FALSE
905	1309-48-4	Magnesium oxide	$8.00x10^{2}$	$1.11x10^{-4}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE

Table D.1–8. 1996 Annual Purchases of Toxic Air Pollutants (TAPs) Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
905	109-99-9	Tetrahydrofuran	$3.34x10^3$	$4.64x10^{-4}$	$1.50x10^3$	1.77	FALSE
963	67-63-0	Isopropyl alcohol	$7.85x10^2$	$1.09x10^{-4}$	$4.90x10^3$	5.79	FALSE
981	67-64-1	Acetone	$2.99x10^3$	$4.15x10^{-4}$	$5.90x10^3$	6.97	FALSE
981	7664-93-9	Sulfuric acid	$4.69x10^4$	$6.52x10^{-3}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
986	67-64-1	Acetone	$2.99x10^3$	$4.15x10^{-4}$	$5.90x10^3$	6.97	FALSE

[a] No CAS number is available

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULT
605	79-09-4	Propionic acid	1.03×10^{2}	1.43×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
605	7664-93-9	Sulfuric acid	8.25×10^{1}	1.15×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
6580	141-78-6	Ethyl acetate	7.20×10^{3}	1.00×10^{-3}	1.40×10^{4}	1.65×10^{1}	FALSE
6580	7722-84-1	Hydrogen peroxide (concentration> 52%)	4.99×10^{2}	6.94×10^{-5}	1.40×10^{1}	1.65×10^{-2}	FALSE
6580	7697-37-2	Nitric acid	1.57×10^{4}	2.19×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
6580	1310-73-2	Sodium hydroxide	1.13×10^{4}	1.57×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
6580	7664-93-9	Sulfuric acid	9.20×10^{3}	1.28×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
6920	7697-37-2	Nitric acid	1.87×10^{2}	2.60×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
6920	1310-73-2	Sodium hydroxide	4.54×10^{2}	6.30×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
6920	7440-66-6	Zinc	1.00×10^{3}	1.39×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
858	64-19-7	Acetic acid	5.64×10^{4}	7.83×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	67-64-1	Acetone	3.04×10^{4}	4.22×10^{-3}	5.90×10^{3}	6.97	FALSE
858	7722-84-1	Hydrogen peroxide (concentration> 52%)	3.10×10^{6}	4.31×10^{-1}	1.40×10^{1}	1.65×10^{-2}	TRUE
858	7697-37-2	Nitric acid	3.99×10^{6}	5.54×10^{-1}	5.00×10^{1}	5.90×10^{-2}	TRUE
858	7664-38-2	Phosphoric acid	7.59×10^{4}	1.05×10^{-2}	1.00×10^{1}	1.18×10^{-2}	FALSE
858	7803-62-5	Silane (silicon tetrahydride)	1.78×10^{5}	2.47×10^{-2}	6.60×10^{1}	7.79×10^{-2}	FALSE
858	1310-73-2	Sodium hydroxide	6.12×10^{7}	8.50	2.00×10^{1}	2.36×10^{-2}	TRUE
858	7664-93-9	Sulfuric acid	5.78×10^{4}	8.02×10^{3}	1.00×10^{1}	1.18×10^{-2}	FALSE
870	64-19-7	Acetic Acid	1.05×10^{5}	1.45×10^{-2}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	64-19-7	Acetic Acid, Glacial	1.15×10^{5}	1.60×10^{-2}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	67-64-1	Acetone	6.46×10^{6}	8.97×10^{-1}	5.90×10^{3}	6.97	FALSE
870	71-36-3	Alcohol, Butyl	1.21×10^{4}	1.69×10^{-3}	3.00×10^{3}	3.54	FALSE
870	67-63-0	Alcohol, Isopropyl	2.61×10^{5}	3.63×10^{-2}	4.90×10^{3}	5.79	FALSE

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
870	7429-90-5	Aluminum	6.65×10^{5}	9.23×10^{-2}	5.00×10^{1}	5.90×10^{-2}	TRUE
870	1344-28-1	Aluminum Oxide	2.99×10^{5}	4.16×10^{-2}	5.00×10^{1}	5.90×10^{-2}	FALSE
870	1336-21-6	Ammonium Hydroxide	1.35×10^{4}	1.87×10^{-3}	No OEL		
870	1113-50-1	Boric Acid	1.20×10^{5}	1.66×10^{-2}	No OEL		
870	11-15-9	Cellosolve Acetate	6.52×10^{3}	9.05×10^{-4}	No OEL		
870		Cerric Ammonium Nitrate	2.00×10^{6}	2.77×10^{-1}	No OEL		
870		Citridet Cleaner	1.15×10^{6}	1.59×10^{-1}	1.21×10^{3}	1.43	FALSE
870	7440-50-8	Copper	6.65×10^{5}	9.23×10^{-2}	1.00	1.18×10^{-3}	TRUE
870	7440-50-8	Copper (0.10%)	5.99×10^{1}	8.32×10^{-6}	1.00	1.18×10^{-3}	FALSE
870		Carboxyl terminated acrylonitrile-butadiene Epoxy Resin	2.99×10^{5}	4.16×10^{-2}	No OEL		
870		Curing Agent Z (37% Methylene dianiline)	4.53×10^{5}	6.29×10^{-2}	No OEL		
870		2,6-diethylaniline curing agent	3.59×10^{5}	4.99×10^{-2}	No OEL		
870		Diala oil	5.01×10^{5}	6.95×10^{-2}	No OEL		
870	106-42-3	Di-p Xylene	9.07×10^{5}	1.26×10^{-1}	4.34×10^{3}	5.12	FALSE
870	7440-52-0	Erbium	1.50×10^{4}	2.08×10^{-3}	No OEL		
870		Fluorinert	5.60×10^{6}	7.77×10^{-1}	No OEL		
870		Glass microballoons filler	7.48×10^{4}	1.04×10^{-2}	No OEL		
870		Hexylene glycol	1.00×10^{6}	1.39×10^{-1}	1.21×10^{3}	1.43	FALSE
870	1309-37-1	Iron (53%)	3.17×10^{4}	4.41×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
870	123-92-2	Iso Amyl Acetate	7.94×10^{5}	1.10×10^{-1}	5.25×10^{3}	6.20	FALSE
870		Isopropyl alcohol	2.61×10^{5}	3.63×10^{-2}	4.90×10^{3}	5.79	FALSE
870		Mold Release	2.81×10^{5}	3.90×10^{-2}	No OEL		

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
870	7439-98-7	Molybdenum	$6.66x10^{3}$	$9.24x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
870	7697-37-2	Nitric Acid (70%)	$1.60x10^{5}$	$2.22x10^{-2}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
870		Oakite Citridet	$1.00x10^{6}$	$1.39x10^{-1}$	No OEL		
870	127-18-4	Perchloroethylene	$1.01x10^{6}$	$1.41x10^{-1}$	$1.70x10^{3}$	2.01	FALSE
870	7664-38-2	Phosphoric Acid	$1.10x10^{5}$	$1.53x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	TRUE
870	1310-58-3	Potassium Hydroxide	$1.50x10^{4}$	$2.08x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
870	7440-20-2	Scandium	$1.50x10^{4}$	$2.08x10^{-3}$	No OEL		
870	7631-86-9	Silica	$9.04x10^{5}$	$1.26x10^{-1}$	$4.00x10^{1}$	$4.72x10^{-2}$	TRUE
870		Silver Epoxy	$1.50x10^{4}$	$2.08x10^{-3}$	No OEL		
870	1310-73-2	Sodium Hydroxide	$1.50x10^{4}$	$2.08x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
870	7664-93-9	Sulfuric Acid	$1.10x10^{5}$	$1.53x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	TRUE
870	7704-98-5	Titanium Hydride	$3.29x10^{3}$	$4.57x10^{-4}$	No OEL		
870		Ultima Gold – Packard (alkylnapthalene)	$1.58x10^{6}$	$2.20x10^{-1}$	No OEL		
878	110-80-5	2-Ethoxyethanol	$1.86x10^{2}$	$2.59x10^{-5}$	$1.80x10^{1}$	$2.13x10^{-2}$	FALSE
878	111-15-9	2-Ethoxyethyl acetate	$1.28x10^{4}$	$1.78x10^{-3}$	$2.70x10^{1}$	$3.19x10^{-2}$	FALSE
878	109-86-4	2-Methoxyethanol	$1.31x10^{2}$	$1.82x10^{-5}$	3.00	$3.54x10^{-3}$	FALSE
878	64-19-7	Acetic acid	$1.92x10^{4}$	$2.66x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
878	67-64-1	Acetone	$5.88x10^{5}$	$8.16x10^{-2}$	$5.90x10^{3}$	6.97	FALSE
878	7429-90-5	Aluminum (fume or dust)	$1.60x10^{4}$	$2.23x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	$2.50x10^{6}$	$3.47x10^{-1}$	$5.00x10^{1}$	$5.90x10^{-2}$	TRUE
878	12125-02-9	Ammonium chloride	$1.50x10^{5}$	$2.08x10^{-2}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
878	1303-96-4	Borates, tetra, sodium salts (anhydrous)	$1.50x10^{4}$	$2.08x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	111-76-2	Butyl cellosolve (R)	$8.95x10^{3}$	$1.24x10^{-3}$	$2.40x10^{2}$	$2.83x10^{-1}$	FALSE

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	1305-62-0	Calcium hydroxide	$1.68x10^{4}$	$2.34x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	76-22-2	Camphor	$1.12x10^{2}$	$1.55x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	1333-86-4	Carbon black	$6.68x10^{2}$	$9.28x10^{-5}$	$3.50x10^{1}$	$4.13x10^{-2}$	FALSE
878	2921-88-2	Chlorpyrifos	3.40	$4.72x10^{-7}$	2.00	$2.36x10^{-3}$	FALSE
878	7440-50-8	Copper dusts and mists, as copper	$1.14x10^{5}$	$1.58x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	TRUE
878	110-82-7	Cyclohexane	$5.11x10^{2}$	$7.09x10^{-5}$	$7.00x10^{3}$	8.26	FALSE
878	108-93-0	Cyclohexanol	$1.20x10^{1}$	$1.67x10^{-6}$	$2.00x10^{3}$	2.36	FALSE
878	108-91-8	Cyclohexylamine	$2.74x10^{4}$	$3.81x10^{-3}$	$4.00x10^{2}$	$4.72x10^{-1}$	FALSE
878	111-40-0	Diethylene triamine	$3.10x10^{3}$	$4.31x10^{-4}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
878	109-87-5	Dimethyoxymethane (methylal)	5.10	$7.09x10^{-7}$	$3.10x10^{4}$	$3.66x10^{1}$	FALSE
878	141-43-5	Ethanolamine	$2.29x10^{2}$	$3.18x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	141-78-6	Ethyl acetate	$7.32x10^{2}$	$1.02x10^{-4}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
878	78-10-4	Ethyl silicate	$7.18x10^{2}$	$9.97x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	64-18-6	Formic acid	$8.52x10^{3}$	$1.18x10^{-3}$	$9.00x10^{1}$	$1.06x10^{-1}$	FALSE
878	7722-84-1	Hydrogen peroxide (concentration> 52%)	$4.41x10^{4}$	$6.12x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
878	7783-06-4	Hydrogen sulfide	$5.49x10^{3}$	$7.62x10^{-4}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
878	61788-32-7	Hydrogenated terphenyls	$4.77x10^{3}$	$6.62x10^{-4}$	$4.90x10^{1}$	$5.79x10^{-2}$	FALSE
878	7440-74-6	Indium & compounds as indium	$1.32x10^{4}$	$1.83x10^{-3}$	1.00	$1.18x10^{-3}$	TRUE
878	7553-56-2	Iodine	$1.05x10^{3}$	$1.46x10^{-4}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1309-37-1	Iron oxide fume (Fe_2O_3) as iron	$1.54x10^{4}$	$2.14x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7439-89-6	Iron salts, soluble, as iron	$1.20x10^{4}$	$1.67x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	26952-21-6	Isoacytl alcohol	$1.02x10^{1}$	$1.42x10^{-6}$	$2.66x10^{3}$	3.14	FALSE
878	110-19-0	Isobutyl acetate	$7.64x10^{1}$	$1.06x10^{-5}$	$7.00x10^{3}$	8.26	FALSE

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
878	4098-71-9	Isophorone diisocyanate	1.50	$2.08x10^{-7}$	$4.50x10^{-1}$	$5.31x10^{-4}$	FALSE
878	67-63-0	Isopropyl alcohol	$3.32x10^{5}$	$4.61x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
878	1309-48-4	Magnesium oxide	$1.77x10^{3}$	$2.45x10^{-4}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE
878	5124-30-1	Methylene bis(4-cyclohexylisocyanate)	$2.49x10^{2}$	$3.46x10^{-5}$	$5.40x10^{-1}$	$6.38x10^{-4}$	FALSE
878	7439-98-7	Molybdenum as molybdenum (insoluble compounds)	$2.36x10^{4}$	$3.28x10^{-3}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
878	628-63-7	n-Amyl acetate	$6.57x10^{2}$	$9.12x10^{-5}$	$2.60x10^{3}$	3.07	FALSE
878	123-86-4	n-Butyl acetate	$2.05x10^{3}$	$2.84x10^{-4}$	$7.10x10^{3}$	8.38	FALSE
878	71-36-3	n-Butyl alcohol	$1.01x10^{4}$	$1.40x10^{-3}$	$3.00x10^{3}$	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	$4.08x10^{2}$	$5.67x10^{-5}$	$1.33x10^{3}$	1.57	FALSE
878	142-82-5	n-Heptane	$9.04x10^{2}$	$1.26x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
878	7697-37-2	Nitric acid	$9.49x10^{4}$	$1.32x10^{-2}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	109-66-0	Pentane	$4.87x10^{2}$	$6.76x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	8002-05-9	Petroleum	$6.80x10^{2}$	$9.44x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	$1.57x10^{2}$	$2.19x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	7664-38-2	Phosphoric acid	$1.00x10^{4}$	$1.39x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	7440-06-4	Platinum metal	$1.53x10^{4}$	$2.12x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1310-58-3	Potassium hydroxide	$4.35x10^{3}$	$6.05x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	71-23-8	Propyl alcohol	$6.08x10^{3}$	$8.45x10^{-4}$	$4.92x10^{3}$	5.81	FALSE
878	8003-34-7	Pyrethrins	$3.54x10^{-1}$	$4.91x10^{-8}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	110-86-1	Pyridine	$2.90x10^{2}$	$4.03x10^{-5}$	$1.50x10^{2}$	$1.77x10^{-1}$	FALSE
878	14808-60-7	Quartz	$6.03x10^{3}$	$8.38x10^{-4}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	78-92-2	sec-Butyl alcohol	$2.01x10^{3}$	$2.79x10^{-4}$	$3.00x10^{3}$	3.54	FALSE
878	7631-86-9	Silica, fused (respirable)	$9.68x10^{3}$	$1.34x10^{-3}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	7440-22-4	Silver metal	$2.10x10^{4}$	$2.92x10^{-3}$	$1.00x10^{-1}$	$1.18x10^{-4}$	TRUE
878	7631-90-5	Sodium bisulfite	$7.50x10^{2}$	$1.04x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	1310-73-2	Sodium hydroxide	$7.31x10^{2}$	$1.01x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	8052-41-3	Stoddard solvent	$3.41x10^{2}$	$4.73x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	7664-93-9	Sulfuric acid	$3.27x10^{2}$	$4.54x10^{-5}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	75-65-0	t-Butyl alcohol	5.10	$7.09x10^{-7}$	$3.00x10^{3}$	3.54	FALSE
878	7440-25-7	Tantalum	$1.56x10^{3}$	$2.17x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	26140-60-3	Terphenyls	$7.15x10^{2}$	$9.94x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	109-99-9	Tetrahydrofuran	$6.34x10^{2}$	$8.81x10^{-5}$	$1.50x10^{3}$	1.77	FALSE
878	7722-88-5	Tetrasodium pyrophosphate	2.25	$3.12x10^{-7}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7440-31-5	Tin metal	$2.06x10^{4}$	$2.86x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	91-08-7	Toluene-2,6-diisocyanate	$3.06x10^{1}$	$4.25x10^{-6}$	$7.00x10^{-1}$	$8.26x10^{-4}$	FALSE
878	7440-33-7	Tungsten as Wolfram insoluble compounds	$4.11x10^{4}$	$5.71x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7440-62-2	Vanadium (fume or dust)	$3.27x10^{4}$	$4.54x10^{-3}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	$4.12x10^{-1}$	$5.73x10^{-8}$	$3.50x10^{3}$	4.13	FALSE
878	7440-66-6	Zinc	$1.45x10^{1}$	$2.01x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	1314-13-2	Zinc oxide	$1.71x10^{2}$	$2.37x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
893	67-64-1	Acetone	$4.68x10^{5}$	$6.50x10^{-2}$	$5.90x10^{3}$	6.97	FALSE
893	7726-95-6	Bromine	$1.55x10^{2}$	$2.16x10^{-5}$	6.60	$7.79x10^{-3}$	FALSE
893	7722-84-1	Hydrogen peroxide (concentration> 52%)	$1.30x10^{4}$	$1.80x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
893	67-63-0	Isopropyl alcohol	$1.77x10^{5}$	$2.46x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
893	7697-37-2	Nitric acid	$1.36x10^{4}$	$1.89x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
893	1310-58-3	Potassium hydroxide	$2.04x10^{3}$	$2.84x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
893	7664-93-9	Sulfuric acid	$7.07x10^4$	$9.82x10^{-3}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	$2.40x10^3$	$3.33x10^{-4}$	$3.50x10^3$	4.13	FALSE
897	64-19-7	Acetic acid	$4.95x10^4$	$6.88x10^{-3}$	$2.50x10^2$	$2.95x10^{-1}$	FALSE
897	67-64-1	Acetone	$6.84x10^4$	$9.51x10^{-3}$	$5.90x10^3$	6.97	FALSE
897	106-92-3	Allyl glycidyl ether	$1.67x10^1$	$2.32x10^{-6}$	$2.20x10^2$	$2.60x10^{-1}$	FALSE
897	1344-28-1	Aluminum oxide (fibrous forms)	$1.50x10^3$	$2.08x10^{-4}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
897	128-37-0	Butylated hydroxytoluene	$9.90x10^1$	$1.37x10^{-5}$	$1.00x10^2$	$1.18x10^{-1}$	FALSE
897	420-04-2	Cyanamide	$2.47x10^1$	$3.44x10^{-6}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
897	110-82-7	Cyclohexane	2.99	$4.15x10^{-7}$	$7.00x10^3$	8.26	FALSE
897	107-66-4	Dibutyl phosphate	$2.72x10^2$	$3.78x10^{-5}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
897	124-40-3	Dimethylamine	$3.98x10^2$	$5.53x10^{-5}$	$4.00x10^1$	$4.72x10^{-2}$	FALSE
897	141-78-6	Ethyl acetate	$1.78x10^4$	$2.47x10^{-3}$	$1.40x10^4$	$1.65x10^1$	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	$2.18x10^4$	$3.03x10^{-3}$	$1.20x10^4$	$1.42x10^1$	FALSE
897	78-10-4	Ethyl silicate	$6.27x10^2$	$8.72x10^{-5}$	$8.50x10^2$	1.00	FALSE
897	7722-84-1	Hydrogen peroxide (concentration> 52%)	$2.36x10^3$	$3.28x10^{-4}$	$1.40x10^1$	$1.65x10^{-2}$	FALSE
897	67-63-0	Isopropyl alcohol	$7.77x10^4$	$1.08x10^{-2}$	$4.90x10^3$	5.79	FALSE
897	8008-20-6	Kerosene	$3.01x10^3$	$4.18x10^{-4}$	$1.00x10^3$	1.18	FALSE
897	126-98-7	Methacrylonitrile	$7.95x10^1$	$1.10x10^{-5}$	$2.70x10^1$	$3.19x10^{-2}$	FALSE
897	681-84-5	Methyl silicate	$2.24x10^2$	$3.12x10^{-5}$	$6.00x10^1$	$7.08x10^{-2}$	FALSE
897	71-36-3	n-Butyl alcohol	$1.57x10^2$	$2.19x10^{-5}$	$3.00x10^3$	3.54	FALSE
897	142-82-5	n-Heptane	$5.42x10^3$	$7.52x10^{-4}$	$3.50x10^3$	4.13	FALSE
897	7697-37-2	Nitric acid	$1.60x10^1$	$2.22x10^{-6}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
897	144-62-7	Oxalic acid	$3.92x10^3$	$5.44x10^{-4}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE

Table D.1–9. Projected Toxic Air Pollutant (TAP) Emissions No Action Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
897	109-66-0	Pentane	$1.91x10^{3}$	$2.66x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	9003-53-6	Phenlylethylene (styrene, monomer)	$8.00x10^{-1}$	$1.11x10^{-7}$	$8.50x10^{2}$	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-trinitrophenol)	9.95	$1.38x10^{-6}$	1.00	$1.18x10^{-3}$	FALSE
897	1310-58-3	Potassium hydroxide	$9.30x10^{3}$	$1.29x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	71-23-8	Propyl alcohol	$2.98x10^{4}$	$4.14x10^{-3}$	$4.92x10^{3}$	5.81	FALSE
897	7440-22-4	Silver metal	$1.68x10^{1}$	$2.33x10^{-6}$	$1.00x10^{-1}$	$1.18x10^{-4}$	FALSE
897	1310-73-2	Sodium hydroxide	$5.00x10^{2}$	$6.94x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	7664-93-9	Sulfuric acid	$7.75x10^{3}$	$1.08x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
897	109-99-9	Tetrahydrofuran	$1.17x10^{4}$	$1.62x10^{-3}$	$1.50x10^{3}$	1.77	FALSE
897	7719-09-7	Thionyl chloride	$4.89x10^{3}$	$6.80x10^{-4}$	$4.90x10^{1}$	$5.79x10^{-2}$	FALSE
897	76-03-9	Trichloroacetic acid	$5.00x10^{2}$	$6.94x10^{-5}$	$6.70x10^{1}$	$7.91x10^{-2}$	FALSE
905	67-64-1	Acetone	$2.81x10^{4}$	$3.90x10^{-3}$	$5.90x10^{3}$	6.97	FALSE
905	67-63-0	Isopropyl alcohol	$2.47x10^{4}$	$3.44x10^{-3}$	$4.90x10^{3}$	5.79	FALSE
905	1309-48-4	Magnesium oxide	$1.60x10^{3}$	$2.22x10^{-4}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE
905	109-99-9	Tetrahydrofuran	$6.69x10^{3}$	$9.29x10^{-4}$	$1.50x10^{3}$	1.77	FALSE
963	67-63-0	Isopropyl alcohol	$7.85x10^{2}$	$1.09x10^{-4}$	$4.90x10^{3}$	5.79	FALSE
981	67-64-1	Acetone	$8.97x10^{3}$	$1.25x10^{-3}$	$5.90x10^{3}$	6.97	FALSE
981	7664-93-9	Sulfuric acid	$1.41x10^{5}$	$1.95x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	TRUE
986	67-64-1	Acetone	$1.50x10^{4}$	$2.08x10^{-3}$	$5.90x10^{3}$	6.97	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
605	79-09-4	Propionic acid	2.06×10^{2}	2.87×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
605	7664-93-9	Sulfuric acid	1.65×10^{2}	2.29×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
6580	141-78-6	Ethyl acetate	5.40×10^{3}	7.50×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
6580	7722-84-1	Hydrogen peroxide (concentration> 52%)	1.33×10^{3}	1.85×10^{-4}	1.40×10^{1}	1.65×10^{-2}	FALSE
6580	7697-37-2	Nitric acid	4.20×10^{4}	5.83×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
6580	1310-73-2	Sodium hydroxide	1.50×10^{4}	2.09×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
6580	7664-93-9	Sulfuric acid	2.76×10^{4}	3.83×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
6920	7697-37-2	Nitric acid	3.75×10^{2}	5.21×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
6920	1310-73-2	Sodium hydroxide	9.07×10^{2}	1.26×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
6920	7440-66-6	Zinc	2.00×10^{3}	2.78×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
858	64-19-7	Acetic acid	6.04×10^{4}	8.39×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	67-64-1	Acetone	3.26×10^{4}	4.53×10^{-3}	5.90×10^{3}	6.97	FALSE
858	7722-84-1	Hydrogen peroxide (concentration> 52%)	3.33×10^{6}	4.62×10^{-1}	1.40×10^{1}	1.65×10^{-2}	TRUE
858	7697-37-2	Nitric acid	4.27×10^{6}	5.93×10^{-1}	5.00×10^{1}	5.90×10^{-2}	TRUE
858	7664-38-2	Phosphoric acid	8.13×10^{4}	1.13×10^{-2}	1.00×10^{1}	1.18×10^{-2}	FALSE
858	7803-62-5	Silane (silicon tetrahydride)	1.90×10^{5}	2.65×10^{-2}	6.60×10^{1}	7.79×10^{-2}	FALSE
858	1310-73-2	Sodium hydroxide	6.56×10^{7}	9.11	2.00×10^{1}	2.36×10^{-2}	TRUE
858	7664-93-9	Sulfuric acid	6.19×10^{4}	8.60×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
870	64-19-7	Acetic Acid	1.05×10^{5}	1.45×10^{-2}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	64-19-7	Acetic Acid, Glacial	1.15×10^{5}	1.60×10^{-2}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	67-64-1	Acetone	6.46×10^{6}	8.97×10^{-1}	5.90×10^{3}	6.97	FALSE
870	71-36-3	Alcohol, Butyl	1.21×10^{4}	1.69×10^{-3}	3.00×10^{3}	3.54	FALSE
870	67-63-0	Alcohol, Isopropyl	2.61×10^{5}	3.63×10^{-2}	4.90×10^{3}	5.79	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
870	7429-90-5	Aluminum	6.65×10^5	9.23×10^{-2}	5.00×10^1	5.90×10^{-2}	TRUE
870	1344-28-1	Aluminum Oxide	2.99×10^5	4.16×10^{-2}	5.00×10^1	5.90×10^{-2}	FALSE
870	1336-21-6	Ammonium Hydroxide	1.35×10^4	1.87×10^{-3}	No OEL		
870	1113-50-1	Boric Acid	1.20×10^5	1.66×10^{-2}	No OEL		
870	11-15-9	Cellosolve Acetate	6.52×10^3	9.05×10^{-4}	No OEL		
870		Cerric Ammonium Nitrate	2.00×10^6	2.77×10^{-1}	No OEL		
870		Citridet Cleaner	1.15×10^6	1.59×10^{-1}	1.21×10^3	1.43	FALSE
870	7440-50-8	Copper	6.65×10^5	9.23×10^{-2}	1.00	1.18×10^{-3}	TRUE
870	7440-50-8	Copper (0.10%)	5.99×10^1	8.32×10^{-6}	1.00	1.18×10^{-3}	FALSE
870		Carboxyl terminated acrylonitrile-butadiene Epoxy Resin	2.99×10^5	4.16×10^{-2}	No OEL		
870		Curing Agent Z (37% Methylene dianiline)	4.53×10^5	6.29×10^{-2}	No OEL		
870		2,6-diethylaniline curing agent	3.59×10^5	4.99×10^{-2}	No OEL		
870		Diala oil	5.01×10^5	6.95×10^{-2}	No OEL		
870	106-42-3	Di-p Xylene	9.07×10^5	1.26×10^{-1}	4.35×10^3	5.12	FALSE
870	7440-52-0	Erbium	1.50×10^4	2.08×10^{-3}	No OEL		
870		Fluorinert	5.60×10^6	7.77×10^{-1}	No OEL		
870		Glass microballoons filler	7.48×10^4	1.04×10^{-2}	No OEL		
870		Hexylene glycol	1.00×10^6	1.39×10^{-1}	1.21×10^3	1.43	FALSE
870	1309-37-1	Iron (53%)	3.17×10^4	4.41×10^{-3}	5.00×10^1	5.90×10^{-2}	FALSE
870	123-92-2	Iso Amyl Acetate	7.94×10^5	1.10×10^{-1}	5.25×10^3	6.20	FALSE
870		Isopropyl alcohol	2.61×10^5	3.63×10^{-2}	4.90×10^3	5.79	FALSE
870		Mold Release	2.81×10^5	3.90×10^{-2}	No OEL		

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
870	7439-98-7	Molybdenum	$6.66x10^3$	$9.24x10^{-4}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
870	7697-37-2	Nitric Acid (70%)	$1.60x10^5$	$2.22x10^{-2}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
870		Oakite Citridet	$1.00x10^6$	$1.39x10^{-1}$	No OEL		
870	127-18-4	Perchloroethylene	$1.01x10^6$	$1.41x10^{-1}$	$1.70x10^3$	2.01	FALSE
870	7664-38-2	Phosphoric Acid	$1.10x10^5$	$1.53x10^{-2}$	$1.00x10^1$	$1.18x10^{-2}$	TRUE
870	1310-58-3	Potassium Hydroxide	$1.50x10^4$	$2.08x10^{-3}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
870	7440-20-2	Scandium	$1.50x10^4$	$2.08x10^{-3}$	No OEL		
870	7631-86-9	Silica	$9.04x10^5$	$1.26x10^{-1}$	$4.00x10^1$	$4.72x10^{-2}$	TRUE
870		Silver Epoxy	$1.50x10^4$	$2.08x10^{-3}$	No OEL		
870	1310-73-2	Sodium Hydroxide	$1.50x10^4$	$2.08x10^{-3}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
870	7664-93-9	Sulfuric Acid	$1.10x10^5$	$1.53x10^{-2}$	$1.00x10^1$	$1.18x10^{-2}$	TRUE
870	7704-98-5	Titanium Hydride	$3.29x10^3$	$4.57x10^{-4}$	No OEL		
870		Ultima Gold – Packard (alkylnapthalene)	$1.58x10^6$	$2.20x10^{-1}$	No OEL		
878	110-80-5	2-Ethoxyethanol	$2.48x10^2$	$3.45x10^{-5}$	$1.80x10^1$	$2.13x10^{-2}$	FALSE
878	111-15-9	2-Ethoxyethyl acetate	$1.71x10^4$	$2.37x10^{-3}$	$2.70x10^1$	$3.19x10^{-2}$	FALSE
878	109-86-4	2-Methoxyethanol	$1.75x10^2$	$2.43x10^{-5}$	3.00	$3.54x10^{-3}$	FALSE
878	64-19-7	Acetic acid	$2.55x10^4$	$3.55x10^{-3}$	$2.50x10^2$	$2.95x10^{-1}$	FALSE
878	67-64-1	Acetone	$7.83x10^5$	$1.09x10^{-1}$	$5.90x10^3$	6.97	FALSE
878	7429-90-5	Aluminum (fume or dust)	$2.14x10^4$	$2.97x10^{-3}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	$3.33x10^6$	$4.63x10^{-1}$	$5.00x10^1$	$5.90x10^{-2}$	TRUE
878	12125-02-9	Ammonium chloride	$2.00x10^5$	$2.78x10^{-2}$	$1.00x10^2$	$1.18x10^{-1}$	FALSE
878	1303-96-4	Borates, tetra, sodium salts (anhydrous)	$2.00x10^4$	$2.78x10^{-3}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
878	111-76-2	Butyl cellosolve (R)	$1.19x10^4$	$1.66x10^{-3}$	$2.40x10^2$	$2.83x10^{-1}$	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
878	1305-62-0	Calcium hydroxide	2.24×10^{4}	3.12×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	76-22-2	Camphor	1.49×10^{2}	2.07×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	1333-86-4	Carbon black	8.91×10^{2}	1.24×10^{-4}	3.50×10^{1}	4.13×10^{-2}	FALSE
878	2921-88-2	Chlorpyrifos	4.54	6.30×10^{-7}	2.00	2.36×10^{-3}	FALSE
878	7440-50-8	Copper dusts and mists, as copper	1.52×10^{5}	2.11×10^{-2}	1.00×10^{1}	1.18×10^{-2}	TRUE
878	110-82-7	Cyclohexane	6.81×10^{2}	9.46×10^{-5}	7.00×10^{3}	8.26	FALSE
878	108-93-0	Cyclohexanol	1.60×10^{1}	2.22×10^{-6}	2.00×10^{3}	2.36	FALSE
878	108-91-8	Cyclohexylamine	3.65×10^{4}	5.07×10^{-3}	4.00×10^{2}	4.72×10^{-1}	FALSE
878	111-40-0	Diethylene triamine	4.13×10^{3}	5.74×10^{-4}	4.00×10^{1}	4.72×10^{-2}	FALSE
878	109-87-5	Dimethyoxymethane (methylal)	6.80	9.45×10^{-7}	3.10×10^{4}	3.66×10^{1}	FALSE
878	141-43-5	Ethanolamine	3.05×10^{2}	4.24×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	141-78-6	Ethyl acetate	9.75×10^{2}	1.35×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
878	78-10-4	Ethyl silicate	9.57×10^{2}	1.33×10^{-4}	8.50×10^{2}	1.00	FALSE
878	64-18-6	Formic acid	1.14×10^{4}	1.58×10^{-3}	9.00×10^{1}	1.06×10^{-1}	FALSE
878	7722-84-1	Hydrogen peroxide (concentration> 52%)	5.88×10^{4}	8.16×10^{-3}	1.40×10^{1}	1.65×10^{-2}	FALSE
878	7783-06-4	Hydrogen sulfide	7.32×10^{3}	1.02×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
878	61788-32-7	Hydrogenated terphenyls	6.36×10^{3}	8.83×10^{-4}	4.90×10^{1}	5.79×10^{-2}	FALSE
878	7440-74-6	Indium & compounds as indium	1.76×10^{4}	2.44×10^{-3}	1.00	1.18×10^{-3}	TRUE
878	7553-56-2	Iodine	1.40×10^{3}	1.94×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	1309-37-1	Iron oxide fume (Fe_2O_3) as iron	2.05×10^{4}	2.85×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7439-89-6	Iron salts, soluble, as iron	1.61×10^{4}	2.23×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	26952-21-6	Isoacytl alcohol	1.36×10^{1}	1.89×10^{-6}	2.66×10^{3}	3.14	FALSE
878	110-19-0	Isobutyl acetate	1.02×10^{2}	1.42×10^{-5}	7.00×10^{3}	8.26	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULT
878	4098-71-9	Isophorone diisocyanate	2.00	2.78×10^{-7}	4.50×10^{-1}	5.31×10^{-4}	FALSE
878	67-63-0	Isopropyl alcohol	4.42×10^{5}	6.14×10^{-2}	4.90×10^{3}	5.79	FALSE
878	1309-48-4	Magnesium oxide	2.35×10^{3}	3.27×10^{-4}	6.00×10^{1}	7.08×10^{-2}	FALSE
878	5124-30-1	Methylene bis(4-cyclohexylisocyanate)	3.32×10^{2}	4.61×10^{-5}	5.40×10^{-1}	6.38×10^{-4}	FALSE
878	7439-98-7	Molybdenum as molybdenum (insoluble compounds)	3.15×10^{4}	4.37×10^{-3}	1.00×10^{2}	1.18×10^{-1}	FALSE
878	628-63-7	n-Amyl acetate	8.76×10^{2}	1.22×10^{-4}	2.60×10^{3}	3.07	FALSE
878	123-86-4	n-Butyl acetate	2.73×10^{3}	3.79×10^{-4}	7.10×10^{3}	8.38	FALSE
878	71-36-3	n-Butyl alcohol	1.35×10^{4}	1.87×10^{-3}	3.00×10^{3}	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	5.44×10^{2}	7.56×10^{-5}	1.33×10^{3}	1.57	FALSE
878	142-82-5	n-Heptane	1.21×10^{3}	1.67×10^{-4}	3.50×10^{3}	4.13	FALSE
878	7697-37-2	Nitric acid	1.27×10^{5}	1.76×10^{-2}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	109-66-0	Pentane	6.49×10^{2}	9.02×10^{-5}	3.50×10^{3}	4.13	FALSE
878	8002-05-9	Petroleum	9.07×10^{2}	1.26×10^{-4}	3.50×10^{3}	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	2.10×10^{2}	2.92×10^{-5}	8.50×10^{2}	1.00	FALSE
878	7664-38-2	Phosphoric acid	1.34×10^{4}	1.86×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	7440-06-4	Platinum metal	2.03×10^{4}	2.83×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	1310-58-3	Potassium hydroxide	5.80×10^{3}	8.06×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	71-23-8	Propyl alcohol	8.11×10^{3}	1.13×10^{-3}	4.92×10^{3}	5.81	FALSE
878	8003-34-7	Pyrethrins	4.72×10^{-1}	6.55×10^{-8}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	110-86-1	Pyridine	3.87×10^{2}	5.38×10^{-5}	1.50×10^{2}	1.77×10^{-1}	FALSE
878	14808-60-7	Quartz	8.05×10^{3}	1.12×10^{-3}	5.00×10^{-1}	5.90×10^{-4}	TRUE
878	78-92-2	sec-Butyl alcohol	2.67×10^{3}	3.71×10^{-4}	3.00×10^{3}	3.54	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
878	7631-86-9	Silica, fused (respirable)	$1.29x10^{4}$	$1.79x10^{-3}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	7440-22-4	Silver metal	$2.80x10^{4}$	$3.89x10^{-3}$	$1.00x10^{-1}$	$1.18x10^{-4}$	TRUE
878	7631-90-5	Sodium bisulfite	$1.00x10^{3}$	$1.39x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	1310-73-2	Sodium hydroxide	$9.74x10^{2}$	$1.35x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	8052-41-3	Stoddard solvent	$4.54x10^{2}$	$6.31x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	7664-93-9	Sulfuric acid	$4.35x10^{2}$	$6.05x10^{-5}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	75-65-0	t-Butyl alcohol	6.80	$9.45x10^{-7}$	$3.00x10^{3}$	3.54	FALSE
878	7440-25-7	Tantalum	$2.08x10^{3}$	$2.89x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	26140-60-3	Terphenyls	$9.54x10^{2}$	$1.32x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	109-99-9	Tetrahydrofuran	$8.46x10^{2}$	$1.17x10^{-4}$	$1.50x10^{3}$	1.77	FALSE
878	7722-88-5	Tetrasodium pyrophosphate	3.00	$4.17x10^{-7}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7440-31-5	Tin metal	$2.74x10^{4}$	$3.81x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	91-08-7	Toluene-2,6-diisocyanate	$4.08x10^{1}$	$5.67x10^{-6}$	$7.00x10^{-1}$	$8.26x10^{-4}$	FALSE
878	7440-33-7	Tungsten as Wolfram insoluble compounds	$5.49x10^{4}$	$7.62x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7440-62-2	Vanadium (fume or dust)	$4.36x10^{4}$	$6.05x10^{-3}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	$5.50x10^{-1}$	$7.64x10^{-8}$	$3.50x10^{3}$	4.13	FALSE
878	7440-66-6	Zinc	$1.93x10^{1}$	$2.68x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	1314-13-2	Zinc oxide	$2.28x10^{2}$	$3.17x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
893	67-64-1	Acetone[a]	$9.36x10^{5}$	$1.30x10^{-1}$	$5.90x10^{3}$	6.97	FALSE
893	7726-95-6	Bromine[a]	$3.11x10^{2}$	$4.32x10^{-5}$	6.60	$7.79x10^{-3}$	FALSE
893	7722-84-1	Hydrogen peroxide (concentration> 52%)[a]	$2.60x10^{4}$	$3.61x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
893	67-63-0	Isopropyl alcohol[a]	$3.54x10^{5}$	$4.92x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
893	7697-37-2	Nitric acid[a]	$2.71x10^{4}$	$3.77x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
893	1310-58-3	Potassium hydroxide[a]	4.09×10^{3}	5.67×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
893	7664-93-9	Sulfuric acid[a]	1.41×10^{5}	1.96×10^{-2}	1.00×10^{1}	1.18×10^{-2}	TRUE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha[a]	4.80×10^{3}	6.67×10^{-4}	3.50×10^{3}	4.13	FALSE
MESA	107-98-2	1-Methoxy-2-propanol[b]	1.09×10^{2}	1.51×10^{-5}	3.75×10^{3}	4.43	FALSE
MESA	872-50-4	1-Methyl-2-pyrrolidinone[b]	8.21×10^{3}	1.14×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
MESA	111-15-9	2-Ethoxyethyl acetate[b]	1.91×10^{3}	2.65×10^{-4}	2.70×10^{1}	3.19×10^{-2}	FALSE
MESA	64-19-7	Acetic acid[b]	1.06×10^{3}	1.47×10^{-4}	2.50×10^{2}	2.95×10^{-1}	FALSE
MESA	67-64-1	Acetone[b]	7.49×10^{5}	1.04×10^{-1}	5.90×10^{3}	6.97	FALSE
MESA	21645-51-2	Aluminum hydroxide[b]	5.00×10^{2}	6.95×10^{-5}	6.00×10^{1}	7.08×10^{-2}	FALSE
MESA	1344-28-1	Aluminum oxide anhydrous[b]	4.99×10^{1}	6.93×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE
MESA	7664-41-7	Ammonia[b]	4.54×10^{4}	6.30×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
MESA	7664-41-7	Ammonia anhydrous[b]	1.92×10^{6}	2.67×10^{-1}	1.40×10^{2}	1.65×10^{-1}	TRUE
MESA	7784-42-1	Arsine[b]	1.34×10^{5}	1.86×10^{-2}	1.60	1.89×10^{-3}	TRUE
MESA	7637-07-2	Boron trifluoride[b]	3.49×10^{1}	4.85×10^{-6}	3.00×10^{1}	3.54×10^{-2}	FALSE
MESA	7726-95-6	Bromine[b]	1.53×10^{2}	2.13×10^{-5}	6.60	7.79×10^{-3}	FALSE
MESA	110-82-7	Cyclohexane[b]	9.42×10^{1}	1.31×10^{-5}	7.00×10^{3}	8.26	FALSE
MESA	34590-94-8	Dipropylene glycol methyl ether[b]	1.45×10^{2}	2.02×10^{-5}	3.00×10^{3}	3.54	FALSE
MESA	64-17-5	Ethanol[b]	2.83×10^{3}	3.92×10^{-4}	1.88×10^{4}	2.22×10^{1}	FALSE
MESA	78-10-4	Ethyl silicate[b]	3.72×10^{3}	5.17×10^{-4}	8.50×10^{2}	1.00	FALSE
MESA	56-81-5	Glycerin[b]	6.30×10^{2}	8.75×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
MESA	7722-84-1	Hydrogen peroxide[b]	2.73×10^{4}	3.79x10	1.40×10^{1}	1.65×10^{-2}	FALSE
MESA	67-63-1	Isopropyl alcohol[b]	3.31×10^{5}	4.59×10^{-2}	4.90×10^{3}	5.79	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
MESA	8030-30-6	Naphtha[b]	3.88×10^{3}	5.39×10^{-4}	4.00×10^{3}	4.72	FALSE
MESA	123-86-4	N-Butyl acetate[b]	2.01×10^{2}	2.79×10^{-5}	7.10×10^{3}	8.38	FALSE
MESA	7697-37-2	Nitric acid[b]	4.41×10^{4}	6.12×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
MESA	10024-97-2	Nitrous oxide[b]	9.53×10^{3}	1.32×10^{-3}	4.60×10^{2}	5.43×10^{-1}	FALSE
MESA	71-23-8	N-Propyl alcohol[b]	4.02×10^{2}	5.59×10^{-5}	4.92×10^{3}	5.81	FALSE
MESA	7664-38-2	Phosphoric acid[b]	2.14×10^{3}	2.98×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
MESA	1310-58-3	Potassium hydroxide[b]	1.02×10^{4}	1.42×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
MESA	112926-00-8	Precipitated silica gel[b]	2.50×10^{3}	3.47×10^{-4}	4.00×10^{1}	4.72×10^{-2}	FALSE
MESA	7803-62-5	Silane[b]	5.63×10^{3}	7.81×10^{-4}	6.60×10^{1}	7.79×10^{-2}	FALSE
MESA	9005-25-8	Starch[b, c]	5.68	7.89×10^{-7}	5.00×10^{1}	5.90×10^{-2}	FALSE
MESA	2551-62-4	Sulfur hexafluoride[b]	2.40×10^{5}	3.33×10^{-2}	5.79×10^{4}	6.84×10^{1}	FALSE
MESA	7664-93-9	Sulfuric acid[b]	1.56×10^{5}	2.17×10^{-2}	1.00×10^{1}	1.18×10^{-2}	TRUE
897	64-19-7	Acetic acid	4.95×10^{4}	6.88×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
897	67-64-1	Acetone	6.84×10^{4}	9.51×10^{-3}	5.90×10^{3}	6.97	FALSE
897	106-92-3	Allyl glycidyl ether	1.67×10^{1}	2.32×10^{-6}	2.20×10^{2}	2.60×10^{-1}	FALSE
897	1344-28-1	Aluminum oxide (fibrous forms)	1.50×10^{3}	2.08×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
897	128-37-0	Butylated hydroxytoluene	9.90×10^{1}	1.37×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	420-04-2	Cyanamide	2.47×10^{1}	3.44×10^{-6}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	110-82-7	Cyclohexane	2.99	4.15×10^{-7}	7.00×10^{3}	8.26	FALSE
897	107-66-4	Dibutyl phosphate	2.72×10^{2}	3.78×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
897	124-40-3	Dimethylamine	3.98×10^{2}	5.53×10^{-5}	4.00×10^{1}	4.72×10^{-2}	FALSE
897	141-78-6	Ethyl acetate	1.78×10^{4}	2.47×10^{-3}	1.40×10^{4}	1.65×10^{1}	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
897	60-29-7	Ethyl ether (diethyl ether)	$2.18x10^{4}$	$3.03x10^{-3}$	$1.20x10^{4}$	$1.42x10^{1}$	FALSE
897	78-10-4	Ethyl silicate	$6.27x10^{2}$	$8.72x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
897	7722-84-1	Hydrogen peroxide (concentration> 52%)	$2.36x10^{3}$	$3.28x10^{-4}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
897	67-63-0	Isopropyl alcohol	$7.77x10^{4}$	$1.08x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
897	8008-20-6	Kerosene	$3.01x10^{3}$	$4.18x10^{-4}$	$1.00x10^{3}$	1.18	FALSE
897	126-98-7	Methacrylonitrile	$7.95x10^{1}$	$1.10x10^{-5}$	$2.70x10^{1}$	$3.19x10^{-2}$	FALSE
897	681-84-5	Methyl silicate	$2.24x10^{2}$	$3.12x10^{-5}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE
897	71-36-3	n-Butyl alcohol	$1.57x10^{2}$	$2.19x10^{-5}$	$3.00x10^{3}$	3.54	FALSE
897	142-82-5	n-Heptane	$5.42x10^{3}$	$7.52x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	7697-37-2	Nitric acid	$1.60x10^{1}$	$2.22x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
897	144-62-7	Oxalic acid	$3.92x10^{3}$	$5.44x10^{-4}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
897	109-66-0	Pentane	$1.91x10^{3}$	$2.66x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	9003-53-6	Phenlylethylene (styrene, monomer)	$8.00x10^{-1}$	$1.11x10^{-7}$	$8.50x10^{2}$	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-trinitrophenol)	9.95	$1.38x10^{-6}$	1.00	$1.18x10^{-3}$	FALSE
897	1310-58-3	Potassium hydroxide	$9.30x10^{3}$	$1.29x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	71-23-8	Propyl alcohol	$2.98x10^{4}$	$4.14x10^{-3}$	$4.92x10^{3}$	5.81	FALSE
897	7440-22-4	Silver metal	$1.68x10^{1}$	$2.33x10^{-6}$	$1.00x10^{-1}$	$1.18x10^{-4}$	FALSE
897	1310-73-2	Sodium hydroxide	$5.00x10^{2}$	$6.94x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	7664-93-9	Sulfuric acid	$7.75x10^{3}$	$1.08x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
897	109-99-9	Tetrahydrofuran	$1.17x10^{4}$	$1.62x10^{-3}$	$1.50x10^{3}$	1.77	FALSE
897	7719-09-7	Thionyl chloride	$4.89x10^{3}$	$6.80x10^{-4}$	$4.90x10^{1}$	$5.79x10^{-2}$	FALSE
897	76-03-9	Trichloroacetic acid	$5.00x10^{2}$	$6.94x10^{-5}$	$6.70x10^{1}$	$7.91x10^{-2}$	FALSE
905	67-64-1	Acetone	$2.81x10^{4}$	$3.90x10^{-3}$	$5.90x10^{3}$	6.97	FALSE

Table D.1–10. Projected Toxic Air Pollutant (TAP) Emissions Expanded Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 $\mu g/m^3$	TEV g/sec	RESULT
905	67-63-0	Isopropyl alcohol	2.47×10^{4}	3.44×10^{-3}	4.90×10^{3}	5.79	FALSE
905	1309-48-4	Magnesium oxide	1.60×10^{3}	2.22×10^{-4}	6.00×10^{1}	7.08×10^{-2}	FALSE
905	109-99-9	Tetrahydrofuran-	6.69×10^{3}	9.29×10^{-4}	1.50×10^{3}	1.77	FALSE
963	67-63-0	Isopropyl alcohol	1.57×10^{3}	2.18×10^{-4}	4.90×10^{3}	5.79	FALSE
981	67-64-1	Acetone	2.30×10^{4}	3.20×10^{-3}	5.90×10^{3}	6.97	FALSE
981	7664-93-9	Sulfuric acid	3.61×10^{5}	5.02×10^{-2}	1.00×10^{1}	1.18×10^{-2}	TRUE
986	67-64-1	Acetone	2.21×10^{4}	3.07×10^{-3}	5.90×10^{3}	6.97	FALSE

MESA: Microsystems and Engineering Sciences Applications

[a] If the MESA is Complex configuration is implemented, Building 893 would cease operations and the chemicals listed would no longer contribute TAP emissions under the Expanded Operations Alternative.

[b] If Building 893 is not replaced by the MESA Complex configuration, the chemicals listed would not contribute to TAP emissions under the Expanded Opertions Alternative.

[c] Starch was icluded for completeness because the chemical was listed in the inventory.

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
605	79-09-4	Propionic acid	1.03×10^{2}	1.43×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
605	7664-93-9	Sulfuric acid	8.25×10^{1}	1.15×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
6580	141-78-6	Ethyl acetate	9.00×10^{2}	1.25×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
6580	7722-84-1	Hydrogen peroxide (concentration> 52%)	1.66×10^{2}	2.31×10^{-5}	1.40×10^{1}	1.65×10^{-2}	FALSE
6580	7697-37-2	Nitric acid	5.25×10^{3}	7.29×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
6580	1310-73-2	Sodium hydroxide	5.65×10^{3}	7.85×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
6580	7664-93-9	Sulfuric acid	2.76×10^{3}	3.83×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
6920	7697-37-2	Nitric acid	1.87×10^{2}	2.60×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
6920	1310-73-2	Sodium hydroxide	4.54×10^{2}	6.30×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
6920	7440-66-6	Zinc	1.00×10^{3}	1.39×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
858	64-19-7	Acetic acid	2.16×10^{4}	3.00×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	67-64-1	Acetone	1.16×10^{4}	1.62×10^{-3}	5.90×10^{3}	6.97	FALSE
858	7722-84-1	Hydrogen peroxide (concentration> 52%)	1.19×10^{6}	1.65×10^{-1}	1.40×10^{1}	1.65×10^{-2}	TRUE
858	7697-37-2	Nitric acid	1.53×10^{6}	2.12×10^{-1}	5.00×10^{1}	5.90×10^{-2}	TRUE
858	7664-38-2	Phosphoric acid	2.91×10^{4}	4.04×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
858	7803-62-5	Silane (silicon tetrahydride)	6.81×10^{4}	9.45×10^{-3}	6.60×10^{1}	7.79×10^{-2}	FALSE
858	1310-73-2	Sodium hydroxide	2.34×10^{7}	3.25	2.00×10^{1}	2.36×10^{-2}	TRUE
858	7664-93-9	Sulfuric acid	2.21×10^{4}	3.07×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
870	64-19-7	Acetic Acid	1.05×10^{5}	1.45×10^{-2}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	64-19-7	Acetic Acid, Glacial	1.15×10^{5}	1.60×10^{-2}	2.50×10^{2}	2.95×10^{-1}	FALSE
870	67-64-1	Acetone	6.46×10^{6}	8.97×10^{-1}	5.90×10^{3}	6.97	FALSE
870	71-36-3	Alcohol, Butyl	1.21×10^{4}	1.69×10^{3}	3.00×10^{3}	3.54	FALSE
870	67-63-0	Alcohol, Isopropyl	2.61×10^{5}	3.63×10^{-2}	4.90×10^{3}	5.79	FALSE

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
870	7429-90-5	Aluminum	$6.65x10^{5}$	$9.23x10^{-2}$	$5.00x10^{1}$	$5.90x10^{-2}$	TRUE
870	1344-28-1	Aluminum Oxide	$2.99x10^{5}$	$4.16x10^{-2}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
870	1336-21-6	Ammonium Hydroxide	$1.35x10^{4}$	$1.87x10^{-3}$	No OEL		
870	1113-50-1	Boric Acid	$1.20x10^{5}$	$1.66x10^{-2}$	No OEL		
870	11-15-9	Cellosolve Acetate	$6.52x10^{3}$	$9.05x10^{-4}$	No OEL		
870		Cerric Ammonium Nitrate	$2.00x10^{6}$	$2.77x10^{-1}$	No OEL		
870		Citridet Cleaner	$1.15x10^{6}$	$1.59x10^{-1}$	$1.21x10^{3}$	1.43	FALSE
870	7440-50-8	Copper	$6.65x10^{5}$	$9.23x10^{-2}$	1.00	$1.18x10^{-3}$	TRUE
870	7440-50-8	Copper (0.10%)	$5.99x10^{1}$	$8.32x10^{-6}$	1.00	$1.18x10^{-3}$	FALSE
870		Carboxyl terminated acrylonitrile-butadiene Epoxy Resin	$2.99x10^{5}$	$4.16x10^{-2}$	No OEL		
870		Curing Agent Z (37% Methylene dianiline)	$4.53x10^{5}$	$6.29x10^{-2}$	No OEL		
870		2,6-diethylaniline curing agent	$3.59x10^{5}$	$4.99x10^{-2}$	No OEL		
870		Diala oil	$5.01x10^{5}$	$6.95x10^{-2}$	No OEL		
870	106-42-3	Di-p Xylene	$9.07x10^{5}$	$1.26x10^{-1}$	$4.35x10^{3}$	5.12	FALSE
870	7440-52-0	Erbium	$1.50x10^{4}$	$2.08x10^{-3}$	No OEL		
870		Fluorinert	$5.60x10^{6}$	$7.77x10^{-1}$	No OEL		
870		Glass microballoons filler	$7.48x10^{4}$	$1.04x10^{-2}$	No OEL		
870		Hexylene glycol	$1.00x10^{6}$	$1.39x10^{-1}$	$1.21x10^{3}$	1.43	FALSE
870	1309-37-1	Iron (53%)	$3.17x10^{4}$	$4.41x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
870	123-92-2	Iso Amyl Acetate	$7.94x10^{5}$	$1.10x10^{-1}$	$5.25x10^{3}$	6.20	FALSE
870		Isopropyl alcohol	$2.61x10^{5}$	$3.63x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
870		Mold Release	$2.81x10^{5}$	$3.90x10^{-2}$	No OEL		

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
870	7439-98-7	Molybdenum	6.66×10^{3}	9.24×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
870	7697-37-2	Nitric Acid (70%)	1.60×10^{5}	2.22×10^{-2}	5.00×10^{1}	5.90×10^{-2}	FALSE
870		Oakite Citridet	1.00×10^{6}	1.39×10^{-1}	No OEL		
870	127-18-4	Perchloroethylene	1.01×10^{6}	1.41×10^{-1}	1.70×10^{3}	2.01	FALSE
870	7664-38-2	Phosphoric Acid	1.10×10^{5}	1.53×10^{-2}	1.00×10^{1}	1.18×10^{-2}	TRUE
870	1310-58-3	Potassium Hydroxide	1.50×10^{4}	2.08×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	7440-20-2	Scandium	1.50×10^{4}	2.08×10^{-3}	No OEL		
870	7631-86-9	Silica	9.04×10^{5}	1.26×10^{-1}	4.00×10^{1}	4.72×10^{-2}	TRUE
870		Silver Epoxy	1.50×10^{4}	2.08×10^{-3}	No OEL		
870	1310-73-2	Sodium Hydroxide	1.50×10^{4}	2.08×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	7664-93-9	Sulfuric Acid	1.10×10^{5}	1.53×10^{-2}	1.00×10^{1}	1.18×10^{-2}	TRUE
870	7704-98-5	Titanium Hydride	3.29×10^{3}	4.57×10^{-4}	No OEL		
870		Ultima Gold – Packard (alkylnapthalene)	1.58×10^{6}	2.20×10^{-1}	No OEL		
878	110-80-5	2-Ethoxyethanol	1.24×10^{2}	1.73×10^{-5}	1.80×10^{1}	2.13×10^{-2}	FALSE
878	111-15-9	2-Ethoxyethyl acetate	8.53×10^{3}	1.18×10^{-3}	2.70×10^{1}	3.19×10^{-2}	FALSE
878	109-86-4	2-Methoxyethanol	8.75×10^{1}	1.22×10^{-5}	3.00	3.54×10^{-3}	FALSE
878	64-19-7	Acetic acid	1.28×10^{4}	1.77×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
878	67-64-1	Acetone	3.92×10^{5}	5.44×10^{-2}	5.90×10^{3}	6.97	FALSE
878	7429-90-5	Aluminum (fume or dust)	1.07×10^{4}	1.48×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	1.67×10^{6}	2.31×10^{-1}	5.00×10^{1}	5.90×10^{-2}	TRUE
878	12125-02-9	Ammonium chloride	9.99×10^{4}	1.39×10^{-2}	1.00×10^{2}	1.18×10^{-1}	FALSE
878	1303-96-4	Borates, tetra, sodium salts (anhydrous)	1.00×10^{4}	1.39×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	111-76-2	Butyl cellosolve (R)	5.97×10^{3}	8.29×10^{-4}	2.40×10^{2}	2.83×10^{-1}	FALSE

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
878	1305-62-0	Calcium hydroxide	1.12×10^{4}	1.56×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	76-22-2	Camphor	7.44×10^{1}	1.03×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	1333-86-4	Carbon black	4.46×10^{2}	6.19×10^{-5}	3.50×10^{1}	4.13×10^{-2}	FALSE
878	2921-88-2	Chlorpyrifos	2.27	3.15×10^{-7}	2.00	2.36×10^{-3}	FALSE
878	7440-50-8	Copper dusts and mists, as copper	7.60×10^{4}	1.06×10^{-2}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	110-82-7	Cyclohexane	3.40×10^{2}	4.73×10^{-5}	7.00×10^{3}	8.26	FALSE
878	108-93-0	Cyclohexanol	8.00	1.11×10^{-6}	2.00×10^{3}	2.36	FALSE
878	108-91-8	Cyclohexylamine	1.83×10^{4}	2.54×10^{-3}	4.00×10^{2}	4.72×10^{-1}	FALSE
878	111-40-0	Diethylene triamine	2.07×10^{3}	2.87×10^{-4}	4.00×10^{1}	4.72×10^{-2}	FALSE
878	109-87-5	Dimethyoxymethane (methylal)	3.40	4.72×10^{-7}	3.10×10^{4}	3.66×10^{1}	FALSE
878	141-43-5	Ethanolamine	1.53×10^{2}	2.12×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	141-78-6	Ethyl acetate	4.88×10^{2}	6.77×10^{-5}	1.40×10^{4}	1.65×10^{1}	FALSE
878	78-10-4	Ethyl silicate	4.79×10^{2}	6.65×10^{-5}	8.50×10^{2}	1.00	FALSE
878	64-18-6	Formic acid	5.68×10^{3}	7.89×10^{-4}	9.00×10^{1}	1.06×10^{-1}	FALSE
878	7722-84-1	Hydrogen peroxide (concentration> 52%)	2.94×10^{4}	4.08×10^{-3}	1.40×10^{1}	1.65×10^{-2}	FALSE
878	7783-06-4	Hydrogen sulfide	3.66×10^{3}	5.08×10^{-4}	1.40×10^{2}	1.65×10^{-1}	FALSE
878	61788-32-7	Hydrogenated terphenyls	3.18×10^{3}	4.42×10^{-4}	4.90×10^{1}	5.79×10^{-2}	FALSE
878	7440-74-6	Indium & compounds as indium	8.80×10^{3}	1.22×10^{-3}	1.00	1.18×10^{-3}	TRUE
878	7553-56-2	Iodine	7.00×10^{2}	9.72×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	1309-37-1	Iron oxide fume (Fe_2O_3) as iron	1.03×10^{4}	1.43×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7439-89-6	Iron salts, soluble, as iron	8.03×10^{3}	1.12×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	26952-21-6	Isoacytl alcohol	6.80	9.45×10^{-7}	2.66×10^{3}	3.14	FALSE
878	110-19-0	Isobutyl acetate	5.10×10^{1}	7.08×10^{-6}	7.00×10^{3}	8.26	FALSE

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
878	4098-71-9	Isophorone diisocyanate	1.00	$1.39x10^{-7}$	$4.50x10^{-1}$	$5.31x10^{-4}$	FALSE
878	67-63-0	Isopropyl alcohol	$2.21x10^{5}$	$3.07x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
878	1309-48-4	Magnesium oxide	$1.18x10^{3}$	$1.63x10^{-4}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE
878	5124-30-1	Methylene bis(4-cyclohexylisocyanate)	$1.66x10^{2}$	$2.31x10^{-5}$	$5.40x10^{-1}$	$6.38x10^{-4}$	FALSE
878	7439-98-7	Molybdenum as molybdenum (insoluble compounds)	$1.57x10^{4}$	$2.18x10^{-3}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
878	628-63-7	n-Amyl acetate	$4.38x10^{2}$	$6.08x10^{-5}$	$2.60x10^{3}$	3.07	FALSE
878	123-86-4	n-Butyl acetate	$1.36x10^{3}$	$1.89x10^{-4}$	$7.10x10^{3}$	8.38	FALSE
878	71-36-3	n-Butyl alcohol	$6.74x10^{3}$	$9.36x10^{-4}$	$3.00x10^{3}$	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	$2.72x10^{2}$	$3.78x10^{-5}$	$1.33x10^{3}$	1.57	FALSE
878	142-82-5	n-Heptane	$6.03x10^{2}$	$8.37x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	7697-37-2	Nitric acid	$6.33x10^{4}$	$8.79x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	109-66-0	Pentane	$3.25x10^{2}$	$4.51x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	8002-05-9	Petroleum	$4.53x10^{2}$	$6.30x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	$1.05x10^{2}$	$1.46x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	7664-38-2	Phosphoric acid	$6.69x10^{3}$	$9.30x10^{-4}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	7440-06-4	Platinum metal	$1.02x10^{4}$	$1.41x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1310-58-3	Potassium hydroxide	$2.90x10^{3}$	$4.03x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	71-23-8	Propyl alcohol	$4.06x10^{3}$	$5.63x10^{-4}$	$4.92x10^{3}$	5.81	FALSE
878	8003-34-7	Pyrethrins	$2.36x10^{-1}$	$3.28x10^{-8}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	110-86-1	Pyridine	$1.94x10^{2}$	$2.69x10^{-5}$	$1.50x10^{2}$	$1.77x10^{-1}$	FALSE
878	14808-60-7	Quartz	$4.02x10^{3}$	$5.59x10^{-4}$	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	78-92-2	sec-Butyl alcohol	$1.34x10^{3}$	$1.86x10^{-4}$	$3.00x10^{3}$	3.54	FALSE

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
878	7631-86-9	Silica, fused (respirable)	$6.46x10^3$	$8.97x10^{-4}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	7440-22-4	Silver metal	$1.40x10^4$	$1.95x10^{-3}$	$1.00x10^{-1}$	$1.18x10^{-4}$	TRUE
878	7631-90-5	Sodium bisulfite	$5.00x10^2$	$6.94x10^{-5}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	1310-73-2	Sodium hydroxide	$4.87x10^2$	$6.77x10^{-5}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
878	8052-41-3	Stoddard solvent	$2.27x10^2$	$3.15x10^{-5}$	$3.50x10^3$	4.13	FALSE
878	7664-93-9	Sulfuric acid	$2.18x10^2$	$3.02x10^{-5}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
878	75-65-0	t-Butyl alcohol	3.40	$4.72x10^{-7}$	$3.00x10^3$	3.54	FALSE
878	7440-25-7	Tantalum	$1.04x10^3$	$1.44x10^{-4}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	26140-60-3	Terphenyls	$4.77x10^2$	$6.62x10^{-5}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	109-99-9	Tetrahydrofuran	$4.23x10^2$	$5.87x10^{-5}$	$1.50x10^3$	1.77	FALSE
878	7722-88-5	Tetrasodium pyrophosphate	1.50	$2.08x10^{-7}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	7440-31-5	Tin metal	$1.37x10^4$	$1.91x10^{-3}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
878	91-08-7	Toluene-2,6-diisocyanate	$2.04x10^1$	$2.83x10^{-6}$	$7.00x10^{-1}$	$8.26x10^{-4}$	FALSE
878	7440-33-7	Tungsten as Wolfram insoluble compounds	$2.74x10^4$	$3.81x10^{-3}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	7440-62-2	Vanadium (fume or dust)	$2.18x10^4$	$3.03x10^{-3}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	$2.75x10^{-1}$	$3.82x10^{-8}$	$3.50x10^3$	4.13	FALSE
878	7440-66-6	Zinc	9.64	$1.34x10^{-6}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	1314-13-2	Zinc oxide	$1.14x10^2$	$1.58x10^{-5}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
893	67-64-1	Acetone	$4.68x10^5$	$6.50x10^{-2}$	$5.90x10^3$	6.97	FALSE
893	7726-95-6	Bromine	$1.55x10^2$	$2.16x10^{-5}$	6.60	$7.79x10^{-3}$	FALSE
893	7722-84-1	Hydrogen peroxide (concentration> 52%)	$1.30x10^4$	$1.80x10^{-3}$	$1.40x10^1$	$1.65x10^{-2}$	FALSE
893	67-63-0	Isopropyl alcohol	$1.77x10^5$	$2.46x10^{-2}$	$4.90x10^3$	5.79	FALSE
893	7697-37-2	Nitric acid	$1.36x10^4$	$1.89x10^{-3}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
893	1310-58-3	Potassium hydroxide	2.04×10^{3}	2.84×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
893	7664-93-9	Sulfuric acid	7.07×10^{4}	9.82×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	2.40×10^{3}	3.33×10^{-4}	3.50×10^{3}	4.13	FALSE
897	64-19-7	Acetic acid	4.56×10^{4}	6.33×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
897	67-64-1	Acetone	6.30×10^{4}	8.75×10^{-3}	5.90×10^{3}	6.97	FALSE
897	106-92-3	Allyl glycidyl ether	1.54×10^{1}	2.13×10^{-6}	2.20×10^{2}	2.60×10^{-1}	FALSE
897	1344-28-1	Aluminum oxide (fibrous forms)	1.38×10^{3}	1.92×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
897	128-37-0	Butylated hydroxytoluene	9.11×10^{1}	1.26×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	420-04-2	Cyanamide	2.28×10^{1}	3.16×10^{-6}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	110-82-7	Cyclohexane	2.75	3.82×10^{-7}	7.00×10^{3}	8.26	FALSE
897	107-66-4	Dibutyl phosphate	2.50×10^{2}	3.48×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
897	124-40-3	Dimethylamine	3.66×10^{2}	5.09×10^{-5}	4.00×10^{1}	4.72×10^{-2}	FALSE
897	141-78-6	Ethyl acetate	1.64×10^{4}	2.28×10^{-3}	1.40×10^{4}	1.65×10^{1}	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	2.01×10^{4}	2.79×10^{-3}	1.20×10^{4}	1.42×10^{1}	FALSE
897	78-10-4	Ethyl silicate	5.77×10^{2}	8.02×10^{-5}	8.50×10^{2}	1.00	FALSE
897	7722-84-1	Hydrogen peroxide (concentration> 52%)	2.17×10^{3}	3.02×10^{-4}	1.40×10^{1}	1.65×10^{-2}	FALSE
897	67-63-0	Isopropyl alcohol	7.15×10^{4}	9.93×10^{-3}	4.90×10^{3}	5.79	FALSE
897	8008-20-6	Kerosene	2.77×10^{3}	3.85×10^{-4}	1.00×10^{3}	1.18	FALSE
897	126-98-7	Methacrylonitrile	7.31×10^{1}	1.02×10^{-5}	2.70×10^{1}	3.19×10^{-2}	FALSE
897	681-84-5	Methyl silicate	2.06×10^{2}	2.87×10^{-5}	6.00×10^{1}	7.08×10^{-2}	FALSE
897	71-36-3	n-Butyl alcohol	1.45×10^{2}	2.01×10^{-5}	3.00×10^{3}	3.54	FALSE
897	142-82-5	n-Heptane	4.98×10^{3}	6.92×10^{-4}	3.50×10^{3}	4.13	FALSE
897	7697-37-2	Nitric acid	1.47×10^{1}	2.04×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE

Table D.1–11. Projected Toxic Air Pollutant (TAP) Emissions Reduced Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULT
897	144-62-7	Oxalic acid	$3.61x10^3$	$5.01x10^{-4}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
897	109-66-0	Pentane	$1.76x10^3$	$2.44x10^{-4}$	$3.50x10^3$	4.13	FALSE
897	9003-53-6	Phenlylethylene (styrene, monomer)	$7.36x10^{-1}$	$1.02x10^{-7}$	$8.50x10^2$	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-trinitrophenol)	9.15	$1.27x10^{-6}$	1.00	$1.18x10^{-3}$	FALSE
897	1310-58-3	Potassium hydroxide	$8.55x10^3$	$1.19x10^{-3}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
897	71-23-8	Propyl alcohol	$2.74x10^4$	$3.81x10^{-3}$	$4.92x10^3$	5.81	FALSE
897	7440-22-4	Silver metal	$1.55x10^1$	$2.15x10^{-6}$	$1.00x10^{-1}$	$1.18x10^{-4}$	FALSE
897	1310-73-2	Sodium hydroxide	$4.60x10^2$	$6.39x10^{-5}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
897	7664-93-9	Sulfuric acid	$7.13x10^3$	$9.90x10^{-4}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
897	109-99-9	Tetrahydrofuran	$1.07x10^4$	$1.49x10^{-3}$	$1.50x10^3$	1.77	FALSE
897	7719-09-7	Thionyl chloride	$4.50x10^3$	$6.25x10^{-4}$	$4.90x10^1$	$5.79x10^{-2}$	FALSE
897	76-03-9	Trichloroacetic acid	$4.60x10^2$	$6.39x10^{-5}$	$6.70x10^1$	$7.91x10^{-2}$	FALSE
905	67-64-1	Acetone	$2.81x10^3$	$3.90x10^{-4}$	$5.90x10^3$	6.97	FALSE
905	67-63-0	Isopropyl alcohol	$2.47x10^3$	$3.44x10^{-4}$	$4.90x10^3$	5.79	FALSE
905	1309-48-4	Magnesium oxide	$1.60x10^2$	$2.22x10^{-5}$	$6.00x10^1$	$7.08x10^{-2}$	FALSE
905	109-99-9	Tetrahydrofuran	$6.69x10^2$	$9.29x10^{-5}$	$1.50x10^3$	1.77	FALSE
963	67-63-0	Isopropyl alcohol	$1.57x10^2$	$2.18x10^{-5}$	$4.90x10^3$	5.79	FALSE
981	67-64-1	Acetone	$2.09x10^3$	$2.91x10^{-4}$	$5.90x10^3$	6.97	FALSE
981	7664-93-9	Sulfuric acid	$3.28x10^4$	$4.56x10^{-3}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
986	67-64-1	Acetone	$1.50x10^3$	$2.08x10^{-4}$	$5.90x10^3$	6.97	FALSE

Table D.1–12. 1996 Annual Purchases of Volatile Organic Compounds (VOCs) Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
605	64-17-5	Ethanol	4.54×10^{2}	6.30×10^{-5}	1.88×10^{4}	2.22×10^{1}	FALSE
605	79-09-4	Propionic acid	1.03×10^{2}	1.43×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
6580	64-17-5	Ethanol	2.97×10^{1}	4.12×10^{-6}	1.88×10^{4}	2.22×10^{1}	FALSE
6580	141-78-6	Ethyl acetate	3.60×10^{3}	5.00×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
858	64-19-7	Acetic acid	3.22×10^{4}	4.48×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	107-83-5	Isohexanes	1.40×10^{3}	1.94×10^{-4}	3.50×10^{3}	4.13	FALSE
858	108-65-6	Methoxy acetate	5.94×10^{4}	8.25×10^{-3}	2.75×10^{3}	3.25	FALSE
870	872-50-4	1-Methyl-2-Pyrrolidinone	4.99×10^{3}	6.93×10^{-4}	8.00×10^{2}	9.45×10^{-1}	FALSE
870	100-51-6	Alcohol, Benzyl	2.63×10^{5}	3.65×10^{-2}	No OEL		
870	64-17-5	Alcohol, Ethyl	1.03×10^{7}	1.43	1.88×10^{4}	2.22×10^{1}	FALSE
878	110-71-4	1,2-Dimethoxyethane	7.18×10^{2}	9.97×10^{-5}	No OEL		
878	142-96-1	1-Butoxybutane, butyl ether	6.53×10^{2}	9.07×10^{-5}	No OEL		
878	90-72-2	2,4,6-Tri(dimethylaminomethyl) phenol	2.69×10^{3}	3.74×10^{-4}	No OEL		
878	112-34-5	2-Butyl oxyethanol dipropylene glycol	3.94×10^{4}	5.47×10^{-3}	1.00×10^{3}	1.18	FALSE
878	111-15-9	2-Ethoxyethyl acetate	8.53×10^{3}	1.18×10^{-3}	2.70×10^{1}	3.19×10^{-2}	FALSE
878	64-19-7	Acetic acid	1.28×10^{4}	1.77×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
878	64742-89-8	Aliphatic petroleum distillates	4.52×10^{3}	6.27×10^{-4}	No OEL		
878	100-51-6	Benzyl alcohol	1.25×10^{4}	1.74×10^{-3}	No OEL		
878	111-76-2	Butyl cellosolve (R)	5.97×10^{3}	8.29×10^{-4}	2.40×10^{2}	2.83×10^{-1}	FALSE
878	76-22-2	Camphor	7.44×10^{1}	1.03×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	76-12-0	Chlorofluorocarbon-112	1.25×10^{2}	1.74×10^{-5}	1.69×10^{4}	2.00×10^{1}	FALSE
878	110-82-7	Cyclohexane	3.40×10^{2}	4.73×10^{-5}	7.00×10^{3}	8.26	FALSE

Table D.1–12. 1996 Annual Purchases of Volatile Organic Compounds (VOCs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULTS
878	108-93-0	Cyclohexanol	8.00	1.11×10^{-6}	2.00×10^{3}	2.36	FALSE
878	108-91-8	Cyclohexylamine	1.83×10^{4}	2.54×10^{-3}	4.00×10^{2}	4.72×10^{-1}	FALSE
878	124-18-5	Decane	3.50×10^{2}	4.86×10^{-5}	No OEL		
878	115-10-6	Dimethyl ether	9.17×10^{2}	1.27×10^{-4}	1.91×10^{4}	2.26×10^{1}	FALSE
878	67-68-5	Dimethylsulfoxide	4.40×10^{3}	6.11×10^{-4}	No OEL		
878	109-87-5	Dimethyoxymethane (methylal)	3.40	4.72×10^{-7}	3.10×10^{4}	3.66×10^{1}	FALSE
878	2807-30-9	Ektasolve ep	2.27×10^{1}	3.15×10^{-6}	8.50×10^{2}	1.00	FALSE
878	64-17-5	Ethanol	8.84×10^{4}	1.23×10^{-2}	1.88×10^{4}	2.22×10^{1}	FALSE
878	141-78-6	Ethyl acetate	4.88×10^{2}	6.77×10^{-5}	1.40×10^{4}	1.65×10^{1}	FALSE
878	78-10-4	Ethyl silicate	4.79×10^{2}	6.65×10^{-5}	8.50×10^{2}	1.00	FALSE
878	74-85-1	Ethylene	5.17×10^{4}	7.18×10^{-3}	No OEL		
878	64-18-6	Formic acid	5.68×10^{3}	7.89×10^{-4}	9.00×10^{1}	1.06×10^{-1}	FALSE
878	75-28-5	Isobutane	1.71×10^{3}	2.37×10^{-4}	1.90×10^{4}	2.24×10^{1}	FALSE
878	110-19-0	Isobutyl acetate	5.10×10^{1}	7.08×10^{-6}	7.00×10^{3}	8.26	FALSE
878	67-63-0	Isopropyl alcohol	2.21×10^{5}	3.07×10^{-2}	4.90×10^{3}	5.79	FALSE
878	64742-88-7	Medium aliphatic solvent naphtha	2.61×10^{2}	3.62×10^{-5}	No OEL		
878	108-65-6	Methoxy acetate	5.30×10^{2}	7.37×10^{-5}	2.75×10^{3}	3.25	FALSE
878	4253-34-3	Methyltriacetoxy silane	7.26×10^{1}	1.01×10^{-5}	No OEL		
878	1185-55-3	Methyltrimethoysilane	8.69×10^{1}	1.21×10^{-5}	No OEL		
878	628-63-7	n-Amyl acetate	4.38×10^{2}	6.08×10^{-5}	2.60×10^{3}	3.07	FALSE
878	106-97-8	n-Butane	1.91×10^{2}	2.66×10^{-5}	1.90×10^{4}	2.24×10^{1}	FALSE
878	123-86-4	n-Butyl acetate	1.36×10^{3}	1.89×10^{-4}	7.10×10^{3}	8.38	FALSE

Table D.1–12. 1996 Annual Purchases of Volatile Organic Compounds (VOCs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULTS
878	71-23-8	n-Butyl alcohol	6.74×10^{3}	9.36×10^{-4}	3.00×10^{3}	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	2.72×10^{2}	3.78×10^{-5}	1.33×10^{3}	1.57	FALSE
878	142-82-5	n-Heptane	6.03×10^{2}	8.37×10^{-5}	3.50×10^{3}	4.13	FALSE
878	872-50-4	N-Methyl-2-pyrrolidone	3.70×10^{4}	5.13×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
878	109-66-0	Pentane	3.25×10^{2}	4.51×10^{-5}	3.50×10^{3}	4.13	FALSE
878	8002-05-9	Petroleum	4.53×10^{2}	6.30×10^{-5}	No OEL		
878	64742-47-8	Petroleum distillate	1.73×10^{3}	2.40×10^{-4}	3.50×10^{3}	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	1.05×10^{2}	1.46×10^{-5}	8.50×10^{2}	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	5.03	6.99×10^{-7}	No OEL		
878	74-98-6	Propane	2.13×10^{3}	2.95×10^{-4}	1.80×10^{4}	2.13×10^{1}	FALSE
878	71-23-8	Propyl alcohol	4.06×10^{3}	5.63×10^{-4}	4.92×10^{3}	5.81	FALSE
878	57-55-6	Propylene gylcol	3.29×10^{2}	4.57×10^{-5}	No OEL		
878	110-86-1	Pyridine	1.94×10^{2}	2.69×10^{-5}	1.50×10^{2}	1.77×10^{-1}	FALSE
878	78-92-2	sec-Butyl alcohol	1.34×10^{3}	1.86×10^{-4}	3.00×10^{3}	3.54	FALSE
878	8052-41-3	Stoddard solvent	2.27×10^{2}	3.15×10^{-5}	3.50×10^{3}	4.13	FALSE
878	75-65-0	t-Butyl alcohol	3.40	4.72×10^{-7}	3.00×10^{3}	3.54	FALSE
878	26140-60-3	Terphenyls	4.77×10^{2}	6.62×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	109-99-9	Tetrahydrofuran	4.23×10^{2}	5.87×10^{-5}	1.50×10^{3}	1.77	FALSE
878	546-68-9	Titanium isopropoxides	7.09×10^{1}	9.84×10^{-6}	No OEL		
878	26471-62-5	Toluene diisocyanate	2.95×10^{3}	4.10×10^{-4}	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	2.04×10^{1}	2.83×10^{-6}	7.00×10^{-1}	8.26×10^{-4}	FALSE
878	102-71-6	Triethanolamine	2.68×10^{1}	3.72×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE

Table D.1–12. 1996 Annual Purchases of Volatile Organic Compounds (VOCs) Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULTS
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	$2.75x10^{-1}$	$3.82x10^{-8}$	$3.50x10^{3}$	4.13	FALSE
893	67-68-5	Dimethylsulfoxide	$2.20x10^{3}$	$3.06x10^{-4}$	No OEL		
893	64-17-5	Ethanol	$3.92x10^{3}$	$5.44x10^{-4}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
893	67-63-0	Isopropyl alcohol	$1.77x10^{5}$	$2.46x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
893	108-65-6	Methoxy acetate	$8.20x10^{3}$	$1.14x10^{-3}$	$2.75x10^{3}$	3.25	FALSE
893	872-50-4	N-Methyl-2-pyrrolidone	$8.21x10^{3}$	$1.14x10^{-3}$	$8.00x10^{2}$	$9.45x10^{-1}$	FALSE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	$2.40x10^{3}$	$3.33x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	764-41-0	1,4-Dichloro-2-butene	$4.90x10^{1}$	$6.81x10^{-6}$	$2.50x10^{-1}$	$2.95x10^{-4}$	FALSE
897	64-19-7	Acetic acid	$4.95x10^{4}$	$6.88x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
897	75-36-5	Acetyl chloride	$1.53x10^{3}$	$2.13x10^{-4}$	No OEL		
897	106-92-3	Allyl glycidyl ether	$1.67x10^{1}$	$2.32x10^{-6}$	$2.20x10^{2}$	$2.60x10^{-1}$	FALSE
897	100-51-6	Benzyl alcohol	$5.21x10^{2}$	$7.24x10^{-5}$	No OEL		
897	128-37-0	Butylated hydroxytoluene	$9.90x10^{1}$	$1.37x10^{-5}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
897	110-82-7	Cyclohexane	2.99	$4.15x10^{-7}$	$7.00x10^{3}$	8.26	FALSE
897	124-40-3	Dimethylamine	$3.98x10^{2}$	$5.53x10^{-5}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
897	67-68-5	Dimethylsulfoxide	$1.12x10^{3}$	$1.56x10^{-4}$	No OEL		
897	64-17-5	Ethanol	$8.36x10^{1}$	$1.16x10^{-5}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
897	141-78-6	Ethyl acetate	$1.78x10^{4}$	$2.47x10^{-3}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	$2.18x10^{4}$	$3.03x10^{-3}$	$1.20x10^{4}$	$1.42x10^{1}$	FALSE
897	78-10-4	Ethyl silicate	$6.27x10^{2}$	$8.72x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
897	107-83-5	Isohexanes	$1.41x10^{4}$	$1.96x10^{-3}$	$3.50x10^{3}$	4.13	FALSE

Table D.1–12. 1996 Annual Purchases of Volatile Organic Compounds (VOCs) Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULTS
897	67-63-0	Isopropyl alcohol	$7.77x10^{4}$	$1.08x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
897	8008-20-6	Kerosene	$3.01x10^{3}$	$4.18x10^{-4}$	$1.00x10^{3}$	1.18	FALSE
897	126-98-7	Methacrylonitrile	$7.95x10^{1}$	$1.10x10^{-5}$	$2.70x10^{1}$	$3.19x10^{-2}$	FALSE
897	55-55-0	Methal amino phenol sulphate	$4.11x10^{2}$	$5.70x10^{-5}$	No OEL		
897	75-79-6	Methyltrichlorosilane	$6.40x10^{2}$	$8.89x10^{-5}$	No OEL		
897	71-23-8	n-Butyl alcohol	$1.57x10^{2}$	$2.19x10^{-5}$	$3.00x10^{3}$	3.54	FALSE
897	142-82-5	n-Heptane	$5.42x10^{3}$	$7.52x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	109-66-0	Pentane	$1.91x10^{3}$	$2.66x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
897	79-21-0	Peracetic acid	$5.65x10^{1}$	$7.85x10^{-6}$	No OEL		
897	9003-53-6	Phenlylethylene (styrene, monomer)	$8.00x10^{-1}$	$1.11x10^{-7}$	$8.50x10^{2}$	1.00	FALSE
897	71-23-8	Propyl alcohol	$2.98x10^{4}$	$4.14x10^{-3}$	$4.92x10^{3}$	5.81	FALSE
897	109-99-9	Tetrahydrofuran	$1.17x10^{4}$	$1.62x10^{-3}$	$1.50x10^{3}$	1.77	FALSE
897	998-30-1	Triethoxysilane	$4.23x10^{2}$	$5.87x10^{-5}$	No OEL		
905	64-17-5	Ethanol	$5.76x10^{3}$	$8.00x10^{-4}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
905	67-63-0	Isopropyl alcohol	$1.24x10^{4}$	$1.72x10^{-3}$	$4.90x10^{3}$	5.79	FALSE
905	109-99-9	Tetrahydrofuran	$3.34x10^{3}$	$4.64x10^{-4}$	$1.50x10^{3}$	1.77	FALSE
963	67-63-0	Isopropyl alcohol	$7.85x10^{2}$	$1.09x10^{-4}$	$4.90x10^{3}$	5.79	FALSE

Table D.1–13. Projected Volatile Organic Compound (VOC) Emissions No Action Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
605	64-17-5	Ethanol	4.54×10^{2}	6.30×10^{-5}	1.88×10^{4}	2.22×10^{1}	FALSE
605	79-09-4	Propionic acid	1.03×10^{2}	1.43×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
6580	64-17-5	Ethanol	2.97×10^{1}	4.12×10^{-6}	1.88×10^{4}	2.22×10^{1}	FALSE
6580	141-78-6	Ethyl acetate	3.60×10^{3}	5.00×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
858	64-19-7	Acetic acid	5.64×10^{4}	7.83×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	107-83-5	Isohexanes	2.45×10^{3}	3.40×10^{-4}	3.50×10^{3}	4.13	FALSE
858	108-65-6	Methoxy acetate	1.04×10^{5}	1.44×10^{-2}	2.75×10^{3}	3.25	FALSE
870	872-50-4	1-Methyl-2-Pyrrolidinone	1.54×10^{4}	2.14×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
870	100-51-6	Alcohol, Benzyl	7.89×10^{5}	1.10×10^{-1}	No OEL		
870	64-17-5	Alcohol, Ethyl	3.08×10^{7}	4.28	1.88×10^{4}	2.22×10^{1}	FALSE
878	110-71-4	1,2-Dimethoxyethane	1.08×10^{3}	1.50×10^{-4}	No OEL		
878	142-96-1	1-Butoxybutane, butyl ether	9.80×10^{2}	1.36×10^{-4}	No OEL		
878	90-72-2	2,4,6-Tri(dimethylaminomethyl) phenol	4.04×10^{3}	5.61×10^{-4}	No OEL		
878	112-34-5	2-Butyl oxyethanol dipropylene glycol	5.90×10^{4}	8.20×10^{-3}	1.00×10^{3}	1.18	FALSE
878	111-15-9	2-Ethoxyethyl acetate	1.28×10^{4}	1.78×10^{-3}	2.70×10^{1}	3.19×10^{-2}	FALSE
878	64-19-7	Acetic acid	1.92×10^{4}	2.66×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
878	64742-89-8	Aliphatic petroleum distillates	6.78×10^{3}	9.41×10^{-4}	No OEL		
878	100-51-6	Benzyl alcohol	1.88×10^{4}	2.60×10^{-3}	No OEL		
878	111-76-2	Butyl cellosolve (R)	8.95×10^{3}	1.24×10^{-3}	2.40×10^{2}	2.83×10^{-1}	FALSE
878	76-22-2	Camphor	1.12×10^{2}	1.55×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	76-12-0	Chlorofluorocarbon-112	1.87×10^{2}	2.60×10^{-5}	1.69×10^{4}	2.00×10^{1}	FALSE
878	110-82-7	Cyclohexane	5.11×10^{2}	7.09×10^{-5}	7.00×10^{3}	8.26	FALSE

Table D.1–13. Projected Volatile Organic Compound (VOC) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
878	108-93-0	Cyclohexanol	1.20×10^{1}	1.67×10^{-6}	2.00×10^{3}	2.36	FALSE
878	108-91-8	Cyclohexylamine	2.74×10^{4}	3.81×10^{-3}	4.00×10^{2}	4.72×10^{-1}	FALSE
878	124-18-5	Decane	5.25×10^{2}	7.29×10^{-5}	No OEL		
878	115-10-6	Dimethyl ether	1.38×10^{3}	1.91×10^{-4}	1.91×10^{4}	2.26×10^{1}	FALSE
878	67-68-5	Dimethylsulfoxide	6.60×10^{3}	9.17×10^{-4}	No OEL		
878	109-87-5	Dimethyoxymethane (methylal)	5.10	7.09×10^{-7}	3.10×10^{4}	3.66×10^{1}	FALSE
878	2807-30-9	Ektasolve ep	3.40×10^{1}	4.72×10^{-6}	8.50×10^{2}	1.00	FALSE
878	64-17-5	Ethanol	1.33×10^{5}	1.84×10^{-2}	1.88×10^{4}	2.22×10^{1}	FALSE
878	141-78-6	Ethyl acetate	7.32×10^{2}	1.02×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
878	78-10-4	Ethyl silicate	7.18×10^{2}	9.97×10^{-5}	8.50×10^{2}	1.00	FALSE
878	74-85-1	Ethylene	7.76×10^{4}	1.08×10^{-2}	No OEL		
878	64-18-6	Formic acid	8.52×10^{3}	1.18×10^{-3}	9.00×10^{1}	1.06×10^{-1}	FALSE
878	75-28-5	Isobutane	2.56×10^{3}	3.55×10^{-4}	1.90×10^{4}	2.24×10^{1}	FALSE
878	110-19-0	Isobutyl acetate	7.64×10^{1}	1.06×10^{-5}	7.00×10^{3}	8.26	FALSE
878	67-63-0	Isopropyl alcohol	3.32×10^{5}	4.61×10^{-2}	4.90×10^{3}	5.79	FALSE
878	64742-88-7	Medium aliphatic solvent naphtha	3.91×10^{2}	5.43×10^{-5}	No OEL		
878	108-65-6	Methoxy acetate	7.96×10^{2}	1.11×10^{-4}	2.75×10^{3}	3.25	FALSE
878	4253-34-3	Methyltriacetoxy silane	1.09×10^{2}	1.51×10^{-5}	No OEL		
878	1185-55-3	Methyltrimethoysilane	1.30×10^{2}	1.81×10^{-5}	No OEL		
878	628-63-7	n-Amyl acetate	6.57×10^{2}	9.12×10^{-5}	2.60×10^{3}	3.07	FALSE
878	106-97-8	n-Butane	2.87×10^{2}	3.99×10^{-5}	1.90×10^{4}	2.24×10^{1}	FALSE
878	123-86-4	n-Butyl acetate	2.05×10^{3}	2.84×10^{-4}	7.10×10^{3}	8.38	FALSE

Table D.1–13. Projected Volatile Organic Compound (VOC) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
878	71-23-8	n-Butyl alcohol	1.01×10^{4}	1.40×10^{-3}	3.00×10^{3}	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	4.08×10^{2}	5.67×10^{-5}	1.33×10^{3}	1.57	FALSE
878	142-82-5	n-Heptane	9.04×10^{2}	1.26×10^{-4}	3.50×10^{3}	4.13	FALSE
878	872-50-4	N-Methyl-2-pyrrolidone	5.54×10^{4}	7.70×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
878	109-66-0	Pentane	4.87×10^{2}	6.76×10^{-5}	3.50×10^{3}	4.13	FALSE
878	8002-05-9	Petroleum	6.80×10^{2}	9.44×10^{-5}	No OEL		
878	64742-47-8	Petroleum distillate	2.60×10^{3}	3.61×10^{-4}	3.50×10^{3}	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	1.57×10^{2}	2.19×10^{-5}	8.50×10^{2}	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	7.54	1.05×10^{-6}	No OEL		
878	74-98-6	Propane	3.19×10^{3}	4.43×10^{-4}	1.80×10^{4}	2.13×10^{1}	FALSE
878	71-23-8	Propyl alcohol	6.08×10^{3}	8.45×10^{-4}	4.92×10^{3}	5.81	FALSE
878	57-55-6	Propylene gylcol	4.94×10^{2}	6.86×10^{-5}	No OEL		
878	110-86-1	Pyridine	2.90×10^{2}	4.03×10^{-5}	1.50×10^{2}	1.77×10^{-1}	FALSE
878	78-92-2	sec-Butyl alcohol	2.01×10^{3}	2.79×10^{-4}	3.00×10^{3}	3.54	FALSE
878	8052-41-3	Stoddard solvent	3.41×10^{2}	4.73×10^{-5}	3.50×10^{3}	4.13	FALSE
878	75-65-0	t-Butyl alcohol	5.10	7.09×10^{-7}	3.00×10^{3}	3.54	FALSE
878	26140-60-3	Terphenyls	7.15×10^{2}	9.94×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	109-99-9	Tetrahydrofuran	6.34×10^{2}	8.81×10^{-5}	1.50×10^{3}	1.77	FALSE
878	546-68-9	Titanium isopropoxides	1.06×10^{2}	1.48×10^{-5}	No OEL		
878	26471-62-5	Toluene diisocyanate	4.43×10^{3}	6.15×10^{-4}	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	3.06×10^{1}	4.25×10^{-6}	7.00×10^{-1}	8.26×10^{-4}	FALSE
878	102-71-6	Triethanolamine	4.02×10^{1}	5.58×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE

Table D.1–13. Projected Volatile Organic Compound (VOC) Emissions No Action Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	4.12×10^{-1}	5.73×10^{-8}	3.50×10^{3}	4.13	FALSE
893	67-68-5	Dimethylsulfoxide	2.20×10^{3}	3.06×10^{-4}	No OEL		
893	64-17-5	Ethanol	3.92×10^{3}	5.44×10^{-4}	1.88×10^{4}	2.22×10^{1}	FALSE
893	67-63-0	Isopropyl alcohol	1.77×10^{5}	2.46×10^{-2}	4.90×10^{3}	5.79	FALSE
893	108-65-6	Methoxy acetate	8.20×10^{3}	1.14×10^{-3}	2.75×10^{3}	3.25	FALSE
893	872-50-4	N-Methyl-2-pyrrolidone	8.21×10^{3}	1.14×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	2.40×10^{3}	3.33×10^{-4}	3.50×10^{3}	4.13	FALSE
897	764-41-0	1,4-Dichloro-2-butene	4.90×10^{1}	6.81×10^{-6}	2.50×10^{-1}	2.95×10^{-4}	FALSE
897	64-19-7	Acetic acid	4.95×10^{4}	6.88×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
897	75-36-5	Acetyl chloride	1.53×10^{3}	2.13×10^{-4}	No OEL		
897	106-92-3	Allyl glycidyl ether	1.67×10^{1}	2.32×10^{-6}	2.20×10^{2}	2.60×10^{-1}	FALSE
897	100-51-6	Benzyl alcohol	5.21×10^{2}	7.24×10^{-5}	No OEL		
897	128-37-0	Butylated hydroxytoluene	9.90×10^{1}	1.37×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	110-82-7	Cyclohexane	2.99	4.15×10^{-7}	7.00×10^{3}	8.26	FALSE
897	124-40-3	Dimethylamine	3.98×10^{2}	5.53×10^{-5}	4.00×10^{1}	4.72×10^{-2}	FALSE
897	67-68-5	Dimethylsulfoxide	1.12×10^{3}	1.56×10^{-4}	No OEL		
897	64-17-5	Ethanol	8.36×10^{1}	1.16×10^{-5}	1.88×10^{4}	2.22×10^{1}	FALSE
897	141-78-6	Ethyl acetate	1.78×10^{4}	2.47×10^{-3}	1.40×10^{4}	1.65×10^{1}	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	2.18×10^{4}	3.03×10^{-3}	1.20×10^{4}	1.42×10^{1}	FALSE
897	78-10-4	Ethyl silicate	6.27×10^{2}	8.72×10^{-5}	8.50×10^{2}	1.00	FALSE
897	107-83-5	Isohexanes	1.41×10^{4}	1.96×10^{-3}	3.50×10^{3}	4.13	FALSE
897	67-63-0	Isopropyl alcohol	7.77×10^{4}	1.08×10^{-2}	4.90×10^{3}	5.79	FALSE

Table D.1–13. Projected Volatile Organic Compound (VOC) Emissions No Action Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULTS
897	8008-20-6	Kerosene	$3.01x10^3$	$4.18x10^{-4}$	$1.00x10^3$	1.18	FALSE
897	126-98-7	Methacrylonitrile	$7.95x10^1$	$1.10x10^{-5}$	$2.70x10^1$	$3.19x10^{-2}$	FALSE
897	55-55-0	Methal amino phenol sulphate	$4.11x10^2$	$5.70x10^{-5}$	No OEL		
897	75-79-6	Methyltrichlorosilane	$6.40x10^2$	$8.89x10^{-5}$	No OEL		
897	71-23-8	n-Butyl alcohol	$1.57x10^2$	$2.19x10^{-5}$	$3.00x10^3$	3.54	FALSE
897	142-82-5	n-Heptane	$5.42x10^3$	$7.52x10^{-4}$	$3.50x10^3$	4.13	FALSE
897	109-66-0	Pentane	$1.91x10^3$	$2.66x10^{-4}$	$3.50x10^3$	4.13	FALSE
897	79-21-0	Peracetic acid	$5.65x10^1$	$7.85x10^{-6}$	No OEL		
897	9003-53-6	Phenlylethylene (styrene, monomer)	$8.00x10^{-1}$	$1.11x10^{-7}$	$8.50x10^2$	1.00	FALSE
897	71-23-8	Propyl alcohol	$2.98x10^4$	$4.14x10^{-3}$	$4.92x10^3$	5.81	FALSE
897	109-99-9	Tetrahydrofuran	$1.17x10^4$	$1.62x10^{-3}$	$1.50x10^3$	1.77	FALSE
897	998-30-1	Triethoxysilane	$4.23x10^2$	$5.87x10^{-5}$	No OEL		
905	64-17-5	Ethanol	$1.15x10^4$	$1.60x10^{-3}$	$1.88x10^4$	$2.22x10^1$	FALSE
905	67-63-0	Isopropyl alcohol	$2.47x10^4$	$3.44x10^{-3}$	$4.90x10^3$	5.79	FALSE
905	109-99-9	Tetrahydrofuran	$6.69x10^3$	$9.29x10^{-4}$	$1.50x10^3$	1.77	FALSE
963	67-63-0	Isopropyl alcohol	$7.85x10^2$	$1.09x10^{-4}$	$4.90x10^3$	5.79	FALSE

Table D.1–14. Projected Volatile Organic Compound (VOC) Emissions Expanded Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^{3}	TEV g/sec	RESULTS
605	64-17-5	Ethanol	9.07×10^{2}	1.26×10^{-4}	1.88×10^{4}	2.22×10^{1}	FALSE
605	79-09-4	Propionic acid	2.06×10^{2}	2.87×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
6580	64-17-5	Ethanol	5.94×10^{1}	8.25×10^{-6}	1.88×10^{4}	2.22×10^{1}	FALSE
6580	141-78-6	Ethyl acetate	7.20×10^{3}	1.00×10^{-3}	1.40×10^{4}	1.65×10^{1}	FALSE
858	64-19-7	Acetic acid	6.04×10^{4}	8.39×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	107-83-5	Isohexanes	2.62×10^{3}	3.65×10^{-4}	3.50×10^{3}	4.13	FALSE
858	108-65-6	Methoxy acetate	1.11×10^{5}	1.55×10^{-2}	2.75×10^{3}	3.25	FALSE
870	872-50-4	1-Methyl-2-Pyrrolidinone	1.54×10^{4}	2.14×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
870	100-51-6	Alcohol, Benzyl	7.89×10^{5}	1.10×10^{-1}	No OEL		
870	64-17-5	Alcohol, Ethyl	3.08×10^{7}	4.28	1.88×10^{4}	2.22×10^{1}	FALSE
878	110-71-4	1,2-Dimethoxyethane	1.44×10^{3}	1.99×10^{-4}	No OEL		
878	142-96-1	1-Butoxybutane, butyl ether	1.31×10^{3}	1.81×10^{-4}	No OEL		
878	90-72-2	2,4,6-Tri(dimethylaminomethyl) phenol	5.38×10^{3}	7.48×10^{-4}	No OEL		
878	112-34-5	2-Butyl oxyethanol dipropylene glycol	7.87×10^{4}	1.09×10^{-2}	1.00×10^{3}	1.18	FALSE
878	111-15-9	2-Ethoxyethyl acetate	1.71×10^{4}	2.37×10^{-3}	2.70×10^{1}	3.19×10^{-2}	FALSE
878	64-19-7	Acetic acid	2.55×10^{4}	3.55×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
878	64742-89-8	Aliphatic petroleum distillates	9.04×10^{3}	1.25×10^{-3}	No OEL		
878	100-51-6	Benzyl alcohol	2.50×10^{4}	3.47×10^{-3}	No OEL		
878	111-76-2	Butyl cellosolve (R)	1.19×10^{4}	1.66×10^{-3}	2.40×10^{2}	2.83×10^{-1}	FALSE
878	76-22-2	Camphor	1.49×10^{2}	2.07×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	76-12-0	Chlorofluorocarbon-112	2.50×10^{2}	3.47×10^{-5}	1.69×10^{4}	2.00×10^{1}	FALSE
878	110-82-7	Cyclohexane	6.81×10^{2}	9.46×10^{-5}	7.00×10^{3}	8.26	FALSE

Table D.1–14. Projected Volatile Organic Compound (VOC) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
878	108-93-0	Cyclohexanol	1.60×10^{1}	2.22×10^{-6}	2.00×10^{3}	2.36	FALSE
878	108-91-8	Cyclohexylamine	3.65×10^{4}	5.07×10^{-3}	4.00×10^{2}	4.72×10^{-1}	FALSE
878	124-18-5	Decane	7.00×10^{2}	9.72×10^{-5}	No OEL		
878	115-10-6	Dimethyl ether	1.83×10^{3}	2.55×10^{-4}	1.91×10^{4}	2.26×10^{1}	FALSE
878	67-68-5	Dimethylsulfoxide	8.80×10^{3}	1.22×10^{-3}	No OEL		
878	109-87-5	Dimethyoxymethane (methylal)	6.80	9.45×10^{-7}	3.10×10^{4}	3.66×10^{1}	FALSE
878	2807-30-9	Ektasolve ep	4.54×10^{1}	6.30×10^{-6}	8.50×10^{2}	1.00	FALSE
878	64-17-5	Ethanol	1.77×10^{5}	2.46×10^{-2}	1.88×10^{4}	2.22×10^{1}	FALSE
878	141-78-6	Ethyl acetate	9.75×10^{2}	1.35×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
878	78-10-4	Ethyl silicate	9.57×10^{2}	1.33×10^{-4}	8.50×10^{2}	1.00	FALSE
878	74-85-1	Ethylene	1.03×10^{5}	1.44×10^{-2}	No OEL		
878	64-18-6	Formic acid	1.14×10^{4}	1.58×10^{-3}	9.00×10^{1}	1.06×10^{-1}	FALSE
878	75-28-5	Isobutane	3.41×10^{3}	4.74×10^{-4}	1.90×10^{4}	2.24×10^{1}	FALSE
878	110-19-0	Isobutyl acetate	1.02×10^{2}	1.42×10^{-5}	7.00×10^{3}	8.26	FALSE
878	67-63-0	Isopropyl alcohol	4.42×10^{5}	6.14×10^{-2}	4.90×10^{3}	5.79	FALSE
878	64742-88-7	Medium aliphatic solvent naphtha	5.22×10^{2}	7.24×10^{-5}	No OEL		
878	108-65-6	Methoxy acetate	1.06×10^{3}	1.47×10^{-4}	2.75×10^{3}	3.25	FALSE
878	4253-34-3	Methyltriacetoxy silane	1.45×10^{2}	2.02×10^{-5}	No OEL		
878	1185-55-3	Methyltrimethoysilane	1.74×10^{2}	2.41×10^{-5}	No OEL		
878	628-63-7	n-Amyl acetate	8.76×10^{2}	1.22×10^{-4}	2.60×10^{3}	3.07	FALSE
878	106-97-8	n-Butane	3.83×10^{2}	5.32×10^{-5}	1.90×10^{4}	2.24×10^{1}	FALSE
878	123-86-4	n-Butyl acetate	2.73×10^{3}	3.79×10^{-4}	7.10×10^{3}	8.38	FALSE

Table D.1–14. Projected Volatile Organic Compound (VOC) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULTS
878	71-23-8	n-Butyl alcohol	1.35×10^{4}	1.87×10^{-3}	3.00×10^{3}	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	5.44×10^{2}	7.56×10^{-5}	1.33×10^{3}	1.57	FALSE
878	142-82-5	n-Heptane	1.21×10^{3}	1.67×10^{-4}	3.50×10^{3}	4.13	FALSE
878	872-50-4	N-Methyl-2-pyrrolidone	7.39×10^{4}	1.03×10^{-2}	8.00×10^{2}	9.45×10^{-1}	FALSE
878	109-66-0	Pentane	6.49×10^{2}	9.02×10^{-5}	3.50×10^{3}	4.13	FALSE
878	8002-05-9	Petroleum	9.07×10^{2}	1.26×10^{-4}	No OEL		
878	64742-47-8	Petroleum distillate	3.46×10^{3}	4.81×10^{-4}	3.50×10^{3}	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	2.10×10^{2}	2.92×10^{-5}	8.50×10^{2}	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	1.01×10^{1}	1.40×10^{-6}	No OEL		
878	74-98-6	Propane	4.25×10^{3}	5.91×10^{-4}	1.80×10^{4}	2.13×10^{1}	FALSE
878	71-23-8	Propyl alcohol	8.11×10^{3}	1.13×10^{-3}	4.92×10^{3}	5.81	FALSE
878	57-55-6	Propylene gylcol	6.58×10^{2}	9.14×10^{-5}	No OEL		
878	110-86-1	Pyridine	3.87×10^{2}	5.38×10^{-5}	1.50×10^{2}	1.77×10^{-1}	FALSE
878	78-92-2	sec-Butyl alcohol	2.67×10^{3}	3.71×10^{-4}	3.00×10^{3}	3.54	FALSE
878	8052-41-3	Stoddard solvent	4.54×10^{2}	6.31×10^{-5}	3.50×10^{3}	4.13	FALSE
878	75-65-0	t-Butyl alcohol	6.80	9.45×10^{-7}	3.00×10^{3}	3.54	FALSE
878	26140-60-3	Terphenyls	9.54×10^{2}	1.32×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	109-99-9	Tetrahydrofuran	8.46×10^{2}	1.17×10^{-4}	1.50×10^{3}	1.77	FALSE
878	546-68-9	Titanium isopropoxides	1.42×10^{2}	1.97×10^{-5}	No OEL		
878	26471-62-5	Toluene diisocyanate	5.90×10^{3}	8.20×10^{-4}	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	4.08×10^{1}	5.67×10^{-6}	7.00×10^{-1}	8.26×10^{-4}	FALSE
878	102-71-6	Triethanolamine	5.36×10^{1}	7.44×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE

Table D.1–14. Projected Volatile Organic Compound (VOC) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULTS
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	5.50×10^{-1}	7.64×10^{-8}	3.50×10^{3}	4.13	FALSE
893	67-68-5	Dimethylsulfoxide[a]	4.40×10^{3}	6.11×10^{-4}	No OEL		
893	64-17-5	Ethanol[a]	7.84×10^{3}	1.09×10^{-3}	1.88×10^{4}	2.22×10^{1}	FALSE
893	67-63-0	Isopropyl alcohol[a]	3.54×10^{5}	4.92×10^{-2}	4.90×10^{3}	5.79	FALSE
893	108-65-6	Methoxy acetate[a]	1.64×10^{4}	2.28×10^{-3}	2.75×10^{3}	3.25	FALSE
893	872-50-4	N-Methyl-2-pyrrolidone[a]	1.64×10^{4}	2.28×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha[a]	4.80×10^{3}	6.67×10^{-4}	3.50×10^{3}	4.13	FALSE
MESA	872-50-4	1-Methyl-2-pyrrolidinone[b]	8.21×10^{3}	1.14×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
MESA	111-15-9	2-Ethoxyethyl acetate[b]	1.91×10^{3}	2.65×10^{-4}	2.70×10^{1}	3.19×10^{-2}	FALSE
MESA	64-19-7	Acetic acid[b]	1.06×10^{3}	1.47×10^{-4}	2.50×10^{2}	2.95×10^{-1}	FALSE
MESA	67-64-1	Acetone[b]	7.49×10^{5}	1.04×10^{-1}	5.90×10^{3}	6.97	FALSE
MESA	110-82-7	Cyclohexane[b]	9.42×10^{1}	1.31×10^{-5}	7.00×10^{3}	8.26	FALSE
MESA	64-17-5	Ethanol[b]	2.83×10^{3}	3.92×10^{-4}	1.88×10^{4}	2.22×10^{1}	FALSE
MESA	78-10-4	Ethyl silicate[b]	3.72×10^{3}	5.17×10^{-4}	8.50×10^{2}	1.00	FALSE
MESA	67-63-1	Isopropyl alcohol[b]	6.55×10^{3}	9.09×10^{-4}	4.90×10^{3}	5.79	FALSE
MESA	123-86-4	N-Butyl acetate[b]	2.01×10^{2}	2.79×10^{-5}	7.10×10^{3}	8.38	FALSE
MESA	71-23-8	N-Propyl alcohol[b]	4.02×10^{2}	5.59×10^{-5}	4.92×10^{3}	5.81	FALSE
897	764-41-0	1,4-Dichloro-2-butene	4.90×10^{1}	6.81×10^{-6}	2.50×10^{-1}	2.95×10^{-4}	FALSE
897	64-19-7	Acetic acid	4.95×10^{4}	6.88×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
897	75-36-5	Acetyl chloride	1.53×10^{3}	2.13×10^{-4}	No OEL		
897	106-92-3	Allyl glycidyl ether	1.67×10^{1}	2.32×10^{-6}	2.20×10^{2}	2.60×10^{-1}	FALSE
897	100-51-6	Benzyl alcohol	5.21×10^{2}	7.24×10^{-5}	No OEL		

Table D.1–14. Projected Volatile Organic Compound (VOC) Emissions Expanded Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
897	128-37-0	Butylated hydroxytoluene	9.90×10^{1}	1.37×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	110-82-7	Cyclohexane	2.99	4.15×10^{-7}	7.00×10^{3}	8.26	FALSE
897	124-40-3	Dimethylamine	3.98×10^{2}	5.53×10^{-5}	4.00×10^{1}	4.72×10^{-2}	FALSE
897	67-68-5	Dimethylsulfoxide	1.12×10^{3}	1.56×10^{-4}	No OEL		
897	64-17-5	Ethanol	8.36×10^{1}	1.16×10^{-5}	1.88×10^{4}	2.22×10^{1}	FALSE
897	141-78-6	Ethyl acetate	1.78×10^{4}	2.47×10^{-3}	1.40×10^{4}	1.65×10^{1}	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	2.18×10^{4}	3.03×10^{-3}	1.20×10^{4}	1.42×10^{1}	FALSE
897	78-10-4	Ethyl silicate	6.27×10^{2}	8.72×10^{-5}	8.50×10^{2}	1.00	FALSE
897	107-83-5	Isohexanes	1.41×10^{4}	1.96×10^{-3}	3.50×10^{3}	4.13	FALSE
897	67-63-0	Isopropyl alcohol	7.77×10^{4}	1.08×10^{-2}	4.90×10^{3}	5.79	FALSE
897	8008-20-6	Kerosene	3.01×10^{3}	4.18×10^{-4}	1.00×10^{3}	1.18	FALSE
897	126-98-7	Methacrylonitrile	7.95×10^{1}	1.10×10^{-5}	2.70×10^{1}	3.19×10^{-2}	FALSE
897	55-55-0	Methal amino phenol sulphate	4.11×10^{2}	5.70×10^{-5}	No OEL		
897	75-79-6	Methyltrichlorosilane	6.40×10^{2}	8.89×10^{-5}	No OEL		
897	71-23-8	n-Butyl alcohol	1.57×10^{2}	2.19×10^{-5}	3.00×10^{3}	3.54	FALSE
897	142-82-5	n-Heptane	5.42×10^{3}	7.52×10^{-4}	3.50×10^{3}	4.13	FALSE
897	109-66-0	Pentane	1.91×10^{3}	2.66×10^{-4}	3.50×10^{3}	4.13	FALSE
897	79-21-0	Peracetic acid	5.65×10^{1}	7.85×10^{-6}	No OEL		
897	9003-53-6	Phenlylethylene (styrene, monomer)	8.00×10^{-1}	1.11×10^{-7}	8.50×10^{2}	1.00	FALSE
897	71-23-8	Propyl alcohol	2.98×10^{4}	4.14×10^{-3}	4.92×10^{3}	5.81	FALSE
897	109-99-9	Tetrahydrofuran	1.17×10^{4}	1.62×10^{-3}	1.50×10^{3}	1.77	FALSE
897	998-30-1	Triethoxysilane	4.23×10^{2}	5.87×10^{-5}	No OEL		

Table D.1–14. Projected Volatile Organic Compound (VOC) Emissions Expanded Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
905	64-17-5	Ethanol	1.15×10^4	1.60×10^{-3}	1.88×10^4	2.22×10^1	FALSE
905	67-63-0	Isopropyl alcohol	2.47×10^4	3.44×10^{-3}	4.90×10^3	5.79	FALSE
905	109-99-9	Tetrahydrofuran	6.69×10^3	9.29×10^{-4}	1.50×10^3	1.77	FALSE
963	67-63-0	Isopropyl alcohol	1.57×10^3	2.18×10^{-4}	4.90×10^3	5.79	FALSE

MESA: Microsystems and Engineering Sciences Applications

[a] If the MESA Complex configuration is implemented, Building 893 would cease operations (after 2003) and the chemicals listed would no longer contribute VOC emissions under the Expanded Operations Alternative.

[b] If Building 893 is not replaced by the MESA Complex configuration, the VOCs listed would not contribute to VOC emissions under the Expanded Operations Alternative.

Table D.1–15. Projected Volatile Organic Compound (VOC) Emissions Reduced Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
605	64-17-5	Ethanol	4.54×10^{2}	6.30×10^{-5}	1.88×10^{4}	2.22×10^{1}	FALSE
605	79-09-4	Propionic acid	1.03×10^{2}	1.43×10^{-5}	3.00×10^{2}	3.54×10^{-1}	FALSE
6580	64-17-5	Ethanol	2.97×10^{1}	4.12×10^{-6}	1.88×10^{4}	2.22×10^{1}	FALSE
6580	141-78-6	Ethyl acetate	3.60×10^{3}	5.00×10^{-4}	1.40×10^{4}	1.65×10^{1}	FALSE
858	64-19-7	Acetic acid	2.16×10^{4}	3.00×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
858	107-83-5	Isohexanes	9.38×10^{2}	1.30×10^{-4}	3.50×10^{3}	4.13	FALSE
858	108-65-6	Methoxy acetate	3.98×10^{4}	5.53×10^{-3}	2.75×10^{3}	3.25	FALSE
870	872-50-4	1-Methyl-2-Pyrrolidinone	1.54×10^{4}	2.14×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
870	100-51-6	Alcohol, Benzyl	7.89×10^{5}	1.10×10^{-1}	No OEL		
870	64-17-5	Alcohol, Ethyl	3.08×10^{7}	4.28	1.88×10^{4}	2.22×10^{1}	FALSE
878	110-71-4	1,2-Dimethoxyethane	7.18×10^{2}	9.97×10^{-5}	No OEL		
878	142-96-1	1-Butoxybutane, butyl ether	6.53×10^{2}	9.07×10^{-5}	No OEL		
878	90-72-2	2,4,6-Tri(dimethylaminomethyl) phenol	2.69×10^{3}	3.74×10^{-4}	No OEL		
878	112-34-5	2-Butyl oxyethanol dipropylene glycol	3.94×10^{4}	5.47×10^{-3}	1.00×10^{3}	1.18	FALSE
878	111-15-9	2-Ethoxyethyl acetate	8.53×10^{3}	1.18×10^{-3}	2.70×10^{1}	3.19×10^{-2}	FALSE
878	64-19-7	Acetic acid	1.28×10^{4}	1.77×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
878	64742-89-8	Aliphatic petroleum distillates	4.52×10^{3}	6.27×10^{-4}	No OEL		
878	100-51-6	Benzyl alcohol	1.25×10^{4}	1.74×10^{-3}	No OEL		
878	111-76-2	Butyl cellosolve (R)	5.97×10^{3}	8.29×10^{-4}	2.40×10^{2}	2.83×10^{-1}	FALSE
878	76-22-2	Camphor	7.44×10^{1}	1.03×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	76-12-0	Chlorofluorocarbon-112	1.25×10^{2}	1.74×10^{-5}	1.69×10^{4}	2.00×10^{1}	FALSE
878	110-82-7	Cyclohexane	3.40×10^{2}	4.73×10^{-5}	7.00×10^{3}	8.26	FALSE

Table D.1–15. Projected Volatile Organic Compound (VOC) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
878	108-93-0	Cyclohexanol	8.00	$1.11x10^{-6}$	$2.00x10^{3}$	2.36	FALSE
878	108-91-8	Cyclohexylamine	$1.83x10^{4}$	$2.54x10^{-3}$	$4.00x10^{2}$	$4.72x10^{-1}$	FALSE
878	124-18-5	Decane	$3.50x10^{2}$	$4.86x10^{-5}$	No OEL		
878	115-10-6	Dimethyl ether	$9.17x10^{2}$	$1.27x10^{-4}$	$1.91x10^{4}$	$2.26x10^{1}$	FALSE
878	67-68-5	Dimethylsulfoxide	$4.40x10^{3}$	$6.11x10^{-4}$	No OEL		
878	109-87-5	Dimethyoxymethane (methylal)	3.40	$4.72x10^{-7}$	$3.10x10^{4}$	$3.66x10^{1}$	FALSE
878	2807-30-9	Ektasolve ep	$2.27x10^{1}$	$3.15x10^{-6}$	$8.50x10^{-2}$	1.00	FALSE
878	64-17-5	Ethanol	$8.84x10^{4}$	$1.23x10^{-2}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
878	141-78-6	Ethyl acetate	$4.88x10^{2}$	$6.77x10^{-5}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
878	78-10-4	Ethyl silicate	$4.79x10^{2}$	$6.65x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	74-85-1	Ethylene	$5.17x10^{4}$	$7.18x10^{-3}$	No OEL		
878	64-18-6	Formic acid	$5.68x10^{3}$	$7.89x10^{-4}$	$9.00x10^{1}$	$1.06x10^{-1}$	FALSE
878	75-28-5	Isobutane	$1.71x10^{3}$	$2.37x10^{-4}$	$1.90x10^{4}$	$2.24x10^{1}$	FALSE
878	110-19-0	Isobutyl acetate	$5.10x10^{1}$	$7.08x10^{-6}$	$7.00x10^{3}$	8.26	FALSE
878	67-63-0	Isopropyl alcohol	$2.21x10^{5}$	$3.07x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
878	64742-88-7	Medium aliphatic solvent naphtha	$2.61x10^{2}$	$3.62x10^{-5}$	No OEL		
878	108-65-6	Methoxy acetate	$5.30x10^{2}$	$7.37x10^{-5}$	$2.75x10^{3}$	3.25	FALSE
878	4253-34-3	Methyltriacetoxy silane	$7.26x10^{1}$	$1.01x10^{-5}$	No OEL		
878	1185-55-3	Methyltrimethoysilane	$8.69x10^{1}$	$1.21x10^{-5}$	No OEL		
878	628-63-7	n-Amyl acetate	$4.38x10^{2}$	$6.08x10^{-5}$	$2.60x10^{3}$	3.07	FALSE
878	106-97-8	n-Butane	$1.91x10^{2}$	$2.66x10^{-5}$	$1.90x10^{4}$	$2.24x10^{1}$	FALSE
878	123-86-4	n-Butyl acetate	$1.36x10^{3}$	$1.89x10^{-4}$	$7.10x10^{3}$	8.38	FALSE

Table D.1–15. Projected Volatile Organic Compound (VOC) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m^3	TEV g/sec	RESULTS
878	71-23-8	n-Butyl alcohol	6.74×10^{3}	9.36×10^{-4}	3.00×10^{3}	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	2.72×10^{2}	3.78×10^{-5}	1.33×10^{3}	1.57	FALSE
878	142-82-5	n-Heptane	6.03×10^{2}	8.37×10^{-5}	3.50×10^{3}	4.13	FALSE
878	872-50-4	N-Methyl-2-pyrrolidone	3.70×10^{4}	5.13×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
878	109-66-0	Pentane	3.25×10^{2}	4.51×10^{-5}	3.50×10^{3}	4.13	FALSE
878	8002-05-9	Petroleum	4.53×10^{2}	6.30×10^{-5}	No OEL		
878	64742-47-8	Petroleum distillate	1.73×10^{3}	2.40×10^{-4}	3.50×10^{3}	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	1.05×10^{2}	1.46×10^{-5}	8.50×10^{2}	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	5.03	6.99×10^{-7}	No OEL		
878	74-98-6	Propane	2.13×10^{3}	2.95×10^{-4}	1.80×10^{4}	2.13×10^{1}	FALSE
878	71-23-8	Propyl alcohol	4.06×10^{3}	5.63×10^{-4}	4.92×10^{3}	5.81	FALSE
878	57-55-6	Propylene gylcol	3.29×10^{2}	4.57×10^{-5}	No OEL		
878	110-86-1	Pyridine	1.94×10^{2}	2.69×10^{-5}	1.50×10^{2}	1.77×10^{-1}	FALSE
878	78-92-2	sec-Butyl alcohol	1.34×10^{3}	1.86×10^{-4}	3.00×10^{3}	3.54	FALSE
878	8052-41-3	Stoddard solvent	2.27×10^{2}	3.15×10^{-5}	3.50×10^{3}	4.13	FALSE
878	75-65-0	t-Butyl alcohol	3.40	4.72×10^{-7}	3.00×10^{3}	3.54	FALSE
878	26140-60-3	Terphenyls	4.77×10^{2}	6.62×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	109-99-9	Tetrahydrofuran	4.23×10^{2}	5.87×10^{-5}	1.50×10^{3}	1.77	FALSE
878	546-68-9	Titanium isopropoxides	7.09×10^{1}	9.84×10^{-6}	No OEL		
878	26471-62-5	Toluene diisocyanate	2.95×10^{3}	4.10×10^{-4}	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	2.04×10^{1}	2.83×10^{-6}	7.00×10^{-1}	8.26×10^{-4}	FALSE
878	102-71-6	Triethanolamine	2.68×10^{1}	3.72×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE

Table D.1–15. Projected Volatile Organic Compound (VOC) Emissions Reduced Operations Alternative Screening Level Analysis (continued)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULTS
878	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	2.75×10^{-1}	3.82×10^{-8}	3.50×10^{3}	4.13	FALSE
893	67-68-5	Dimethylsulfoxide	2.20×10^{3}	3.06×10^{-4}	No OEL		
893	64-17-5	Ethanol	3.92×10^{3}	5.44×10^{-4}	1.88×10^{4}	2.22×10^{1}	FALSE
893	67-63-0	Isopropyl alcohol	1.77×10^{5}	2.46×10^{-2}	4.90×10^{3}	5.79	FALSE
893	108-65-6	Methoxy acetate	8.20×10^{3}	1.14×10^{-3}	2.75×10^{3}	3.25	FALSE
893	872-50-4	N-Methyl-2-pyrrolidone	8.21×10^{3}	1.14×10^{-3}	8.00×10^{2}	9.45×10^{-1}	FALSE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha	2.40×10^{3}	3.33×10^{-4}	3.50×10^{3}	4.13	FALSE
897	764-41-0	1,4-Dichloro-2-butene	4.51×10^{1}	6.26×10^{-6}	2.50×10^{-1}	2.95×10^{-4}	FALSE
897	64-19-7	Acetic acid	4.56×10^{4}	6.33×10^{-3}	2.50×10^{2}	2.95×10^{-1}	FALSE
897	75-36-5	Acetyl chloride	1.41×10^{3}	1.96×10^{-4}	No OEL		
897	106-92-3	Allyl glycidyl ether	1.54×10^{1}	2.13×10^{-6}	2.20×10^{2}	2.60×10^{-1}	FALSE
897	100-51-6	Benzyl alcohol	4.79×10^{2}	6.66×10^{-5}	No OEL		
897	128-37-0	Butylated hydroxytoluene	9.11×10^{1}	1.26×10^{-5}	1.00×10^{2}	1.18×10^{-1}	FALSE
897	110-82-7	Cyclohexane	2.75	3.82×10^{-7}	7.00×10^{3}	8.26	FALSE
897	124-40-3	Dimethylamine	3.66×10^{2}	5.09×10^{-5}	4.00×10^{1}	4.72×10^{-2}	FALSE
897	67-68-5	Dimethylsulfoxide	1.03×10^{3}	1.44×10^{-4}	No OEL		
897	64-17-5	Ethanol	7.69×10^{1}	1.07×10^{-5}	1.88×10^{4}	2.22×10^{1}	FALSE
897	141-78-6	Ethyl acetate	1.64×10^{4}	2.28×10^{-3}	1.40×10^{4}	1.65×10^{1}	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	2.01×10^{4}	2.79×10^{-3}	1.20×10^{4}	1.42×10^{1}	FALSE
897	78-10-4	Ethyl silicate	5.77×10^{2}	8.02×10^{-5}	8.50×10^{2}	1.00	FALSE
897	107-83-5	Isohexanes	1.30×10^{4}	1.80×10^{-3}	3.50×10^{3}	4.13	FALSE
897	67-63-0	Isopropyl alcohol	7.15×10^{4}	9.93×10^{-3}	4.90×10^{3}	5.79	FALSE

Table D.1–15. Projected Volatile Organic Compound (VOC) Emissions Reduced Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m^3	TEV g/sec	RESULTS
897	8008-20-6	Kerosene	2.77×10^{3}	3.85×10^{-4}	1.00×10^{3}	1.18	FALSE
897	126-98-7	Methacrylonitrile	7.31×10^{1}	1.02×10^{-5}	2.70×10^{1}	3.19×10^{-2}	FALSE
897	55-55-0	Methal amino phenol sulphate	3.78×10^{2}	5.25×10^{-5}	No OEL		
897	75-79-6	Methyltrichlorosilane	5.89×10^{2}	8.18×10^{-5}	No OEL		
897	71-23-8	n-Butyl alcohol	1.45×10^{2}	2.01×10^{-5}	3.00×10^{3}	3.54	FALSE
897	142-82-5	n-Heptane	4.98×10^{3}	6.92×10^{-4}	3.50×10^{3}	4.13	FALSE
897	109-66-0	Pentane	1.76×10^{3}	2.44×10^{-4}	3.50×10^{3}	4.13	FALSE
897	79-21-0	Peracetic acid	5.20×10^{1}	7.22×10^{-6}	No OEL		
897	9003-53-6	Phenlylethylene (styrene, monomer)	7.36×10^{-1}	1.02×10^{-7}	8.50×10^{2}	1.00	FALSE
897	71-23-8	Propyl alcohol	2.74×10^{4}	3.81×10^{-3}	4.92×10^{3}	5.81	FALSE
897	109-99-9	Tetrahydrofuran	1.07×10^{4}	1.49×10^{-3}	1.50×10^{3}	1.77	FALSE
897	998-30-1	Triethoxysilane	3.89×10^{2}	5.40×10^{-5}	No OEL		
905	64-17-5	Ethanol	1.15×10^{3}	1.60×10^{-4}	1.88×10^{4}	2.22×10^{1}	FALSE
905	67-63-0	Isopropyl alcohol	2.47×10^{3}	3.44×10^{-4}	4.90×10^{3}	5.79	FALSE
905	109-99-9	Tetrahydrofuran	6.69×10^{2}	9.29×10^{-5}	1.50×10^{3}	1.77	FALSE
963	67-63-0	Isopropyl alcohol	7.85×10^{2}	1.09×10^{-4}	4.90×10^{3}	5.79	FALSE

Table D.1–16. Additional Chemical List Baseline Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 µg/m³	TEV g/sec	RESULT
858	7664-41-7	Ammonia	$1.36x10^4$	$1.89x10^{-3}$	$1.40x10^2$	$1.65x10^{-1}$	FALSE
858	7784-42-1	Arsine (15%)	$1.55x10^3$	$2.16x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
858	7782-50-5	Chlorine	$9.90x10^4$	$1.38x10^{-2}$	$1.50x10^1$	$1.77x10^{-2}$	FALSE
858	7782-41-4	Fluorine (5%) in argon	$1.70x10^3$	$2.36x10^{-4}$	2.00	$2.36x10^{-3}$	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	$1.37x10^4$	$1.91x10^{-3}$	$6.70x10^1$	$7.91x10^{-2}$	FALSE
858	7783-54-2	Nitrogen trifluoride	$5.00x10^3$	$6.94x10^{-4}$	$2.90x10^2$	$3.42x10^{-1}$	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	$1.68x10^3$	$2.33x10^{-4}$	$1.50x10^3$	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	$4.02x10^4$	$5.59x10^{-3}$	$7.90x10^3$	9.33	FALSE
878	1336-21-6	Ammonium hydroxide	$1.17x10^6$	$1.63x10^{-1}$	$1.4x10^2$	$1.65x10^{-1}$	FALSE
878	7697-37-2	Nitric acid	$6.33x10^4$	$8.79x10^{-3}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
893	7664-41-7	Ammonia	$1.36x10^4$	$1.89x10^{-3}$	$1.40x10^2$	$1.65x10^{-1}$	FALSE
893	7784-42-1	Arsine	$5.54x10^4$	$7.69x10^{-3}$	1.60	$1.89x10^{-3}$	TRUE
893	7783-07-5	Hydrogen selenide	$4.77x10^4$	$6.63x10^{-3}$	1.60	$1.89x10^{-3}$	TRUE
893	7803-51-2	Phosphine (100%)	$2.27x10^3$	$3.15x10^{-4}$	1.40	$1.65x10^{-3}$	FALSE
893	7803-62-5	Silane (silicon tetrafluoride)	$1.03x10^3$	$1.43x10^{-4}$	$6.60x10^1$	$7.79x10^{-3}$	FALSE
893	7446-09-5	Sulfur dioxide	$1.51x10^2$	$2.10x10^{-5}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE

Table D.1–17. Additional Chemical List No Action Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 μg/m³	TEV g/sec	RESULT
858	7664-41-7	Ammonia	$2.38x10^{4}$	$3.31x10^{-3}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
858	7784-42-1	Arsine (15%)	$2.71x10^{3}$	$3.77x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
858	7782-50-5	Chlorine	$1.73x10^{5}$	$2.41x10^{-2}$	$1.50x10^{1}$	$1.77x10^{-2}$	TRUE
858	7782-41-4	Fluorine (5%) in argon	$2.98x10^{3}$	$4.13x10^{-4}$	2.00	$2.36x10^{-3}$	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	$2.40x10^{4}$	$3.34x10^{-3}$	$6.70x10^{1}$	$7.91x10^{-2}$	FALSE
858	7783-54-2	Nitrogen trifluoride	$8.74x10^{3}$	$1.21x10^{-3}$	$2.90x10^{2}$	$3.42x10^{-1}$	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	$2.94x10^{3}$	$4.08x10^{-4}$	$1.50x10^{3}$	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	$7.04x10^{4}$	$9.78x10^{-3}$	$7.90x10^{3}$	9.33	FALSE
878	1336-21-6	Ammonium hydroxide	$1.76x10^{6}$	$2.45x10^{-1}$	$1.4x10^{2}$	$1.65x10^{-1}$	TRUE
878	7697-37-2	Nitric acid	$9.49x10^{4}$	$1.32x10^{-2}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
893	7664-41-7	Ammonia	$2.72x10^{4}$	$3.78x10^{-3}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
893	7784-42-1	Arsine	$1.11x10^{5}$	$1.54x10^{-2}$	1.60	$1.89x10^{-3}$	TRUE
893	7783-07-5	Hydrogen selenide	$9.54x10^{4}$	$1.33x10^{-2}$	1.60	$1.89x10^{-3}$	TRUE
893	7803-51-2	Phosphine (100%)	$4.54x10^{3}$	$6.30x10^{-4}$	1.40	$1.65x10^{-3}$	FALSE
893	7803-62-5	Silane (silicon tetrafluoride)	$2.06x10^{3}$	$2.86x10^{-4}$	$6.60x10^{1}$	$7.79x10^{-3}$	FALSE
893	7446-09-5	Sulfur dioxide	$3.02x10^{2}$	$4.19x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE

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[a] If the MESA Complex configuration is implemented, Building 893 would cease operations (after 2003) and the chemicals listed would no longer contribute chemical emissions under the Expanded Operations Alternative. If implemented, MESA Complex configuration operations are not expected to contribute additional chemical emissions.

Table D.1–18. Additional Chemical List, Expanded Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 $\mu g/m^3$	TEV g/sec	RESULT
858	7664-41-7	Ammonia	2.55×10^{4}	3.54×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
858	7784-42-1	Arsine (15%)	2.91×10^{3}	4.04×10^{-4}	1.60	1.89×10^{-3}	FALSE
858	7782-50-5	Chlorine	1.86×10^{5}	2.58×10^{-2}	1.50×10^{1}	1.77×10^{-2}	TRUE
858	7782-41-4	Fluorine (5%) in argon	3.19×10^{3}	4.43×10^{-4}	2.00	2.36×10^{-3}	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	2.58×10^{4}	3.58×10^{-3}	6.70×10^{1}	7.91×10^{-2}	FALSE
858	7783-54-2	Nitrogen trifluoride	9.37×10^{3}	1.30×10^{-3}	2.90×10^{2}	3.42×10^{-1}	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	3.15×10^{3}	4.37×10^{-4}	1.50×10^{3}	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	7.54×10^{4}	1.05×10^{-2}	7.90×10^{3}	9.33	FALSE
878	1336-21-6	Ammonium hydroxide	2.35×10^{6}	3.26×10^{-1}	1.4×10^{2}	1.65×10^{-1}	TRUE
878	7697-37-2	Nitric acid	1.27×10^{5}	1.76×10^{-2}	5.00×10^{1}	5.90×10^{-2}	FALSE
893	7664-41-7	Ammonia[a]	2.72×10^{4}	3.78×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
893	7784-42-1	Arsine[a]	1.11×10^{5}	1.54×10^{-2}	1.60	1.89×10^{-3}	TRUE
893	7783-07-5	Hydrogen selenide[a]	9.54×10^{4}	1.33×10^{-2}	1.60	1.89×10^{-3}	TRUE
893	7803-51-2	Phosphine (100%)[a]	4.54×10^{3}	6.30×10^{-4}	1.40	1.65×10^{-3}	FALSE
893	7803-62-5	Silane (silicon tetrafluoride)[a]	2.06×10^{3}	2.86×10^{-4}	6.60×10^{1}	7.79×10^{-3}	FALSE
893	7446-09-5	Sulfur dioxide[a]	3.02×10^{2}	4.19×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE

MESA: Microsystems and Engineering Sciences Applications

[a] If the MESA Complex configuration is implemented, Building 893 would cease operations (after 2003) and the chemicals listed would no longer contribute chemical emissions under the Expanded Operations Alternative. If implemented, MESA Complex configuration operations are not expected to contribute additional chemical emissions.

Table D.1–19. Additional Chemical List, Reduced Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSION RATE g/sec	OEL/100 $\mu g/m^3$	TEV g/sec	RESULT
858	7664-41-7	Ammonia	9.12×10^{3}	1.27×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
858	7784-42-1	Arsine (15%)	1.04×10^{3}	1.44×10^{-4}	1.60	1.89×10^{-3}	FALSE
858	7782-50-5	Chlorine	6.63×10^{4}	9.21×10^{-3}	1.50×10^{1}	1.77×10^{-2}	FALSE
858	7782-41-4	Fluorine (5%) in argon	1.14×10^{3}	1.58×10^{-4}	2.00	2.36×10^{-3}	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	9.21×10^{3}	1.28×10^{-3}	6.70×10^{1}	7.91×10^{-2}	FALSE
858	7783-54-2	Nitrogen trifluoride	3.35×10^{3}	4.65×10^{-4}	2.90×10^{2}	3.42×10^{-1}	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	1.12×10^{3}	1.56×10^{-4}	1.50×10^{3}	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	2.70×10^{4}	3.74×10^{-3}	7.90×10^{3}	9.33	FALSE
878	1336-21-6	Ammonium hydroxide	1.17×10^{6}	1.63×10^{-1}	1.4×10^{2}	1.65×10^{-1}	FALSE
878	7697-37-2	Nitric acid	6.33×10^{4}	8.79×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
893	7664-41-7	Ammonia	1.36×10^{4}	1.89×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
893	7784-42-1	Arsine	5.54×10^{4}	7.69×10^{-3}	1.60	1.89×10^{-3}	TRUE
893	7783-07-5	Hydrogen selenide	4.77×10^{4}	6.63×10^{-3}	1.60	1.89×10^{-3}	TRUE
893	7803-51-2	Phosphine (100%)	2.27×10^{3}	3.15×10^{-4}	1.40	1.65×10^{-3}	FALSE
893	7803-62-5	Silane (silicon tetrafluoride)	1.03×10^{3}	1.43×10^{-4}	6.60×10^{1}	7.79×10^{-3}	FALSE
893	7446-09-5	Sulfur dioxide	1.51×10^{2}	2.10×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE

Table D.1–20. No Action Alternative Noncarcinogenic Chemical Emissions Exceeding the Threshold Emission Value

BUILDING NUMBER	CAS NUMBER	CHEMICALS EXCEEDING SCREENING LEVELS	EMISSIONS		ER (g/sec)	OEL/100 mg/m³	TEV (g/sec)	RESULT
			g/yr	EF				
858	7782-50-5	Chlorine	1.73×10^{5}	0.00	0.00	1.50×10^{1}	1.77×10^{-2}	FALSE
858	7722-84-1	Hydrogen peroxide (concentration > 52%)	3.10×10^{6}	3.00×10^{-4}	1.29×10^{-4}	1.40×10^{1}	1.65×10^{-2}	FALSE
858	7697-37-2	Nitric acid	3.99×10^{6}	3.00×10^{-4}	1.66×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
858	1310-73-2	Sodium hydroxide	6.12×10^{7}	0.00	0.00	2.00×10^{1}	2.36×10^{-2}	FALSE
870	101-77-9	4,4'-Methylene dianiline (37%)	1.68×10^{5}	2.40×10^{-3}	5.59×10^{-5}	8.10	9.56×10^{-3}	FALSE
870	1333-82-0	Chromium Trioxide	8.98×10^{3}	2.00×10^{-1}	2.49×10^{-4}	1.00×10^{-2}	1.18×10^{-5}	TRUE
870	7440-48-4	Cobalt (17.4%)	1.04×10^{4}	1.00×10^{-2}	1.45×10^{-5}	2.00×10^{-1}	2.36×10^{-4}	FALSE
870	111-42-2	Diethanolamine (85%)	3.05×10^{5}	2.40×10^{-3}	1.02×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	7429-90-5	Aluminum	6.65×10^{5}	1.00×10^{-2}	9.23×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
870	7440-50-8	Copper	6.65×10^{5}	1.00×10^{-2}	9.23×10^{-4}	1.00	1.18×10^{-3}	FALSE
870	7718-54-9	Nickel Chloride	7.98×10^{5}	1.79×10^{-6}	1.98×10^{-7}	1.50×10^{-1}	1.77×10^{-4}	FALSE
870	7786-81-4	Nickel Sulfate	7.98×10^{5}	1.79×10^{-6}	1.98×10^{-7}	1.50×10^{-1}	1.77×10^{-4}	FALSE
870	7664-38-2	Phosphoric Acid	1.10×10^{5}	1.00×10^{-2}	1.53×10^{-3}	4.00×10^{1}	1.18×10^{-2}	FALSE
870	7631-86-9	Silica	9.04×10^{5}	2.50×10^{-1}	3.14×10^{-2}	6.00×10^{1}	4.72×10^{-2}	FALSE
870	7664-93-9	Sulfuric Acid	1.10×10^{5}	1.00×10^{-2}	1.53×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	2.50×10^{6}	0.00	0.00	1.00×10^{2}	5.90×10^{-2}	FALSE
878	1336-21-6	Ammonium Hydroxide	1.76×10^{6}	2.00×10^{-1}	4.89×10^{-2}	1.40×10^{2}	1.65×10^{-1}	FALSE
878	7440-48-4	Cobalt	3.03×10^{4}	0.01	4.21×10^{-5}	2.00×10^{-1}	2.36×10^{-4}	FALSE
878	7440-50-8	Copper dusts and mists, as copper	1.14×10^{5}	0.26	4.12×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE

Table D.1–20. No Action Alternative Noncarcinogenic Chemical Emissions Exceeding the Threshold Emission Value (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICALS EXCEEDING SCREENING LEVELS	EMISSIONS		ER (g/sec)	OEL/100 mg/m^3	TEV (g/sec)	RESULT
			g/yr	EF				
878	7440-74-6	Indium & compounds as indium	1.32×10^{4}	0.01	1.83×10^{-5}	1.00	1.18×10^{-3}	FALSE
878	7439-92-1	Lead	7.97×10^{3}	0.00	0.00	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	7439-97-6	Mercury	4.08×10^{4}	0.00	0.00	2.50×10^{-1}	2.95×10^{-4}	FALSE
878	14808-60-7	Quartz	6.03×10^{3}	0.00	0.00	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	7631-86-9	Silica, fused (respirable)	9.68×10^{3}	0.00	0.00	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	7440-22-4	Silver metal	2.10×10^{4}	0.00	0.00	1.00×10^{-1}	1.18×10^{-4}	FALSE
878	584-84-9	Toluene-2,4-diisocyanate	4.33×10^{3}	0.03	1.80×10^{-5}	3.60×10^{-1}	4.25×10^{-4}	FALSE
878	7440-62-2	Vanadium (fume or dust)	3.27×10^{4}	0.00	0.00	5.00×10^{-1}	5.90×10^{-4}	FALSE
893	7784-42-1	Arsine	1.11×10^{5}	0.00	0.00	1.60	1.89×10^{-3}	FALSE
893	7783-07-5	Hydrogen selenide	9.54×10^{4}	1.50×10^{-2}	1.99×10^{-4}	1.60	1.89×10^{-3}	FALSE
981	7664-93-9	Sulfuric acid	1.41×10^{5}	0.033	6.45×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE

Sources: SNL/NM 1998c, cc

Table D.1–21. Expanded Operations Alternative Noncarcinogenic Chemical Emissions Exceeding the TEV

BUILDING SOURCE	CAS NUMBER	CHEMICALS EXCEEDING SCREENING LEVELS	EMISSIONS		ER (g/sec)	OEL/100 mg/m^3	TEV (g/sec)	RESULTS
			g/yr	EF				
858	7782-50-5	Chlorine	$1.86x10^5$	0.00	0.00	$1.50x10^1$	$1.77x10^{-2}$	FALSE
858	7722-84-1	Hydrogen peroxide (concentration > 52%)	$3.33x10^6$	$3.00x10^{-4}$	$1.39x10^{-4}$	$1.40x10^1$	$1.65x10^{-2}$	FALSE
858	7697-37-2	Nitric acid	$4.27x10^6$	$3.00x10^{-4}$	$1.78x10^{-4}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
858	1310-73-2	Sodium hydroxide	$6.56x10^7$	0.00	0.00	$2.00x10^1$	$2.36x10^{-2}$	FALSE
870	101-77-9	4,4'-Methylene dianiline (37%)	$1.68x10^5$	$2.40x10^{-3}$	$5.59x10^{-5}$	8.10	$9.56x10^{-3}$	FALSE
870	1333-82-0	Chromium Trioxide	$8.98x10^3$	$2.00x10^{-1}$	$2.49x10^{-4}$	$1.00x10^{-2}$	$1.18x10^{-5}$	TRUE
870	7440-48-4	Cobalt (17.4%)	$1.04x10^4$	$1.00x10^{-2}$	$1.45x10^{-5}$	$2.00x10^{-1}$	$2.36x10^{-4}$	FALSE
870	111-42-2	Diethanolamine (85%)	$3.05x10^5$	$2.40x10^{-3}$	$1.02x10^{-4}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
870	7429-90-5	Aluminum	$6.65x10^5$	$1.00x10^{-2}$	$9.23x10^{-4}$	$5.00x10^1$	$5.90x10^{-2}$	FALSE
870	7440-50-8	Copper	$6.65x10^5$	$1.00x10^{-2}$	$9.23x10^{-4}$	1.00	$1.18x10^{-3}$	FALSE
870	7718-54-9	Nickel Chloride	$7.98x10^5$	$1.79x10^{-6}$	$1.98x10^{-7}$	$1.50x10^{-1}$	$1.77x10^{-4}$	FALSE
870	7786-81-4	Nickel Sulfate	$7.98x10^5$	$1.79x10^{-6}$	$1.98x10^{-7}$	$1.50x10^{-1}$	$1.77x10^{-4}$	FALSE
870	7664-38-2	Phosphoric Acid	$1.10x10^5$	$1.00x10^{-2}$	$1.53x10^{-3}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
870	7631-86-9	Silica	$9.04x10^5$	$2.50x10^{-1}$	$3.14x10^{-2}$	$4.00x10^1$	$4.72x10^{-2}$	FALSE
870	7664-93-9	Sulfuric Acid	$1.10x10^5$	$1.00x10^{-2}$	$1.53x10^{-3}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	$3.33x10^6$	0.00	0.00	$5.00x10^1$	$5.90x10^{-2}$	FALSE
878	1336-21-6	Ammonium hydroxide	$2.35x10^6$	0.20	$6.52x10^{-2}$	$1.40x10^2$	$1.65x10^{-1}$	FALSE
878	7440-48-4	Cobalt	$4.04x10^4$	0.01	$5.61x10^{-5}$	$2.00x10^{-1}$	$2.36x10^{-4}$	FALSE
878	7440-50-8	Copper dusts and mists, as copper	$1.52x10^5$	0.26	$5.49x10^{-3}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE

Table D.1–21. Expanded Operations Alternative Noncarcinogenic Chemical Emissions Exceeding the TEV (concluded)

BUILDING SOURCE	CAS NUMBER	CHEMICALS EXCEEDING SCREENING LEVELS	EMISSIONS		ER (g/sec)	OEL/100 mg/m^3	TEV (g/sec)	RESULTS
			g/yr	EF				
878	7440-74-6	Indium & compounds as indium	$1.76x10^4$	0.01	$2.44x10^{-5}$	1.00	$1.18x10^{-3}$	FALSE
878	7439-92-1	Lead	$1.06x10^4$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	7439-96-5	Manganese	$2.12x10^4$	0.00	0.00	2.00	$2.36x10^{-3}$	FALSE
878	7439-97-6	Mercury	$5.44x10^4$	0.00	0.00	$2.50x10^{-1}$	$2.95x10^{-4}$	FALSE
878	14808-60-7	Quartz	$8.05x10^3$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	7631-86-9	Silica, fused (respirable)	$1.29x10^4$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	7440-22-4	Silver metal	$2.80x10^4$	0.00	0.00	$1.00x10^{-1}$	$1.18x10^{-4}$	FALSE
878	584-84-9	Toluene-2,4-diisocyanate	$5.77x10^3$	0.03	$2.40x10^{-5}$	$3.60x10^{-1}$	$4.25x10^{-4}$	FALSE
878	7440-62-2	Vanadium (fume or dust)	$4.36x10^4$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
893	7784-42-1	Arsine[a]	$1.11x10^5$	0.00	0.00	1.60	$1.89x10^{-3}$	FALSE
893	7783-07-5	Hydrogen selenide[a]	$9.54x10^4$	$1.50x10^{-2}$	$1.99x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
893	7664-93-9	Sulfuric acid[a]	$1.41x10^5$	0.033	$6.46x10^{-4}$	$1.00x10^1$	$1.18x10^{-2}$	FALSE
MESA	7664-41-7	Ammonia anhydrous[b]	$1.92x10^6$	$3.00x10^{-2}$	$8.00x10^{-3}$	$1.40x10^2$	$1.97x10^{-1}$	FALSE
MESA	7784-42-1	Arsine[b]	$1.34x10^5$	0.00	0.00	1.60	$2.26x10^{-3}$	FALSE
MESA	7803-51-2	Phosphine[b]	$5.12x10^4$	$2.00x10^{-1}$	$1.42x10^{-3}$	1.40	$1.97x10^{-3}$	FALSE
MESA	7664-93-9	Sulfuric acid[b]	$1.56x10^5$	$2.00x10^{-2}$	$4.33x10^{-4}$	$1.00x10^1$	$1.41x10^{-2}$	FALSE
981	7664-93-9	Sulfuric acid	$3.61x10^5$	0.00	0.00	$1.00x10^1$	$1.18x10^{-2}$	FALSE

Sources: SNL/NM 1998c, cc

MESA: Microsystems and Engineering Sciences Applications

[a] If the MESA Complex configuration is implemented, Building 893 would cease operations (after 2003) and the chemicals listed would no longer contribute noncarcinogenic chemical emissions under the Expanded Operations Alternative.

[b] If Building 893 is not replaced by the MESA Complex configuration, the chemicals listed would not contribute to noncarcinogenic chemical emissions under the Expanded Operations Alternative.

Table D.1–22. Reduced Operations Alternative Noncarcinogenic Chemical Emissions Exceeding the TEV

BUILDING NUMBER	CAS NUMBER	CHEMICALS EXCEEDING SCREENING LEVELS	EMISSIONS g/yr	EMISSIONS EF	ER (g/sec)	OEL/100 μg/m³	TEV (g/sec)	RESULT
858	7722-84-1	Hydrogen peroxide (concentration > 52%)	1.19×10^{6}	3.00×10^{-4}	4.95×10^{-5}	1.40×10^{1}	1.65×10^{-2}	FALSE
858	7697-37-2	Nitric acid	1.53×10^{6}	3.00×10^{-4}	6.36×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
858	1310-73-2	Sodium hydroxide	2.34×10^{7}	0.00	0.00	2.00×10^{1}	2.36×10^{-2}	FALSE
870	101-77-9	4,4'-Methylene dianiline (37%)	1.68×10^{5}	2.4×10^{-3}	5.59×10^{-5}	8.10	9.56×10^{-3}	FALSE
870	1333-82-0	Chromium Trioxide	8.98×10^{3}	2.00×10^{-1}	2.49×10^{-4}	1.00×10^{-2}	1.18×10^{-5}	TRUE
870	7440-48-4	Cobalt (17.4%)	1.04×10^{4}	1.00×10^{-2}	1.45×10^{-5}	2.00×10^{-1}	2.36×10^{-4}	FALSE
870	111-42-2	Diethanolamine (85%)	3.05×10^{5}	2.4×10^{-3}	1.02×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
870	7429-90-5	Aluminum	6.65×10^{5}	1.00×10^{-2}	9.23×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
870	7440-50-8	Copper	6.65×10^{5}	1.00×10^{-2}	9.23×10^{-4}	1.00	1.18×10^{-3}	FALSE
870	7718-54-9	Nickel Chloride	7.98×10^{5}	1.79×10^{-6}	1.98×10^{-7}	1.50×10^{-1}	1.77×10^{-4}	FALSE
870	7786-81-4	Nickel Sulfate	7.98×10^{5}	1.79×10^{-6}	1.98×10^{-7}	1.50×10^{-1}	1.77×10^{-4}	FALSE
870	7664-38-2	Phosphoric Acid	1.10×10^{5}	1.00×10^{-2}	1.53×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
870	7631-86-9	Silica	9.04×10^{5}	2.50×10^{-1}	3.14×10^{-2}	4.00×10^{1}	4.72×10^{-2}	FALSE
870	7664-93-9	Sulfuric Acid	1.10×10^{5}	1.00×10^{-2}	1.53×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	1.67×10^{6}	0.00	0.00	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7440-48-4	Cobalt	2.02×10^{4}	0.01	2.80×10^{-5}	2.00×10^{-1}	2.36×10^{-4}	FALSE
878	7440-74-6	Indium & compounds as In	8.80×10^{3}	1.00×10^{-2}	1.22×10^{-5}	1.00	1.18×10^{-3}	FALSE
878	7439-92-1	Lead	5.32×10^{3}	0.00	0.00	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	7439-97-6	Mercury	2.72×10^{4}	0.00	0.00	2.50×10^{-1}	2.95×10^{-4}	FALSE
878	7631-86-9	Silica, fused (respirable)	6.46×10^{3}	0.00	0.00	5.00×10^{-1}	5.90×10^{-4}	FALSE
878	7440-22-4	Silver metal	1.40×10^{4}	0.00	0.00	1.00×10^{-1}	1.18×10^{-4}	FALSE

Table D.1–22. Reduced Operations Alternative Noncarcinogenic Chemical Emissions Exceeding the TEV (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICALS EXCEEDING SCREENING LEVELS	EMISSIONS		ER (g/sec)	OEL/100 $\mu g/m^3$	TEV (g/sec)	RESULT
			g/yr	EF				
878	7440-62-2	Vanadium (fume or dust)	$2.18x10^{4}$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
893	7784-42-1	Arsine	$5.54x10^{4}$	0.00	0.00	1.60	$1.89x10^{-3}$	FALSE
893	7783-07-5	Hydrogen selenide	$4.77x10^{4}$	$1.50x10^{-2}$	$9.94x10^{-5}$	1.60	$1.89x10^{-3}$	FALSE

Sources: SNL/NM 1998c, cc

D.1.3.2 Carcinogenic Chemical Screening

The 15 chemicals identified as carcinogenic chemicals are screened according to the following criteria:

For each chemical, a concentration is calculated representing a cancer risk of 1.0×10^{-8} for an exposed individual. This cancer risk represents an incremental cancer risk of one-in-one-million (1.0×10^{-6}) (that is, one person in a million would develop cancer if exposed to this concentration over a lifetime), a level of concern established in the *Clean Air Act* (42 U.S.C. §7401). For the purposes of screening, the one-in-one-million cancer risk, is divided by 100 as a conservative safety factor, thereby establishing 1.0×10^{-8} as the cancer risk screening level.

The calculated concentration representing a cancer risk of 1.0×10^{-8} for an exposed individual at the maximum offsite and special receptor location is divided by the annual average concentration obtained from modeling a 1 gram per second emission rate from the prototypical stack. The annual average concentration is used since the 1.0×10^{-8} risk level represents a long-term exposure risk to an individual. The result is the TEV, an emission rate which results in a concentration with a cancer risk of 1.0×10^{-8}. The TEV is compared to the hypothetical emission rate that is calculated by dividing the purchased quantity by 2,000 hours per year (50 work weeks times 40 hours). Tables D.1–23 through D.1–26 present the results of the carcinogenic chemical screening process comparing the hypothetical emission rate to the TEV representing an emission rate with a 1.0×10^{-8} risk. The tables present 1996 purchases, and No Action Alternative, Expanded Operations Alternative, and Reduced Operations Alternative results, respectively. The word TRUE in the results column indicates that the hypothetical emission rate exceeds the TEV.

Table D.1–23. 1996 Annual Purchases of Carcinogenic Chemicals Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS g/yr	EMISSIONS g/sec	10^{-8} RISK LEVEL $\mu g/m^3$	TEV g/sec	RESULT
6580	67-66-3	Chloroform (Trichloromethane)	5.91×10^{3}	8.21×10^{-4}	4.35×10^{-4}	1.24×10^{-5}	TRUE
870	71-43-2	Benzene	2.36×10^{4}	3.28×10^{-3}	1.20×10^{-3}	3.41×10^{-5}	TRUE
870	75-09-2	Dichloromethane (Methylene chloride)	6.67×10^{4}	9.26×10^{-3}	2.13×10^{-2}	6.05×10^{-4}	TRUE
870	7440-02-0	Nickel (28%)	5.44×10^{3}	7.56×10^{-4}	2.06×10^{-5}	5.85×10^{-7}	TRUE
878	123-91-1	1,4-Dioxane[a]	2.38×10^{3}	3.30×10^{-4}	NA	NA	NA
878	107-13-1	Acrylonitrile	1.00×10^{-1}	1.39×10^{-8}	1.47×10^{-4}	4.18×10^{-6}	FALSE
878	71-43-2	Benzene	8.71×10^{1}	1.21×10^{-5}	1.20×10^{-3}	3.41×10^{-5}	FALSE
878	7440-43-9	Cadmium	4.79×10^{2}	6.65×10^{-5}	5.56×10^{-6}	1.58×10^{-7}	TRUE
878	75-09-2	Dichloromethane (Methylene chloride)	9.82×10^{4}	1.36×10^{-2}	2.13×10^{-2}	6.05×10^{-4}	TRUE
878	106-89-8	Epichlorohydrin	2.23×10^{2}	3.10×10^{-5}	8.33×10^{-3}	2.37×10^{-4}	FALSE
878	50-00-0	Formaldehyde	1.87×10^{4}	2.60×10^{-3}	7.41×10^{-4}	2.11×10^{-5}	TRUE
878	7440-02-0	Nickel	1.62×10^{4}	2.26×10^{-3}	2.06×10^{-5}	5.85×10^{-7}	TRUE
878	79-01-6	Trichloroethylene	7.49×10^{5}	1.04×10^{-1}	5.83×10^{-3}	1.66×10^{-4}	TRUE
893	107-06-2	1,2-Dichloroethane (Ethylene dichloride)	6.27×10^{2}	8.72×10^{-5}	3.77×10^{-4}	1.07×10^{-5}	TRUE
897	764-41-0	1,4-Dichloro-2-butene	4.90×10^{1}	6.81×10^{-6}	3.76×10^{-6}	1.07×10^{-7}	TRUE
897	123-91-1	1,4-Dioxane[a]	5.25×10^{1}	7.29×10^{-6}	NA	NA	NA
897	107-13-1	Acrylonitrile	7.98×10^{1}	1.11×10^{-5}	1.47×10^{-4}	4.18×10^{-6}	TRUE
897	71-43-2	Benzene	1.08×10^{2}	1.50×10^{-5}	1.20×10^{-3}	3.41×10^{-5}	FALSE
897	75-25-2	Bromoform (Tribromomethane)	4.95×10^{1}	6.87×10^{-6}	9.09×10^{-3}	2.58×10^{-4}	FALSE
897	67-66-3	Chloroform (Trichloromethane)	1.48×10^{4}	2.05×10^{-3}	4.35×10^{-4}	1.24×10^{-5}	TRUE
897	75-09-2	Dichloromethane (Methylene chloride)	4.25×10^{4}	5.90×10^{-3}	2.13×10^{-2}	6.05×10^{-4}	TRUE

Table D.1–23. 1996 Annual Purchases of Carcinogenic Chemicals Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS		10^{-8} RISK LEVEL µg/m³	TEV g/sec	RESULT
			g/yr	g/sec			
897	75-56-9	Propylene oxide (1,2-Epoxypropane)	1.50	2.08×10^{-7}	2.70×10^{-3}	7.67×10^{-5}	FALSE
897	79-01-6	Trichloroethylene	2.94×10^{4}	4.08×10^{-3}	5.83×10^{-3}	1.66×10^{-4}	TRUE
905	75-09-2	Dichloromethane (Methylene chloride)	1.99×10^{4}	2.76×10^{-3}	2.13×10^{-2}	6.05×10^{-4}	TRUE

[a] NA: 10^{-8} risk level screening value not available; carcinogenic chemical screening performed using unit risk factors for inhalation risk. This chemical does not have inhalation toxicity information available. It is listed as an ingestion carcinogen.

Table D.1–24. Projected Carcinogenic Chemical Emissions No Action Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS			10^{-8} RISK LEVEL μg/m^3	TEV g/sec	RESULT
			g/yr	EF	g/sec			
6580	67-66-3	Chloroform (Trichloromethane)	1.18×10^{4}	0.10	1.64×10^{-4}	4.35×10^{-4}	1.24×10^{-5}	TRUE
870	71-43-2	Benzene	7.98×10^{4}	0	0	1.20×10^{-3}	3.41×10^{-5}	FALSE
870	75-09-2	Dichloromethane (Methylene chloride)	2.01×10^{5}	0.37	1.03×10^{-2}	2.13×10^{-2}	6.05×10^{-4}	TRUE
870	7440-02-0	Nickel (28%)	1.68×10^{4}	0	0	2.06×10^{-5}	5.85×10^{-7}	FALSE
878	123-91-1	1,4-Dioxane[a]	3.56×10^{3}	1.00	4.95×10^{-4}	NA	NA	NA
878	107-13-1	Acrylonitrile	1.50×10^{-1}	1.00	2.08×10^{-8}	1.47×10^{-4}	4.18×10^{-6}	FALSE
878	71-43-2	Benzene	1.31×10^{2}	0.11	2.00×10^{-6}	1.20×10^{-3}	3.41×10^{-5}	FALSE
878	7440-43-9	Cadmium	7.18×10^{2}	0	0	5.56×10^{-6}	1.58×10^{-7}	FALSE
878	75-09-2	Dichloromethane (Methylene chloride)	1.47×10^{5}	0.03	6.14×10^{-4}	2.13×10^{-2}	6.05×10^{-4}	TRUE
878	106-89-8	Epichlorohydrin	3.35×10^{2}	1.00	4.66×10^{-5}	8.33×10^{-3}	2.37×10^{-4}	FALSE
878	50-00-0	Formaldehyde	2.81×10^{4}	0.01	3.90×10^{-5}	7.41×10^{-4}	2.11×10^{-5}	TRUE
878	7440-02-0	Nickel	2.44×10^{4}	0	0	2.06×10^{-5}	5.85×10^{-7}	FALSE
878	79-01-6	Trichloroethylene	1.12×10^{6}	0.02	3.12×10^{-3}	5.83×10^{-3}	1.66×10^{-4}	TRUE
893	107-06-2	1,2-Dichloroethane (Ethylene dichloride)	6.27×10^{2}	1.00	8.72×10^{-5}	3.77×10^{-4}	1.07×10^{-5}	TRUE
897	764-41-0	1,4-Dichloro-2-butene	4.90×10^{1}	1.00	6.81×10^{-6}	3.76×10^{-6}	1.07×10^{-7}	TRUE
897	123-91-1	1,4-Dioxane[a]	5.25×10^{1}	1.00	7.29×10^{-6}	NA	NA	NA
897	107-13-1	Acrylonitrile	7.98×10^{1}	1.00	1.11×10^{-5}	1.47×10^{-4}	4.18×10^{-6}	TRUE
897	71-43-2	Benzene	1.08×10^{2}	0.11	1.65×10^{-6}	1.20×10^{-3}	3.41×10^{-5}	FALSE
897	75-25-2	Bromoform (Tribromomethane)	4.95×10^{1}	1.00	6.87×10^{-6}	9.09×10^{-3}	2.58×10^{-4}	FALSE
897	67-66-3	Chloroform (Trichloromethane)	1.48×10^{4}	0.10	2.05×10^{-4}	4.35×10^{-4}	1.24×10^{-5}	TRUE
897	75-09-2	Dichloromethane (Methylene chloride)	4.25×10^{4}	0.05	2.95×10^{-4}	2.13×10^{-2}	6.05×10^{-4}	FALSE
897	75-56-9	Propylene oxide (1,2-Epoxypropane)	1.50	1.00	2.08×10^{-7}	2.70×10^{-3}	7.67×10^{-5}	FALSE

Table D.1–24. Projected Carcinogenic Chemical Emissions No Action Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS			10^{-8} RISK LEVEL µg/m³	TEV g/sec	RESULT
			g/yr	EF	g/sec			
897	79-01-6	Trichloroethylene	2.94×10^{4}	0.07	2.86×10^{-4}	5.83×10^{-3}	1.66×10^{-4}	TRUE
905	75-09-2	Dichloromethane (Methylene chloride)	3.98×10^{4}	0.02	1.11×10^{-4}	2.13×10^{-2}	6.05×10^{-4}	FALSE

[a] NA: 10^{-8} risk level screening value not available; carcinogenic chemical screening performed using unit risk factors for inhalation risk. This chemical does not have inhalation toxicity information available. It is listed as an ingestion carcinogen.

Table D.1–25. Projected Carcinogenic Chemical Emissions Expanded Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS		EMISSION RATE	10^{-8} RISK LEVEL	TEV g/sec	RESULT
			g/yr	EF	g/sec	µg/m^3		
6580	67-66-3	Chloroform (Trichloromethane)	8.87×10^{3}	1.00×10^{-1}	1.23×10^{-4}	4.35×10^{-4}	1.24×10^{-5}	TRUE
870	71-43-2	Benzene	7.98×10^{4}	0.00	0.00	1.20×10^{-3}	3.41×10^{-5}	FALSE
870	75-09-2	Dichloromethane (Methylene chloride)	2.01×10^{5}	3.70×10^{-1}	1.03×10^{-2}	2.13×10^{-2}	6.05×10^{-4}	TRUE
870	7440-02-0	Nickel (28%)	1.68×10^{4}	0.00	0.00	2.06×10^{-5}	5.85×10^{-7}	FALSE
878	123-91-1	1,4-Dioxane[a]	4.75×10^{3}	1.00	6.60×10^{-4}	NA	NA	NA
878	107-13-1	Acrylonitrile	2.00×10^{-1}	1.00	2.78×10^{-8}	1.47×10^{-4}	4.18×10^{-6}	FALSE
878	71-43-2	Benzene	1.74×10^{2}	1.10×10^{-1}	2.66×10^{-6}	1.20×10^{-3}	3.41×10^{-5}	FALSE
878	7440-43-9	Cadmium	9.57×10^{2}	0.00	0.00	5.56×10^{-6}	1.58×10^{-7}	FALSE
878	75-09-2	Dichloromethane (Methylene chloride)	1.96×10^{5}	3.00×10^{-2}	8.19×10^{-4}	2.13×10^{-2}	6.05×10^{-4}	TRUE
878	106-89-8	Epichlorohydrin	4.47×10^{2}	1.00	6.21×10^{-5}	8.33×10^{-3}	2.37×10^{-4}	FALSE
878	50-00-0	Formaldehyde	3.74×10^{4}	1.00×10^{-2}	5.19×10^{-5}	7.41×10^{-4}	2.11×10^{-5}	TRUE
878	7440-02-0	Nickel	3.25×10^{4}	0.00	0.00	2.06×10^{-5}	5.85×10^{-7}	FALSE
878	79-01-6	Trichloroethylene	1.50×10^{6}	2.00×10^{-2}	4.16×10^{-3}	5.83×10^{-3}	1.66×10^{-4}	TRUE
893	107-06-2	1,2-Dichloroethane (Ethylene dichloride)[a]	1.25×10^{3}	1.00	1.74×10^{-4}	3.77×10^{-4}	1.07×10^{-5}	TRUE
MESA	71-43-2	Benzene[b]	3.32	1.00	4.61×10^{-7}	1.20×10^{-3}	3.69×10^{-5}	TRUE
897	764-41-0	1,4-Dichloro-2-butene	4.90×10^{1}	1.00	6.81×10^{-6}	3.76×10^{-6}	1.07×10^{-7}	TRUE
897	123-91-1	1,4-Dioxane[a]	5.25×10^{1}	1.00	7.29×10^{-6}	NA	NA	NA
897	107-13-1	Acrylonitrile	7.98×10^{1}	1.00	1.11×10^{-5}	1.47×10^{-4}	4.18×10^{-6}	TRUE
897	71-43-2	Benzene	1.08×10^{2}	1.10×10^{-1}	1.65×10^{-6}	1.20×10^{-3}	3.41×10^{-5}	FALSE
897	75-25-2	Bromoform (Tribromomethane)	4.95×10^{1}	1.00	6.87×10^{-6}	9.09×10^{-3}	2.58×10^{-4}	FALSE
897	67-66-3	Chloroform (Trichloromethane)	1.48×10^{4}	1.00×10^{-1}	2.05×10^{-4}	4.35×10^{-4}	1.24×10^{-5}	TRUE

Table D.1–25. Projected Carcinogenic Chemical Emissions Expanded Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS		EMISSION RATE	10^{-8} RISK LEVEL	TEV g/sec	RESULT
			g/yr	EF	g/sec	µg/m^3		
897	75-09-2	Dichloromethane (Methylene chloride)	4.25×10^{4}	5.00×10^{-2}	2.95×10^{-4}	2.13×10^{-2}	6.05×10^{-4}	FALSE
897	75-56-9	Propylene oxide (1,2-Epoxypropane)	1.50	1.00	2.08×10^{-7}	2.70×10^{-3}	7.67×10^{-5}	FALSE
897	79-01-6	Trichloroethylene	2.94×10^{4}	7.00×10^{-2}	2.86×10^{-4}	5.83×10^{-3}	1.66×10^{-4}	TRUE
905	75-09-2	Dichloromethane (Methylene chloride)	3.98×10^{4}	2.00×10^{-2}	1.11×10^{-4}	2.13×10^{-2}	6.05×10^{-4}	FALSE

MESA: Microsystems and Engineering Sciences Applications
[a] NA: 10^{-8} risk level screening value not available; carcinogenic chemical screening performed using unit risk factors for inhalation risk. This chemical does not have inhalation toxicity information available. It is listed as an ingestion carcinogen.
[b] If the MESA Complex configuration is implemented, Building 893 would cease operations (after 2003) and the chemicals listed would no longer contribute carcinogenic chemical emissions under the Expanded Operations Alternative.
[c] If Building 893 is not replaced by the MESA Complex configuration, the chemical listed would not contribute to carcinogenic chemical emissions under the Expanded Operations Alternative.

Table D.1–26. Projected Carcinogenic Chemical Emissions Reduced Operations Alternative Screening Level Analysis

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS			10^{-6} RISK LEVEL µg/m³	TEV g/sec	RESULT
			g/yr	EF	g/sec			
6580	67-66-3	Chloroform (Trichloromethane)	$1.48x10^{3}$	$1.00x10^{-1}$	$2.05x10^{-5}$	$4.35x10^{-4}$	$1.24x10^{-5}$	TRUE
870	71-43-2	Benzene	$7.98x10^{4}$	0.00	0.00	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
870	75-09-2	Dichloromethane (Methylene chloride)	$2.01x10^{5}$	$3.70x10^{-1}$	$1.03x10^{-2}$	$2.13x10^{-2}$	$6.05x10^{-4}$	TRUE
870	7440-02-0	Nickel (28%)	$1.68x10^{4}$	0.00	0.00	$2.06x10^{-5}$	$5.85x10^{-7}$	FALSE
878	123-91-1	1,4-Dioxane[a]	$2.38x10^{3}$	1.00	$3.30x10^{-4}$	NA	NA	NA
878	107-13-1	Acrylonitrile	$1.00x10^{-1}$	1.00	$1.39x10^{-8}$	$1.47x10^{-4}$	$4.18x10^{-6}$	FALSE
878	71-43-2	Benzene	$8.71x10^{1}$	$1.10x10^{-1}$	$1.33x10^{-6}$	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
878	7440-43-9	Cadmium	$4.79x10^{2}$	0.00	0.00	$5.56x10^{-6}$	$1.58x10^{-7}$	FALSE
878	75-09-2	Dichloromethane (Methylene chloride)	$9.82x10^{4}$	$3.00x10^{-2}$	$4.09x10^{-4}$	$2.13x10^{-2}$	$6.05x10^{-4}$	FALSE
878	106-89-8	Epichlorohydrin	$2.23x10^{2}$	1.00	$3.10x10^{-5}$	$8.33x10^{-3}$	$2.37x10^{-4}$	FALSE
878	50-00-0	Formaldehyde	$1.87x10^{4}$	$1.00x10^{-2}$	$2.60x10^{-5}$	$7.41x10^{-4}$	$2.11x10^{-5}$	TRUE
878	7440-02-0	Nickel	$1.62x10^{4}$	0.00	0.00	$2.06x10^{-5}$	$5.85x10^{-7}$	FALSE
878	79-01-6	Trichloroethylene	$7.49x10^{5}$	$2.00x10^{-2}$	$2.08x10^{-3}$	$5.83x10^{-3}$	$1.66x10^{-4}$	TRUE
893	107-06-2	1,2-Dichloroethane (Ethylene dichloride)	$6.27x10^{2}$	1.00	$8.72x10^{-5}$	$3.77x10^{-4}$	$1.07x10^{-5}$	TRUE
897	764-41-0	1,4-Dichloro-2-butene	$4.51x10^{1}$	1.00	$6.26x10^{-6}$	$3.76x10^{-6}$	$1.07x10^{-7}$	TRUE
897	123-91-1	1,4-Dioxane[a]	$4.83x10^{1}$	1.00	$6.71x10^{-6}$	NA	NA	NA
897	107-13-1	Acrylonitrile	$7.34x10^{1}$	1.00	$1.02x10^{-5}$	$1.47x10^{-4}$	$4.18x10^{-6}$	TRUE
897	71-43-2	Benzene	$9.93x10^{1}$	$1.10x10^{-1}$	$1.52x10^{-6}$	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
897	75-25-2	Bromoform (Tribromomethane)	$4.55x10^{1}$	1.00	$6.32x10^{-6}$	$9.09x10^{-3}$	$2.58x10^{-4}$	FALSE
897	67-66-3	Chloroform (Trichloromethane)	$1.36x10^{4}$	$1.00x10^{-1}$	$1.89x10^{-4}$	$4.35x10^{-4}$	$1.24x10^{-5}$	TRUE
897	75-09-2	Dichloromethane (Methylene chloride)	$3.91x10^{4}$	$5.00x10^{-2}$	$2.71x10^{-4}$	$2.13x10^{-2}$	$6.05x10^{-4}$	FALSE
897	75-56-9	Propylene oxide (1,2-Epoxypropane)	1.38	1.00	$1.92x10^{-7}$	$2.70x10^{-3}$	$7.67x10^{-5}$	FALSE

Table D.1–26. Projected Carcinogenic Chemical Emissions Reduced Operations Alternative Screening Level Analysis (concluded)

BUILDING NUMBER	CAS NUMBER	CHEMICAL	EMISSIONS			10^{-8} RISK LEVEL µg/m³	TEV g/sec	RESULT
			g/yr	EF	g/sec			
897	79-01-6	Trichloroethylene	2.70×10^{4}	7.00×10^{-2}	2.63×10^{-4}	5.83×10^{-3}	1.66×10^{-4}	TRUE
905	75-09-2	Dichloromethane (Methylene chloride)	3.98×10^{3}	2.00×10^{-2}	1.11×10^{-5}	2.13×10^{-2}	6.05×10^{-4}	FALSE

[a] NA: 10^{-8} risk level screening value not available; carcinogenic chemical screening performed using unit risk factors for inhalation risk. This chemical does not have inhalation toxicity information available. It is listed as an ingestion carcinogen.

For those chemicals with a hypothetical emission rate greater than the TEV, additional process engineering estimates of chemical emissions are requested from the respective facilities. Those carcinogenic chemicals whose process engineering estimated emission rates still exceed the TEV are modeled using the process engineering chemical emissions for the building from which emissions occur to determine maximum offsite chemical concentrations and concentrations at public access areas (such as the National Atomic Museum, hospitals, and schools). Tables D.1–27, D.1–28, and D.1–29 present

Table D.1–27. No Action Alternative Carcinogenic Chemical Emissions Exceeding Screening Levels

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	EMISSION RATE (g/sec)	TEV (g/sec)
Chloroform (trichloromethane)	6580	1.64×10^{-5}	1.24×10^{-5}
Dichloromethane (Methylene chloride)	870	1.03×10^{-2}	6.05×10^{-4}
Dichloromethane (Methylene chloride)	878	6.14×10^{-4}	6.05×10^{-4}
Formaldehyde	878	3.90×10^{-5}	2.11×10^{-5}
Trichloroethylene	878	3.12×10^{-3}	1.66×10^{-4}
1,2-Dichloroethane (Ethylene dichloride)	893	8.72×10^{-5}	1.07×10^{-5}
1,4-Dichloro-2-butene	897	6.81×10^{-6}	1.07×10^{-7}
Acrylonitrile	897	1.11×10^{-5}	4.18×10^{-6}
Chloroform (trichloromethane)	897	2.05×10^{-5}	1.24×10^{-5}
Trichloroethylene	897	2.86×10^{-4}	1.66×10^{-4}

Source: SNL/NM 1998a
g/sec: grams per second
TEV: threshold emission value
Bldg. 6580 – Hot Cell Facility (HCF)
Bldg. 870 – Neutron Generator Facility (NGF)
Bldg. 878 – Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 – Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 – Integrated Materials Research Laboratory (IMRL)

Table D.1–28. Expanded Operations Alternative Carcinogenic Chemical Emissions Exceeding Screening Levels

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	EMISSION RATE (g/sec)	TEV (g/sec)
Chloroform (trichloromethane)	6580	1.23×10^{-5}	1.24×10^{-5}
Dichloromethane (Methylene chloride)	870	1.03×10^{-2}	6.05×10^{-4}
Dichloromethane (Methylene chloride)	878	8.19×10^{-4}	6.05×10^{-4}
Formaldehyde	878	5.19×10^{-5}	2.11×10^{-5}
Trichloroethylene	878	4.16×10^{-3}	1.66×10^{-4}
1,2-Dichloroethane (Ethylene dichloride)[a]	893	1.74×10^{-4}	1.07×10^{-5}
1,4-Dichloro-2-butene	897	6.81×10^{-6}	1.07×10^{-7}
Acrylonitrile	897	1.11×10^{-5}	4.18×10^{-6}
Chloroform (trichloromethane)	897	2.05×10^{-5}	1.24×10^{-5}
Trichloroethylene	897	2.86×10^{-4}	1.66×10^{-4}

Source: SNL/NM 1998a
g/sec: grams per second
TEV: threshold emission value
MESA: Microsystems and Engineering Sciences Applications
Bldg. 6580 – Hot Cell Facility (HCF)
Bldg. 870 – Neutron Generator Facility (NGF)
Bldg. 878 – Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 – Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 – Integrated Materials Research Laboratory (IMRL)
[a] If the MESA Complex configuration is implemented, Building 893 would cease operations (after 2003) and the chemical listed would no longer contribute carcinogenic chemical emissions under the Expanded Operations Alternative.

Table D.1–29. Reduced Operations Alternative Carcinogenic Chemical Emissions Exceeding Screening Levels

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	EMISSION RATE (g/sec)	TEV (g/sec)
Chloroform (trichloromethane)	6580	2.05×10^{-5}	1.24×10^{-5}
Dichloromethane (Methylene chloride)	870	1.03×10^{-2}	6.05×10^{-4}
Formaldehyde	878	2.60×10^{-5}	2.11×10^{-5}
Trichloroethylene	878	2.08×10^{-3}	1.66×10^{-4}
1,2-Dichloroethane (Ethylene dichloride)	893	8.72×10^{-5}	1.07×10^{-5}
1,4-Dichloro-2-butene	897	6.26×10^{-6}	1.07×10^{-7}
Acrylonitrile	897	1.02×10^{-5}	4.18×10^{-6}
Chloroform (trichloromethane)	897	1.89×10^{-4}	1.24×10^{-5}
Trichloroethylene	897	2.63×10^{-4}	1.66×10^{-4}

Source: SNL/NM 1998a
g/sec: grams per second
TEV: threshold emission value
Bldg. 6580 – Hot Cell Facility (HCF)
Bldg. 870 – Neutron Generator Facility (NGF)
Bldg. 878 – Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 – Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 – Integrated Materials Research Laboratory (IMRL)

the No Action Alternative, Expanded Operations Alternative, and Reduced Operations Alternative results of the final screening step for the carcinogenic chemicals comparing emission rates derived from process engineering estimates to the TEV. The process engineering estimates are emission factors based upon facility process knowledge applicable to each of the chemical emissions. Concentrations of the carcinogenic chemicals based upon the process engineering emission rates are evaluated in the Human Health and Worker Safety section. (Section 5.3.8)

D.1.4 Mobile Sources

Mobile source emissions were calculated for each alternative based on estimated vehicle commuter traffic and onsite vehicle usage. The EPA model *MOBILE 5a* was used to estimate mobile source emission factors based on vehicular profiles input into the model. These factors were then used to calculate the emissions of carbon monoxide from SNL/NM vehicular traffic. It is assumed that the vehicle carbon monoxide emission factor is 33.4 g per mi in the base year (1996) and is reduced to 28.5 g per mi for the alternatives (2005). Future vehicles will have inherently lower emission rates and more stringent inspection programs, causing the lower rates to be maintained. This is consistent with the input parameters used by the city of Albuquerque Environmental Health Department, Air Pollution Control Division in *MOBILE5A* to determine vehicle carbon monoxide for Bernalillo county (SNL 1996c). Table D.1–30 presents the emission factors, assumptions, and calculations used to estimate the carbon monoxide contribution from SNL/NM vehicular traffic for the proposed alternatives. Figure D.1–5 presents the process used for evaluating mobile source emissions from SNL/NM commuter traffic.

The contributions of carbon monoxide emissions from vehicles commuting to and from SNL/NM and from SNL/NM-operated, on-base vehicles as a percent of the total county carbon monoxide emissions are: No Action Alternative, 4.6 percent; Expanded Operations Alternative, 5.1 percent; and Reduced Operations Alternative, 4.5 percent. There is no increase of carbon monoxide emissions from vehicular traffic for any alternative above the baseline emissions. Rather, the annual emissions would be reduced by 250 tons under the Expanded Operations Alternative due to improvements in vehicle fleet emissions.

The following is a partial list defining input paramenters for *MOBILE5A*, which were used to calculate vehicular carbon monoxide emission rates due to SNL/NM commuters:

- Tampering rates—the rates at which people are expected to make changes to vehicle pollution control devices.

Table D.1–30. Estimated Carbon Monoxide Emissions from SNL/NM

COMMUTER		ONBASE		PARAMETER
1996 BASELINE				
13,582.0		600.0		SNL/NM vehicles per day
x 30.0		x 30.0		Miles per day per vehicle
407,460.0		18,000.0		Total miles per day
x 33.4		x 33.4		Emission factor (grams per mile)
13,609,164.0		601,200.0		Carbon monoxide emissions (grams per day)
x 1.1023x10^{-6}		x 1.1023x10^{-6}		Conversion factor: grams to tons
15.0		0.66		Carbon monoxide emissions (tons per day)
x 261.0		x 261.0		Working days per year
3,915.0		172.0		Carbon monoxide emissions (tons per year)
3,915.0	+	**172.0**	= **4,087**	Total carbon monoxide (tons per year)
Assumptions: Emission factor for the year 1996 assumed.				
NO ACTION ALTERNATIVE				
13,582.0		600.0		SNL/NM vehicles per day
x 30.0		x 30.0		Miles per day per vehicle
407,460.0		18,000.0		Total miles per day
x 28.5		x 28.5		Emission factor (grams per mile)
11,612,610.0		513,000.0		Carbon monoxide emissions (grams per day)
x 1.1023x10^{-6}		x 1.1023x10^{-6}		Conversion factor: grams to tons
12.8		0.57		Carbon monoxide emissions (tons per day)
x 261.0		x 261.0		Working days per year
3,341.0		148.0		Carbon monoxide emissions (tons per year)
3,341.0	+	**148.0**	= **3,489**	Total carbon monoxide (tons per year)
Assumptions: Emission factor for the year 2005 assumed.				
EXPANDED OPERATIONS ALTERNATIVE				
14,940.0		660.0		SNL/NM vehicles per day
x 30.0		x 30.0		Miles per day per vehicle
448,200.0		19,800.0		Total miles per day
x 28.5		x 28.5		Emission factor (grams per mile)
12,773,700.0		564,300.0		Carbon monoxide emissions (grams per day)
x 1.1023x10^{-6}		x 1.1023x10^{-6}		Conversion factor: grams to tons
14.08		0.622		Carbon monoxide emissions (tons per day)
x 261.0		x 261.0		Working days per year
3,674.88		162.35		Carbon monoxide emissions (tons per year)
3,674.88	+	**162.35**	= **3,837**	Total carbon monoxide (tons per year)
Assumptions: Emission factor for the year 2005 assumed; a 10 percent increase in vehicles per day from 1995 assumed.				

Table D.1–30. Estimated Carbon Monoxide Emissions from SNL/NM (concluded)

COMMUTER	ONBASE		PARAMETER
REDUCED OPERATIONS ALTERNATIVE			
13,175.0	582.0		SNL/NM vehicles per day
x 30.0	x 30.0		Miles per day per vehicle
395,250.0	17,460.0		Total miles per day
x 28.5	x 28.5		Emission factor (grams per mile)
11,264,625.0	497,610.0		Carbon monoxide emissions (grams per day)
x 1.1023×10^{-6}	x 1.1023×10^{-6}		Conversion factor: grams to tons
12.42	0.5485		Carbon monoxide emissions (tons per day)
x 261.0	x 261.0		Working days per year
3,241.60	143.16		Carbon monoxide emissions (tons per year)
3,241.60 +	**143.16**	= **3,385**	Total carbon monoxide (tons per year)
Assumptions: Emission factor for the year 2005 assumed; a 3 percent decrease in vehicles per day from 1995 assumed.			

Source: SNL 1996c

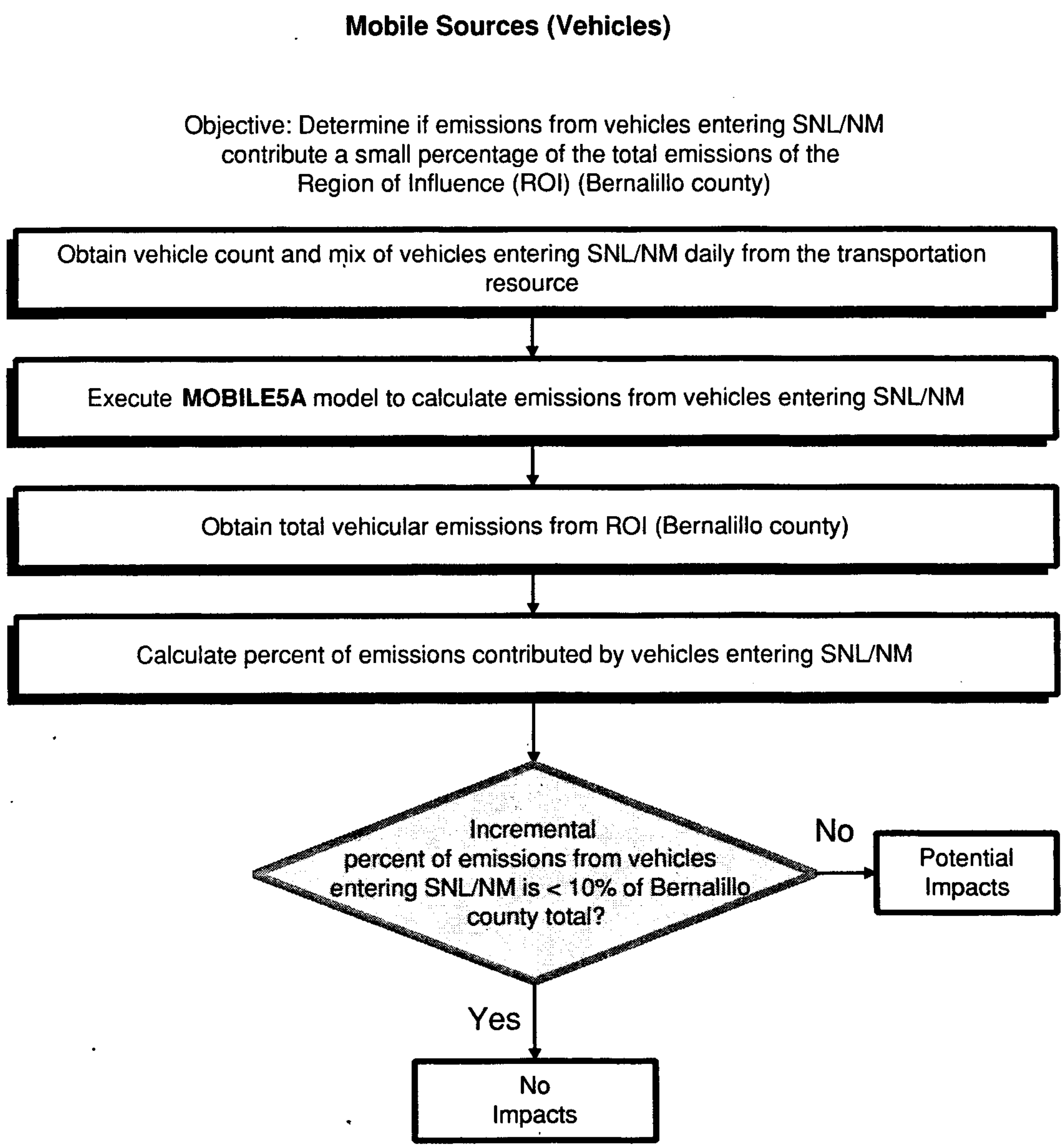

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Figure D.1–5. Flow Chart for Evaluation of Mobile Source Emissions

Various data are input into the MOBILE5A computer model to measure mobile source carbon monoxide emissions from SNL/NM commuters versus Bernalillo County mobile source carbon monoxide emissions.

- Average speed—average speed of vehicles.
- Vehicle miles traveled mix—the mix of vehicle types used in the analysis.
- Mileage accumulation rates by model year—the default is the national average annual milage accumulation rates and registration distribution by model year.
- Adjustment for exhaust emission rates—adjustment by vehicle model year.
- Inspection and Maintenance Program—requires entries to define the characteristics of one or more inspection and maintenance programs.
- Adjustment for load—entries to make allowance for air conditioner usage, load, trailers, and humidity.
- Anti-tampering program—entries to define an anti-tampering program, if applicable.
- Reformulated gasoline—the model does not take into account any "at the pump" vapor recovery systems since these do not affect carbon monoxide emission factors.
- Average minimum and maximum daily temperatures—input parameter includes minimum and maximum daily temperatures and volatility class of fuel.
- Idle emissions—the calculation of idle emissions has been disabled in *MOBILE5A*.

Based upon the analysis of stationary and mobile source emissions for carbon monoxide, even under the Expanded Operations Alternative, carbon monoxide emissions from SNL/NM would be less than the 1996 emissions. Therefore, there is no need for a "conformity analysis."

D.1.5 Fire Testing Facility

Figure D.1–6 presents the process used for evaluating emissions from fire testing facilities. Table D.1–31 presents the 89 chemical pollutants, applicable OEL/100 guidelines, and the respective 8-hour average concentrations at the KAFB boundary from burning 1,000 gallons of JP-8 fuel at the open burn pools located in Lurance Canyon. Historically, the number of burns in a day varies from none to multiple. However, the maximum amount burned in a single day has been and is projected to be, 1,000 gal. The 1-hour pollutant concentrations were estimated using the model *OBODM*. These 1-hour concentrations were converted to 8-hour average concentrations and compared to 1/100th of the American Conference of Governmental Industrial Hygienists (ACGIH) 8-hour exposure standard (OEL/100). Emissions are based on single tests and would be the same under the No Action and Expanded Operations Alternatives. The pollutant concentrations are evaluated in Section 5.3.8, Human Health and Worker Safety.

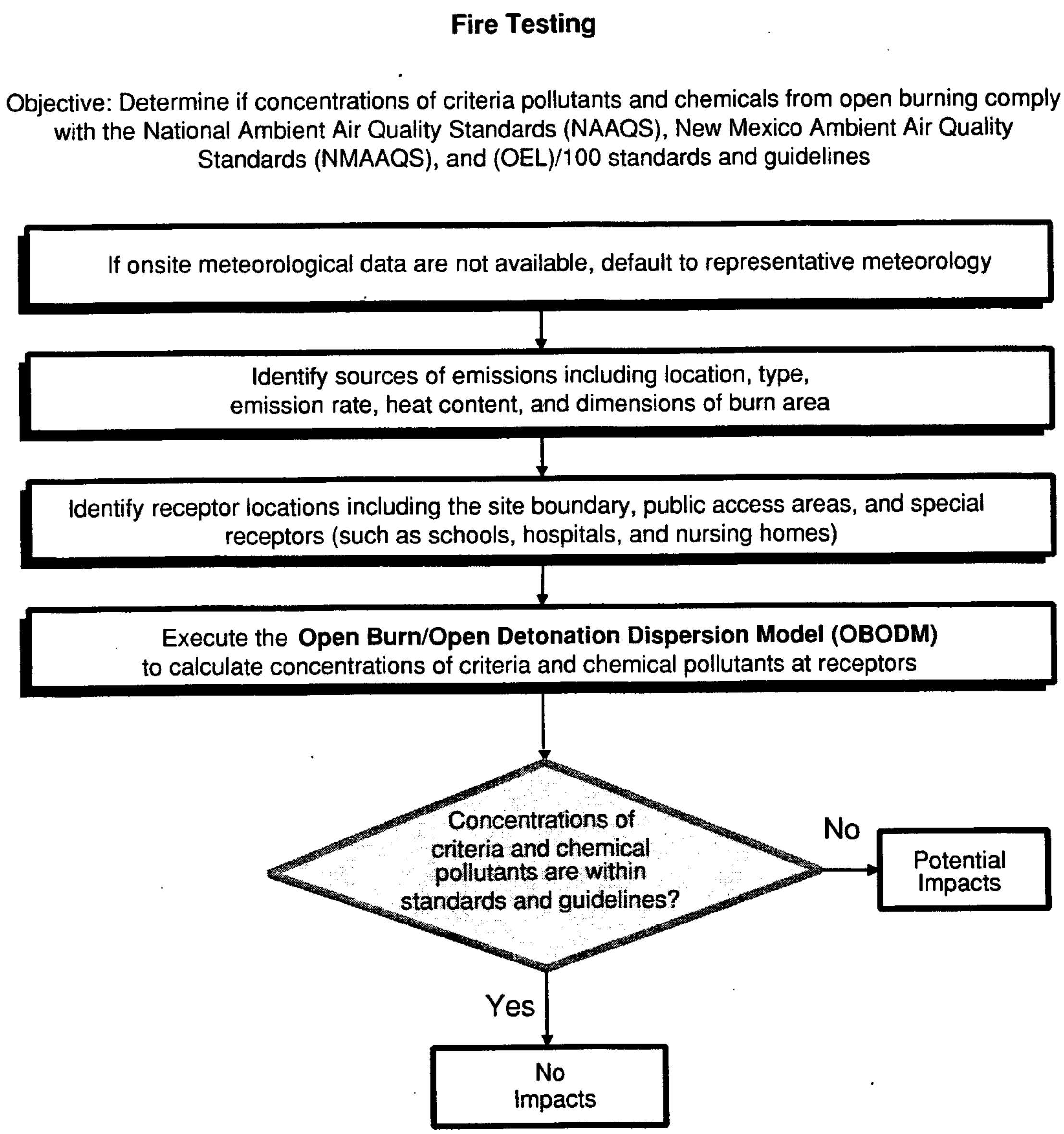

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Figure D.1–6. Flow Chart for Evaluation of Open Burning at the Lurance Canyon Burn Site

Open burning emissions are evaluated against national and state ambient air quality standards, using the OBODM computer model.

Table D.1–31. Toxic Pollutant Emissions from Open Burning of JP-8 Fuel at the Lurance Canyon Burn Site Under the No Action and Expanded Operations Alternatives

POLLUTANT	EMISSION FACTOR (g/g)	OEL/100 (μg/m³)	ESTIMATED 8-HOUR CONCENTRATION (μg/m³)
1,1,2-trichloroethane	5.90×10^{-5}	450	5.42×10^{-2}
1,2,3-trimethylbenzene	1.30×10^{-4}	1,230	1.19×10^{-1}
1,2,4-trichlorobenzene	2.00×10^{-3}	380	1.84
1,2,4-trimethylbenzene	1.40×10^{-4}	1,230	1.29×10^{-1}
1,2-dichloroethane	3.50×10^{-6}	40	3.21×10^{-3}
1,2-dichloropropane	2.50×10^{-7}	3,470	2.29×10^{-4}
1,3,5-trimethylbenzene	2.70×10^{-5}	1,230	2.48×10^{-2}
1,3-butadiene	2.40×10^{-4}	44	2.20×10^{-1}
1,4-dioxane	1.80×10^{-5}	720	1.65×10^{-2}
1-butanol	3.00×10^{-5}	3,000	2.75×10^{-2}
1-heptene	2.40×10^{-6}	NA	2.20×10^{-3}
1-hexene	2.50×10^{-5}	1,300	2.29×10^{-2}
1-octene	1.20×10^{-5}	NA	1.10×10^{-2}
1-pentene	2.10×10^{-5}	NA	1.93×10^{-2}
2,2,3-trimethylpentane	3.80×10^{-6}	NA	3.49×10^{-3}
2,2,5-trimethylhexane	5.40×10^{-6}	NA	4.96×10^{-3}
2,4,4-trimethyl-1-pentene	8.80×10^{-6}	NA	8.08×10^{-3}
2,4-dimethylpentane	1.40×10^{-6}	NA	1.29×10^{-3}
2,5-dimethylhexane	4.20×10^{-6}	NA	3.86×10^{-3}
2,5-dimethylthiophene	1.20×10^{-6}	NA	1.10×10^{-3}
2-butanone	4.00×10^{-6}	5,900	3.67×10^{-3}
2-butyne	2.00×10^{-6}	NA	1.84×10^{-3}
2-methyl-2-butene	4.50×10^{-6}	NA	4.13×10^{-3}
3-methylheptane	1.50×10^{-5}	NA	1.38×10^{-2}
3-methylhexane	1.60×10^{-5}	NA	1.47×10^{-2}
3-methylpentane	2.60×10^{-6}	7,000	2.39×10^{-3}
4-nonene	3.30×10^{-6}	NA	3.03×10^{-3}
A-pinene	1.00×10^{-4}	NA	9.18×10^{-2}
Acetone	1.70×10^{-5}	5,900	1.56×10^{-2}
Acetyaldehyde	6.50×10^{-6}	900	5.97×10^{-3}
B-pinene	1.60×10^{-5}	NA	1.47×10^{-2}

Table D.1–31. Toxic Pollutant Emissions from Open Burning of JP-8 Fuel at the Lurance Canyon Burn Site Under the No Action and Expanded Operations Alternatives (continued)

POLLUTANT	EMISSION FACTOR (g/g)	OEL/100 ($\mu g/m^3$)	ESTIMATED 8-HOUR CONCENTRATION ($\mu g/m^3$)
Benzene	2.00×10^{-3}	3.2	1.84
Benzyl chloride	2.70×10^{-5}	50	2.48×10^{-2}
Bischloroethyl ether	5.00×10^{-6}	290	4.59×10^{-3}
C-2-butene	5.10×10^{-6}	NA	4.68×10^{-3}
C-2-pentene	2.10×10^{-6}	NA	1.93×10^{-3}
C-3-methyl-2-pentene	1.80×10^{-7}	NA	1.65×10^{-4}
Chloromethane	1.50×10^{-6}	1,030	1.38×10^{-3}
Cyclohexanone	1.90×10^{-5}	1,000	1.74×10^{-2}
Cyclopentene	2.00×10^{-6}	NA	1.84×10^{-3}
Dibromochloromethane	4.60×10^{-6}	NA	4.22×10^{-3}
Dichlorodifluoromethane	9.40×10^{-7}	49,500	8.63×10^{-4}
Ethanol	3.50×10^{-5}	18,800	3.21×10^{-2}
Ethylbenzene	3.50×10^{-5}	4,340	3.21×10^{-2}
Heptanal	2.30×10^{-6}	NA	2.11×10^{-3}
Hexachloro-1,3-butadiene	2.30×10^{-6}	2.1	2.11×10^{-3}
Hexanal	5.90×10^{-5}	NA	5.42×10^{-2}
Indan	3.40×10^{-6}	NA	3.12×10^{-3}
Indene	3.80×10^{-4}	450	3.49×10^{-1}
Isobutene	1.10×10^{-4}	NA	1.01×10^{-1}
Isobutylbenzene	5.00×10^{-6}	NA	4.59×10^{-3}
Isoheptane	1.10×10^{-5}	NA	1.01×10^{-2}
Isopentane	3.30×10^{-6}	NA	3.03×10^{-3}
Isopentyl mercaptan	2.70×10^{-6}	NA	2.48×10^{-3}
Isoprene	1.70×10^{-5}	NA	1.56×10^{-2}
Isopropylbenzene	5.10×10^{-6}	2,450	4.68×10^{-3}
Isovaleraldehyde	3.30×10^{-4}	NA	3.03×10^{-1}
Limonene	6.00×10^{-5}	NA	5.51×10^{-2}
M-diethylbenzene	7.00×10^{-5}	NA	6.43×10^{-2}
M-thyltoluene	2.80×10^{-5}	NA	2.57×10^{-2}
Methanol	7.70×10^{-6}	2,600	7.07×10^{-3}
Methylcyclohexane	8.90×10^{-5}	16,000	8.17×10^{-2}

Table D.1–31. Toxic Pollutant Emissions from Open Burning of JP-8 Fuel at the Lurance Canyon Burn Site Under the No Action and Expanded Operations Alternatives (concluded)

POLLUTANT	EMISSION FACTOR (g/g)	OEL/100 (μg/m³)	ESTIMATED 8-HOUR CONCENTRATION (μg/m³)
Methylcyclopentane	$1.90x10^{-5}$	NA	$1.74x10^{-2}$
Methylcyclopentene	$1.80x10^{-7}$	NA	$1.65x10^{-4}$
Methylene chloride	$1.20x10^{-7}$	1,740	$1.10x10^{-4}$
Methylisobutylketone	$8.40x10^{-6}$	820	$7.71x10^{-3}$
N-butylbenzene	$9.10x10^{-5}$	NA	$8.35x10^{-2}$
N-decane	$4.10x10^{-4}$	NA	$3.76x10^{-1}$
N-heptane	$2.90x10^{-5}$	3,500	$2.66x10^{-2}$
N-hexane	$6.80x10^{-6}$	1,760	$6.24x10^{-3}$
N-nonane	$6.20x10^{-5}$	10,500	$5.69x10^{-2}$
N-octane	$4.70x10^{-5}$	3,500	$4.31x10^{-2}$
N-propylbenzene	$4.50x10^{-5}$	NA	$4.13x10^{-2}$
N-undecane	$1.10x10^{-3}$	NA	1.01
Napthalene	$1.20x10^{-3}$	500	1.10
O-ethyltoluene	$4.70x10^{-5}$	NA	$4.31x10^{-2}$
O-xylene	$3.90x10^{-5}$	4,340	$3.58x10^{-2}$
P-diethylbenzene	$1.20x10^{-4}$	NA	$1.10x10^{-1}$
P-ethyltoluene	$1.30x10^{-5}$	NA	$1.19x10^{-2}$
P-isopropyltoluene	$2.60x10^{-6}$	NA	$2.39x10^{-3}$
P-xylene	$1.90x10^{-4}$	4,340	$1.74x10^{-1}$
Propane	$4.80x10^{-7}$	18,000	$4.41x10^{-4}$
Styrene	$2.90x10^{-4}$	850	$2.66x10^{-1}$
T-2-butene	$1.00x10^{-4}$	NA	$9.18x10^{-2}$
T-2-pentene	$3.30x10^{-6}$	NA	$3.03x10^{-3}$
Tetrahydrothiophene	$7.70x10^{-8}$	NA	$7.07x10^{-5}$
Toluene	$3.30x10^{-4}$	1,880	$3.03x10^{-1}$
Trichloroethylene	$3.10x10^{-6}$	2,690	$2.85x10^{-3}$
Vinyl chloride	$2.20x10^{-5}$	130	$2.02x10^{-2}$

Sources: ACGIH 1997, Bjorklund et al. 1997
g/g: grams of pollutant per gram of JP-8 fuel
lb/gal: pounds per gallon
μg/m³: micrograms per cubic meter

NA: Not available
OEL: occupational exposure limit
Notes: 1) The nearest distance from burn site to boundary: 3,050 meters
2) JP-8 density: 6.67 lb/gal
3) *OBODM*-predicted 1-hour decontamination factor (DF): $7.3439x10^{3}$ μg/m³/1,000 gal JP-8
4) See text in D.1.5

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D.2 RADIOLOGICAL AIR QUALITY

This section presents detailed information on the methodology and data used to calculate the potential radiological doses associated with radiological air emissions during normal operations under the No Action, Expanded Operations, and Reduced Operations Alternatives. If implemented, the Microsystems and Engineering Sciences Applications Complex configuration would not change the potential radiological doses associated with radiological air emissions under the Expanded Operations Alternative.

The radiological dose to the maximally exposed individual (MEI) and collective dose to the population within 50 mi of SNL/NM, due to the radiological air emissions from routine SNL/NM facility operations, were evaluated. This evaluation is required to show compliance with the National Emissions Standard for Hazardous Air Pollutants (NESHAP), which limits public dose received from radiological material released to the atmosphere to 10 mrem/yr, in addition to natural background and medical radiation doses normally received.

All SNL/NM facilities that have the potential for radiological emissions were reviewed. Based on historic SNL/NM radionuclide emissions data and NESHAP compliance reports, 10 facilities in 5 TAs were considered for modeling potential radiological impacts (Figure D.2–1). Based on the review of historical reported doses from NESHAP, other facilities that would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI were screened from further consideration. These 10 facilities are also part of the 33 facilities identified in Chapter 2 as "selected" facilities for examination in the SWEIS. They include the following:

- Annular Core Research Reactor (ACRR)—Defense Programs (DP) configuration
- ACRR—medical isotopes production configuration
- Sandia Pulsed Reactor (SPR)
- Hot Cell Facility (HCF)
- Radioactive and Mixed Waste Management Facility (RMWMF)
- Mixed Waste Landfill (MWL)
- High-Energy Radiation Megavolt Electron Source III (HERMES III)
- Radiographic Integrated Test Stand (RITS)
- Explosive Components Facility (ECF)
- Neutron Generator Facility (NGF)

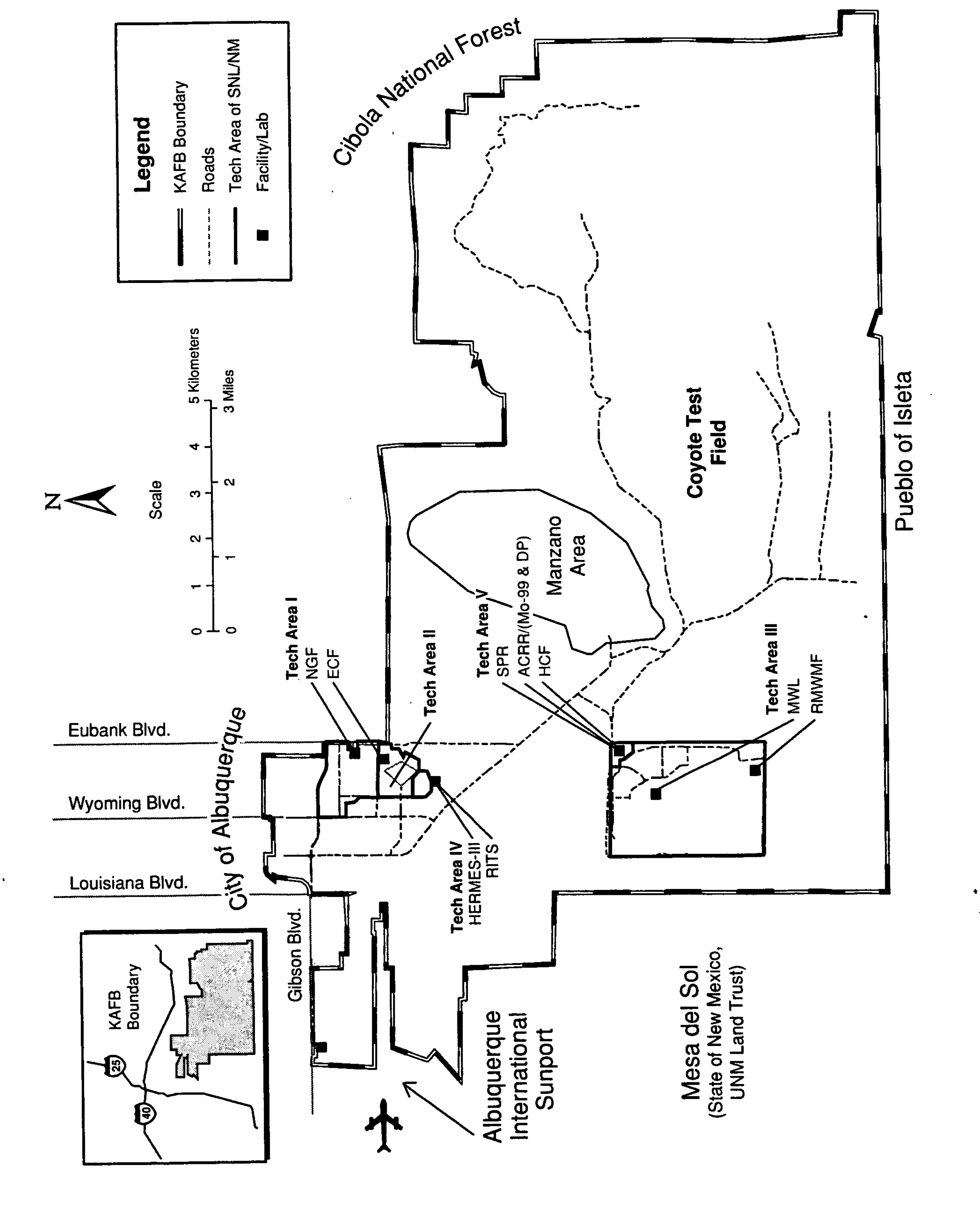
The ACRR could be operated under either DP configuration or medical isotopes production configuration. For purposes of this evaluation and to ensure conservative results, the facility was assumed to be operating under both configurations simultaneously.

TA-V was selected as the center of the 50-mi ROI for all facilities (where modeled releases to the environment would result in a calculated dose to the population). It was selected because the majority of radiological emissions would be from the HCF in TA-V and TA-V has historically been addressed in annual NESHAP compliance reports.

The radiological impacts of normal operations of each alternative, based on estimated radionuclide emissions, were calculated by using the *Clean Air Assessment Package (CAP88-PC)* computer model, which is being used for demonstrating NESHAP compliance (DOE 1997e). *CAP88-PC* is an improved version of its predecessor computer code, *AIRDOS-EPA*. In *CAP88-PC*, a modified Gaussian plume equation is used to estimate both horizontal and vertical air dispersion of as many as 20 radionuclides released from 1 to 6 stacks. The model calculates exposure to radionuclide releases that can occur through external (air immersion and surface ground-shine) and internal (inhalation and ingestion) pathways.

The external dose is from exposure to a cloud of radiation passing over the receptor who is standing on ground that is contaminated with radioactive material. The appropriate dose quantity is called the effective dose equivalent (EDE). The internal dose arises from a radiation source entering the human body through ingestion of contaminated food and water and inhalation of contaminated air. The pathways for internal exposure include ingestion of crops contaminated by airborne radiation that has been deposited on the crops and ingestion of food products from animals that have ingested contaminated food. This is the internal dose that each body receives from a "1-year intake." The integral of the dose rate over the years (that is, 50 years) gives the committed EDE. The sum of the two dose quantities from external and internal pathways is presented in the SWEIS as the total EDE (TEDE), pursuant to U.S. Department of Energy (DOE) 5400.1.

Rates of ingestion of radionuclides are based on the terrestrial transport model of the *U.S. Nuclear Regulatory Commission's Regulatory Guide 1.109* food chain model (NRC 1977a). Dose conversion factors are derived from data generated by the *DARTAB* model, an integral part of



Source: Original

Figure D.2–1. SNL/NM Facilities that Release Radionuclides

The 10 analyzed SNL/NM facilities that release radionuclides are in 5 technical areas.

CAP88-PC, which follows the methodology of the International Commission for Radiation Protection (ICRP). These are the components built into the execution of the *CAP88-PC* model.

In performing the dose calculations using the *CAP88-PC* model, the following types of data are used:

- *Emissions Data*—The estimated radiological emissions from each of the 10 SNL/NM facilities under each alternative are extracted from SNL/NM facility source documents (SNL/NM 1998a) and used in the dose evaluations. Table D.2–1 presents the radiological emissions data from these 10 sources for the No Action, Expanded Operations, and Reduced Operations Alternatives. The radiological emissions from each facility are estimated based on SNL/NM planned operations and tests projected into the future under each alternative. The details are available in the SNL/NM facility source documents (SNL/NM 1998a). The ACRR and HCF emissions for the base year 1996 are different due to refurbishing operations to change over to medical isotopes production configuration. The SPR emissions are estimated to be higher than the base year. This is due to instituting NESHAP requirements for "confirmatory measurements" of radiological air emissions, where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emissions factors. These measurements are source-specific to the SPR and ACRR and would not affect the calculations and measurements for other facilities.
- *Source Parameters Data*—Facility releases, which are point sources, occur from stack exhausts or vents. For these releases, the *CAP88-PC* model calculates a momentum-type plume rise. Plume rise is calculated from the stack diameter and exhaust velocity. The MWL is an area facility and is assumed to be a ground-level release with no exhaust parameters. Therefore, *CAP88-PC* uses a ground release height. Table D.2–2 presents the source parameters.
- *Meteorological Data*—Three years (1994-1996) of meteorological data, including wind speed, wind direction, and stability, are used by SNL/NM to create a stability array (STAR) data file for each of four monitoring towers (CW1, A21, A36, and MW1) (Figure D.2–2). These SNL/NM-supplied meteorological data were used by the *CAP88-PC* model to calculate the doses. The meteorological data from the nearest representative meteorological tower to the source being evaluated were used to calculate the dose to the MEI and the population within 50 mi. Meteorological data from tower A36 were used to model the ACRR, HCF, and SPR. Meteorological data from tower A21 were used to model the HERMES III, RITS, ECF, and NGF. Meteorological data from tower MW1 were used to model the MWL. The RMWMF was modeled using meteorological data from tower CW1.

  In addition, annual average temperature and precipitation data recorded by SNL/NM at these towers were used to calculate composite three-year average temperature and precipitation and further used as input to the *CAP88-PC*. Precipitation is measured only at towers A36 and A21. The composite average precipitation value calculated from A36 is assumed to be representative of towers MW1 and CW1.

  The composite average temperatures for towers A36, A21, MW1, and CW1 are 14.6, 14.3, 14.3, and 14.2 °C, respectively. The composite average precipitation levels at towers A36 and A21 are 26.3 and 24.4 cm/yr, respectively. The mixing height, based on Sunport meteorological data that is used in the NESHAP report (SNL/NM 1996u), 2,055 m above ground level, is used as input to the *CAP88-PC*.
- *Demographic Data*—Demographic data include population, numbers of beef and dairy cattle, and the area of food crop harvesting. Although the *CAP88-PC* model contains default demographic data for the Albuquerque area, based on site-wide demographic averages, SNL/NM generated a more accurate data set based on available data on a per-county basis (SNL/NM 1996u). These data, within 5 equal segments for each wind direction (total 80 equal segments spaced to cover a 50-mi radius, including 16 wind direction subdivisions) were used by SNL/NM.

  SNL/NM estimated population based on 1994-1995 population data and estimated agricultural data obtained from the U.S. Department of Commerce (SNL/NM 1996u). These data were also used in the *CAP88-PC* model. SNL/NM does not have any onsite agricultural production; only agricultural data beyond the site boundary to a 50-mi radius were considered in the impact evaluation.

  Table D.2–3 presents population distribution. The densities of beef and dairy cattle within the 50-mi radius of SNL/NM were 2.016 beef cattle per square kilometer and 0.554 dairy cattle per square kilometer (SNL/NM 1996u).
- *Receptor Locations*—Fourteen core receptor locations were considered in evaluating the impacts due to routine operations at SNL/NM. These receptor

Table D.2–1. Radiological Emissions from Sources at SNL/NM

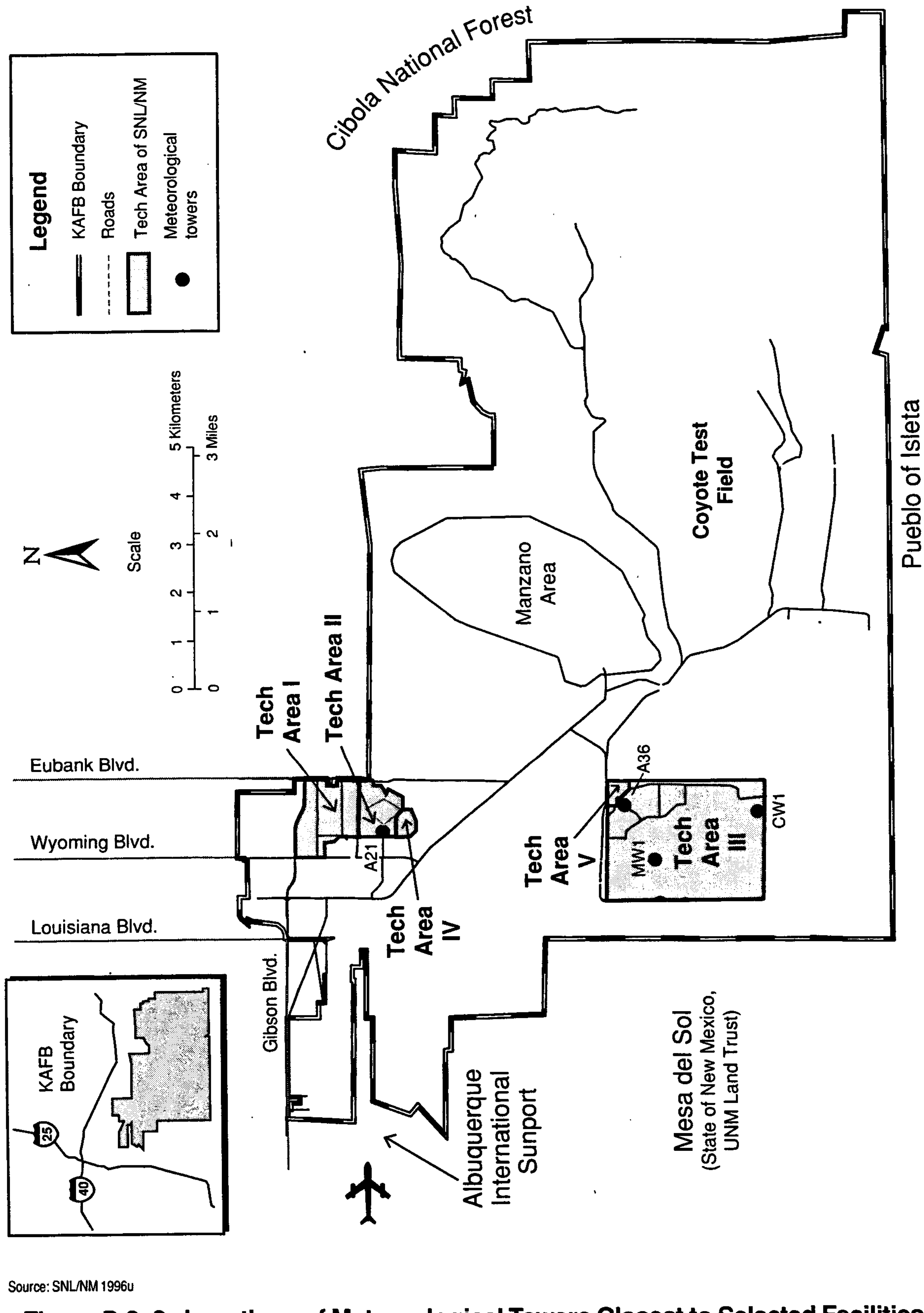
FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	NO ACTION RELEASE (Ci/yr)	EXPANDED OPERATIONS RELEASE (Ci/yr)	REDUCED OPERATIONS RELEASE (Ci/yr)
Annular Core Research Reactor, Building 6588 (ACRR, DP configuration)	V	Argon-41	2.6	7.8	0
Annular Core Research Reactor, Building 6588 (ACRR, medical isotopes production configuration)	V	Argon-41 Tritium	1.1 1.1	2.2 2.2	0.24 0.24
Explosive Components Facility, Building 905 (ECF)	II	Tritium	2.0×10^{-3}	2.0×-10^{-3}	2.0×10^{-3}
High-Energy Radiation Megavolt Electron Source III, Building 970 (HERMES III)	IV	Nitrogen-13 Oxygen-15	1.245×10^{-3} 1.245×10^{-4}	3.603×10^{-3} 3.603×10^{-4}	1.0×10^{-4} 1.0×10^{-5}
Hot Cell Facility, Building 6580 (HCF)	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	1.17 3.0 5.4 0.22 3.3 198.0 0.19 290.0 57.0 480.0 1.8 2,160.0 102.0 2,070.0 360.0	3.90 10.0 18.0 0.72 11.0 660.0 0.63 970.0 190.0 1,600.0 5.9 7,200.0 340.0 6,900.0 1,200.0	0.117 0.3 0.54 0.022 0.33 19.8 0.019 29.0 5.7 48.0 0.18 216.0 10.2 207.0 36.0
Mixed Waste Landfill (MWL)	III	Tritium	0.29	0.29	0.29
Neutron Generator Facility, Building 870 (NGF)	I	Tritium	156	156	156
Radioactive and Mixed Waste Management Facility, Building 6920 (RMWMF)	III	Tritium	2.203[b]	2.203[b]	2.203[b]
Radiographic Integrated Test Stand, Building 970 (RITS)	IV	Nitrogen-13	0.12	0.16	0.02
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	9.5	30.0	2.85

Source: SNL/NM 1998a
Ci/yr: Curies per year
DP: Defense Programs
SNL/NM: Sandia National Laboratories/New Mexico
[a] Radionuclide emissions presented in this table represent projections based on activity forecasts and do not match historical emissions due to changing activities and programs.
[b] Because SNL/California tritium-contaminated oils handled at the RMWMF during the base year were abnormally high, this maximum level of emissions is assumed to be released in any year and, therefore, is constant for all alternatives.

Table D.2–2. Release Parameters for SNL/NM Facilities

FACILITY	RELEASE HEIGHT (m)	STACK DIAMETER (m)	RELEASE TEMPERATURE (°C)	EXHAUST VELOCITY (m/sec)	PLUME RISE
Annular Core Research Reactor (ACRR DP configuration)	16.5	0.20	21	11.1	Momentum
Annular Core Research Reactor (ACRR medical isotopes production configuration)	16.5	0.20	21	11.1	Momentum
Explosive Components Facility (ECF)	3.0	0.5	21	15.4	Momentum
High-Energy Radiation Megavolt Electron Source III (HERMES III)	13.5	0.46	13	7.64	Momentum
Hot Cell Facility (HCF)	38.1	1.8	21	8.7	Momentum
Mixed Waste Landfill (MWL)	0.0	0.00	21	0.00	Zero
Neutron Generator Facility (NGF)	10.6	0.305	21	10.8	Momentum
Radioactive and Mixed Waste Management Facility (RMWMF)	16.8	0.61	19.3	11.2	Momentum
Radiographic Integrated Test Stand (RITS)	13.5	0.46	13	7.64	Momentum
Sandia Pulsed Reactor (SPR)	8.2	0.54	21	38.6	Momentum

Source: SNL/NM 1996u
°C: degrees Celsius
Ci/yr: Curies per year
DP: Defense Programs
m: meter
m/sec: meters per second
SNL/NM: Sandia National Laboratories/New Mexico



Source: SNL/NM 1996u

Figure D.2–2. Locations of Meteorological Towers Closest to Selected Facilities

Data from the meteorological monitoring towers closest to the selected facility were input for modeling.

Table D.2–3. SNL/NM Population Distribution Within 50 Miles (80 km)

DIRECTION / DISTANCE	POPULATION				
	10 mile (16 km)	20 mile (32 km)	30 mile (48 km)	40 mile (64 km)	50 mile (80 km)
N	40,341	33,537	1,929	2,700	3,472
NNW	39,593	98,185	1,929	3,195	3,472
NW	36,716	97,694	4,623	2,700	3,472
WNW	21,134	32,848	11,807	8,788	1,434
W	17,510	9,127	11,508	3,168	640
WSW	26,087	6,445	6,933	6,130	1,535
SW	10,846	3,105	4,622	5,493	1,855
SSW	1,889	10,092	16,438	2,631	196
S	1,472	2,773	4,373	3,882	233
SSE	1,585	951	1,345	534	592
SE	2,110	267	329	461	592
ESE	2,354	6,274	3,001	461	592
E	2,354	4,936	2,823	1,346	1,550
ENE	2,354	6,084	2,765	3,853	4,741
NE	4,327	7,254	3,271	3,853	4,954
NNE	28,405	8,794	1,929	2,969	4,261

Source: SNL/NM 1996u
km: kilometers

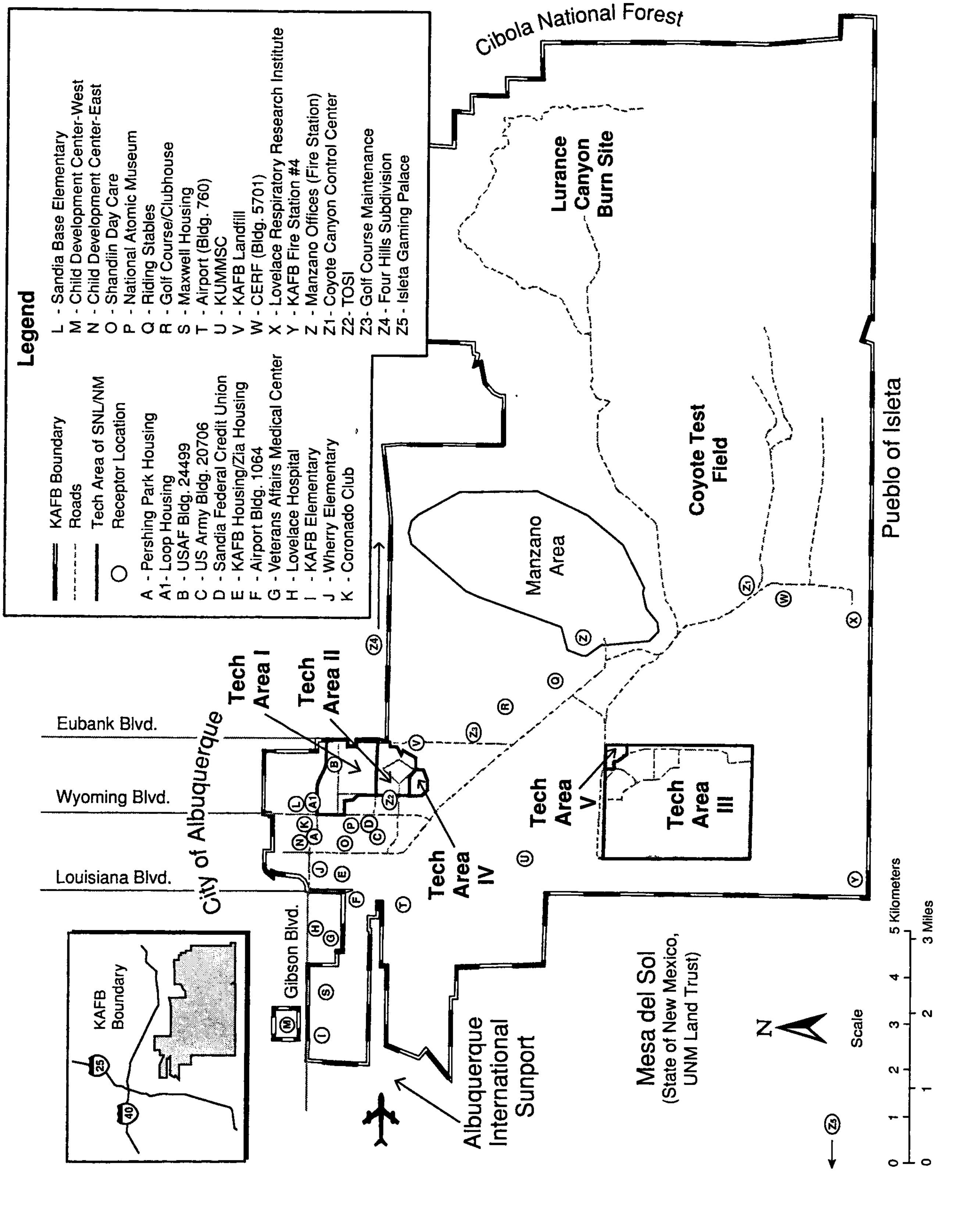
locations were selected based on the review of the NESHAP compliance reports for the public MEI, SNL/NM site information documents, and receptor locations that are in close proximity to the sources, site boundary, or are in prevailing wind directions and that represent children, sick, and elderly (schools, day care centers and hospitals). These 14 core receptors are the Child Development Center-East, Child Development Center-West, Coronado Club, Golf Course (Clubhouse), Kirtland Elementary School, KAFB Housing (Zia Park Housing), Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC), Lovelace Hospital, National Atomic Museum, Riding Stables, Sandia Base Elementary School, Shandiin Day Care Center, Veterans Affairs Medical Center (Hospital), and Wherry Elementary School. In addition, two receptors of public concern representing Four Hills Subdivision and Isleta Gaming Palace, which are farther away from SNL/NM, were also evaluated.

Because the general public and Air Force personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impact evaluation. Based on NESHAP reports, 16 onsite as well as 6 offsite additional receptor locations, which have been historically considered for annual NESHAP reports, were also evaluated (SNL/NM 1996u). Thirty-eight receptor locations were considered for dose impact evaluation. The concept of an onsite potential MEI receptor was conservatively assumed to include members of the military, their dependents, contractors, and other non SNL/NM personnel who have access to locations around KAFB. Offsite receptors include members of the public who are not physically located on Federal properties, which include SNL/NM, DOE, and KAFB lands. Public areas surrounding SNL/NM and adjoining military and DOE lands were surveyed for actual public residents and workers. Public lands include city, county, Bureau of Land Management (BLM), Native

American, national forest, and other private and nonrestricted Federal lands. Thirty-two of a total of 38 receptor locations, representing core receptors, 22 offsite receptors of public concern, and 16 onsite NESHAP considered receptors, are shown on Figure D.2–3. Tables D.2–4, D.2–5, and D.2–6 present the 38 NESHAP, core, and offsite receptors, along with distances and directions from each of the 10 selected SNL/NM facilities/sources that are modeled.

The model-calculated dose contributions, including external, inhalation, and ingestion exposure pathways from each of the 10 facilities/sources calculated individually at each receptor location, were combined to determine the overall SNL/NM site-wide normal operations dose to the MEI, for each alternative. The maximum TEDE was calculated from all exposure pathways from all sources to the MEI under each alternative. The EDE contributions from each of the sources to each of the receptor locations under the No Action Alternative, Expanded Operations Alternative, and Reduced Operations Alternative are presented in Tables D.2–7, D.2–8, and D.2–9, respectively.

Dose assessment results are summarized in Table D.2–10. The total doses (TEDE) from all exposure pathways and all modeled sources to the MEI are 0.15 mrem/yr under the No Action Alternative, 0.51 mrem/yr under the Expanded Operations Alternative, and 0.02 mrem/yr under the Reduced Operations Alternative. The calculated MEI dose for each alternative is much lower than the regulatory limit of 10 mrem/yr from the air pathways, and small compared to the background radiation dose of 360 mrem/yr. The calculated collective doses to population within 50 mi are 5.0 person-rem/yr under the No Action Alternative, 15.8 person-rem/yr under the Expanded Operations Alternative; and 0.80 person-rem/yr under the Reduced Operations Alternative. The calculated annual collective dose from SNL/NM operations under each alternative (5.0, 15.8, and 0.80 person-rem/yr, respectively) to the population within 50 mi would be much lower than the annual 263,700-person-rem collective dose to the population from background radiation (Figure 4.10–2).



Source: SNL/NM 1996u

Figure D.2–3. Locations of Onsite and Near-Site Receptors

Thirty-two onsite or near-site receptors are among a total of 38 that were evaluated for potential impacts.

Table D.2–4. Distance (Meters) and Direction to NESHAP-Considered Receptor Locations from SNL/NM

FACILITY	NGF (BLDG. 870)	ECF (BLDG. 905)	MWL	RMWMF (BLDG. 6920)	RITS AND HERMES III (BLDG. 970)	HCF (BLDG. 6580)	ACRR (BLDG. 6588)	SPR (BLDG. 6590)
Building 20706	990 SSW	1,212 W	5,928 N	8,281 N	1,466 NNW	5,350 NNW	5,386 NNW	5,487 NNW
Building 24499	900 NNE	1,156 N	7,061 N	9,289 N	2,316 NNE	6,239 N	6,280 N	6,386 N
Civil Engineering Research Facility (Bldg. 5701)	10,203 SSE	9,767 SSE	5,465 SE	3,857 ESE	8,885 SSE	5,248 SE	5,228 SE	5,152 SE
Coyote Canyon Control Center	9,873 SSE	9,422 SSE	5,663 ESE	4,391 E	8,615 SE	5,244 SE	5,231 SE	5,169 SE
Golf Course Maintenance Area	2,911 SSE	2,470 SSE	3,675 NNE	5,766 N	1,550 SE	2,708 N	2,751 N	2,856 N
Lovelace Respiratory Research Institute	11,523 SSE	11,092 SSE	6,313 SE	4,282 SE	10,156 SSE	6,335 SSE	6,309 SSE	6,220 SSE
KAFB Firestation #4 (Bldg. 9002)	11,403 SSW	11,159 SSW	5,332 SSW	3,742 SW	9,859 SSW	6,418 SSW	6,374 SSW	6,278 SSW
KAFB Landfill	1,650 SSE	1,163 SSE	4,918 NNE	7,084 N	747 E	4,027 N	4,068 N	4,174 N
Loop Housing	1,080 NW	1,568 NW	7,097 N	9,428 N	2,438 NNW	6,450 N	6,487 N	6,591 N
Manzano Offices (Fire Station)	5,851 SSE	5,364 SSE	3,704 ENE	4,510 NE	4,646 SE	2,563 ENE	2,587 ENE	2,613 ENE
Maxwell Housing	4,921 W	5,298 WNW	8,240 NW	10,562 NNW	5,338 WNW	8,219 NW	8,240 NW	8,318 NW
Pershing Park Housing	1,770 NW	2,270 NW	7,773 N	10,118 N	3,153 NNW	7,155 NNW	7,192 NNW	7,295 N
Sandia Federal Credit Union	870 W	1,147 SW	6,439 N	8,785 N	1,873 NNW	5,834 NNW	5,870 NNW	5,972 NNW
Sunport (Bldg. 760)	2,941 SW	3,100 W	5,778 NNW	8,159 NNW	2,783 WNW	5,601 NW	5,625 NW	5,710 NNW

Table D.2–4. Distance (Meters) and Direction to NESHAP-Considered Receptor Locations from SNL/NM (concluded)

FACILITY	NGF (BLDG. 870)	ECF (BLDG. 905)	MWL	RMWMF (BLDG. 6920)	RITS AND HERMES III (BLDG. 970)	HCF (BLDG. 6580)	ACRR (BLDG. 6588)	SPR (BLDG. 6590)
Sunport (Bldg. 1064)	2,851 W	3,180 W	6,740 NNW	9,128 NNW	3,226 WNW	6,488 NNW	6,515 NNW	6,605 NNW
Technical Onsite Inspection Facility	1,290 SSW	4,385 SSE	5,099 N	7,431 N	642 NW	4,475 NNW	4,511 NNW	4,613 NNW

Source: SNL/NM 1996u
ACRR: Annular Core Research Reactor
ECF: Explosive Components Facility
HCF: Hot Cell Facility
HERMES III: High-Energy Radiation Megavolt Electron Source III
KAFB: Kirtland Air Force Base
MWL: Mixed Waste Landfill
NGF: Neutron Generator Facility
RITS: Radiographic Integrated Test Stand
RMWMF: Radioactive and Mixed Waste Management Facility
SPR: Sandia Pulsed Reactor

Table D.2–5. Distance (Meters) and Direction to Core Receptor Locations from SNL/NM

FACILITY	NGF (BLDG. 870)	ECF (BLDG. 905)	MWL	RMWMF (BLDG. 6920)	RITS AND HERMES-III (BLDG. 970)	HCF (BLDG. 6580)	ACRR (BLDG. 6588)	SPR (BLDG. 6590)
Child Development Center-East	1,729 NW	2,455 NW	6,683 NNW	9,749 N	2,927 NNW	6,898 NNW	6,898 NNW	6,898 NNW
Child Development Center-West	5,487 WNW	6,094 WNW	8,653 NW	11,266 NNW	6,031 WNW	8,984 NW	8,984 NW	8,984 NW
Coronado Club	1,528 NW	2,268 NW	6,630 NNE	9,732 N	2,803 NNW	6,862 NNW	6,862 NNW	6,862 NNW
Golf Course Clubhouse[a]	3,751 SSE	3,289 SSE	3,092 NNE	5,037 N	2,360 SSE	2,004 NNE	2,048 NNE	2,150 NNE
Kirtland Elementary School	5,920 W	6,489 WNW	8,784 NW	11,309 NNW	6,341 WNW	9,107 NW	9,107 NW	9,107 NW
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)[a]	4,321 S	3,973 SSW	2,036 N	4,414 NNW	2,811 SSW	1,770 NW	1,798 NW	1,866 NW
Lovelace Hospital	3,764 WNW	4,386 WNW	7,364 NNW	10,185 NNW	4,454 NNW	7,644 NNW	7,644 NNW	7,644 NNW
National Atomic Museum	1,120 WNW	1,767 WNW	5,835 NNW	8,937 N	2,079 NNW	6,065 NNW	6,065 NNW	6,065 NNW
Riding Stables[a]	4,861 SSE	1,276 WNW	2,985 NE	4,421 NNE	3,543 SE	1,754 NE	1,791 NE	1,859 NE
Sandia Base Elementary	1,572 NNW	2,307 NW 2,297 NNW	6,817 NNE	9,921 NNW	2,961 NNW	7,176 N	7,176 N	7,176 N
Shandiin Day Care Center	1,670 W 1,673 WNW	2,279 WNW	5,981 NNW	9,026 N	2,432 NW	6,240 NNW	6,240 NNW	6,240 NNW
Veterans Affairs Medical Center	3,623 W 3,650 WNW	4,212 WNW	6,936 NNW	9,783 NNW	3,964 NW	7,372 NW 7,201 NNW	7,372 NW 7,201 NNW	7,372 NW 7,201 NNW
Wherry Elementary School	2,124 WNW	2,861 WNW 2,860 NW	6,881 NNW	9,739 NNW	3,091 NW	6,997 NNW	6,997 NNW	6,997 NNW
Zia Park Housing[a]	1,860 W	2,171 W	6,351 NNW	8,739 NWW	2,331 NW	5,934 NNW	5,965 NNW	6,061 NNW

Source: SNL/NM 1996u
ACRR: Annular Core Research Reactor
ECF: Explosive Components Facility
HCF: Hot Cell Facility
HERMES III: High-Energy Radiation Megavolt Electron Source III
MWL: Mixed Waste Landfill
NGF: Neutron Generator Facility
RITS: Radiographic Integrated Test Stand
RMWMF: Radioactive and Mixed Waste Management Facility
SPR: Sandia Pulsed Reactor
[a] Also a NESHAP-considered receptor location

Table D.2–6. Distance (Meters) and Direction to Offsite Receptor Locations From SNL/NM

FACILITY	NGF (BLDG. 870)	ECF (BLDG. 905)	MWL	RMWMF (BLDG. 6920)	RITS AND HERMES III (BLDG. 970)	HCF (BLDG. 6580)	ACRR (BLDG. 6588)	SPR (BLDG. 6590)
Albuquerque City Offices	6,212 SW	6,269 WSW	5,528 WNW	7,472 NW	5,510 WSW	6,084 WNW	6,083 WNW	6,118 WNW
East Resident	18,695 ESE	18,352 NNE	17,917 E	17,291 E	18,294 ESE	16,991 E	16,836 E	16,998 E
Eubank Gate Area (Building 8895)	720 NE	862 ESE	6,746 N	8,960 N	2,022 NNE	5,908 N	5,949 N	6,055 N
Four Hills Subdivision	2,851 ESE	2,520 E	6,554 NNE	8,379 NNE	2,989 ENE	5,435 NNE	5,479 NNE	5,576 NNE
Isleta Gaming Palace	16,354 SW	16,309 SW	12,150 WSW	11,907 WSW	15,298 SW	13,366 WSW	13,332 WSW	13,278 WSW
Northeast Resident	7,562 ESE	7,199 ESE	8,340 ENE	8,999 NE	7,235 E	7,145 ENE	7,175 ENE	7,220 ENE
Seismic Center (USGS)	13,533 SE	13,099 SE	9,472 ESE	7,829 ESE	12,381 SE	9,123 SE	9,110 SE	9,045 SE
Tijeras Arroyo (West)	5,851 W	5,799 SW	4,224 WNW	6,184 NW	4,871 WSW	4,829 WNW	4,825 WNW	4,854 WNW

Source: SNL/NM 1996u
ACRR: Annular Core Research Reactor
ECF: Explosive Components Facility
HCF: Hot Cell Facility
HERMES III: High-Energy Radiation Megavolt Electron Source III
MWL: Mixed Waste Landfill
NGF: Neutron Generator Facility
RITS: Radiographic Integrated Test Stand
RMWMF: Radioactive and Mixed Waste Management Facility
SPR: Sandia Pulsed Reactor
USGS: U.S. Geological Survey

Table D.2–7. Summary of Dose Estimates to Each of the SNL/NM Receptors from No Action Alternative Emissions

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
ONSITE and/or SPECIAL POTENTIAL MEI (mrem/yr)											
Building 20706	1.5×10^{-4}	2.3×10^{-5}	4.4×10^{-5}	2.2×10^{-2}	7.3×10^{-8}	7.8×10^{-8}	2.3×10^{-6}	1.0×10^{-7}	5.6×10^{-3}	7.0×10^{-6}	2.8×10^{-2}
Building 24499	9.6×10^{-5}	1.5×10^{-5}	2.9×10^{-5}	1.4×10^{-2}	2.0×10^{-8}	6.7×10^{-7}	2.0×10^{-6}	7.3×10^{-8}	6.1×10^{-3}	2.0×10^{-6}	2.0×10^{-2}
Civil Engineering Research Facility (Bldg. 5701)	9.0×10^{-5}	1.4×10^{-5}	2.7×10^{-5}	1.2×10^{-2}	5.2×10^{-10}	6.8×10^{-7}	4.4×10^{-6}	2.1×10^{-9}	1.5×10^{-4}	5.2×10^{-6}	1.2×10^{-2}
Child Development Center-East	1.0×10^{-4}	1.5×10^{-5}	2.9×10^{-5}	1.5×10^{-2}	1.3×10^{-8}	8.3×10^{-7}	1.8×10^{-6}	2.9×10^{-8}	3.6×10^{-3}	1.3×10^{-6}	1.8×10^{-2}
Child Development Center-West	1.1×10^{-4}	1.7×10^{-5}	3.2×10^{-5}	1.8×10^{-2}	2.1×10^{-9}	8.4×10^{-7}	2.1×10^{-6}	8.3×10^{-9}	7.3×10^{-4}	2.0×10^{-7}	1.9×10^{-2}
Coronado Club	1.0×10^{-4}	1.5×10^{-5}	2.9×10^{-5}	1.5×10^{-2}	1.5×10^{-8}	6.3×10^{-7}	1.8×10^{-6}	3.2×10^{-8}	4.2×10^{-3}	1.4×10^{-6}	2.0×10^{-2}
Coyote Canyon Control Center	8.9×10^{-5}	1.4×10^{-5}	2.6×10^{-5}	1.2×10^{-2}	4.1×10^{-10}	5.7×10^{-7}	4.0×10^{-6}	2.2×10^{-9}	1.6×10^{-4}	3.9×10^{-8}	1.2×10^{-2}
Golf Course Clubhouse	5.4×10^{-4}	9.0×10^{-5}	1.8×10^{-4}	7.0×10^{-2}	2.1×10^{-8}	2.0×10^{-6}	4.7×10^{-6}	1.1×10^{-8}	6.7×10^{-4}	2.0×10^{-6}	7.2×10^{-2}
Golf Course Maintenance Area	3.4×10^{-4}	5.6×10^{-4}	1.1×10^{-4}	4.4×10^{-2}	3.8×10^{-8}	1.5×10^{-6}	3.9×10^{-6}	1.7×10^{-8}	9.7×10^{-4}	3.7×10^{-6}	4.5×10^{-2}
Lovelace Respiratory Research Institute	8.6×10^{-5}	1.3×10^{-5}	2.5×10^{-5}	1.2×10^{-2}	3.3×10^{-10}	5.5×10^{-10}	4.0×10^{-6}	1.8×10^{-8}	1.3×10^{-4}	3.2×10^{-8}	1.2×10^{-2}
Kirtland Elementary School	1.1×10^{-4}	1.6×10^{-5}	3.1×10^{-5}	1.8×10^{-2}	1.8×10^{-9}	8.2×10^{-7}	2.1×10^{-6}	7.6×10^{-9}	7.3×10^{-4}	1.7×10^{-7}	1.9×10^{-2}
KAFB Firestation #4 (Bldg. 9002)	1.3×10^{-4}	2.0×10^{-5}	3.7×10^{-5}	1.7×10^{-2}	1.6×10^{-10}	1.3×10^{-6}	$9.8\text{x}1^{-6}$	2.4×10^{-9}	1.8×10^{-4}	1.6×10^{-8}	1.7×10^{-2}
KAFB Landfill	1.9×10^{-4}	3.0×10^{-5}	5.9×10^{-5}	$2.6\text{x}1^{-2}$	1.5×10^{-7}	9.8×10^{-7}	2.9×10^{-6}	5.8×10^{-8}	2.4×10^{-3}	1.4×10^{-5}	2.9×10^{-2}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	1.3×10^{-3}	2.1×10^{-4}	4.2×10^{-4}	1.5×10^{-1}	1.0×10^{-8}	4.0×10^{-6}	7.5×10^{-6}	9.9×10^{-9}	7.4×10^{-4}	9.8×10^{-7}	1.5×10^{-1}
Loop Housing	9.1×10^{-5}	1.4×10^{-5}	2.7×10^{-5}	1.4×10^{-2}	2.2×10^{-8}	6.0×10^{-7}	1.9×10^{-6}	5.8×10^{-8}	7.0×10^{-3}	2.1×10^{-6}	2.1×10^{-2}

Table D.2–7. Summary of Dose Estimates to Each of the SNL/NM Receptors from No Action Alternative Emissions (continued)

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
Lovelace Hospital	8.4×10^{-5}	1.3×10^{-5}	2.4×10^{-5}	1.3×10^{-2}	4.1×10^{-9}	7.2×10^{-7}	2.4×10^{-6}	1.3×10^{-8}	1.2×10^{-3}	4.1×10^{-7}	1.4×10^{-2}
Manzano Offices (Fire Station)	2.7×10^{-4}	4.3×10^{-5}	8.6×10^{-5}	3.3×10^{-2}	2.6×10^{-9}	1.2×10^{-6}	4.9×10^{-6}	5.1×10^{-9}	3.5×10^{-4}	2.6×10^{-7}	3.4×10^{-2}
Maxwell Housing	1.3×10^{-4}	1.9×10^{-5}	3.7×10^{-5}	2.1×10^{-2}	3.0×10^{-9}	9.0×10^{-7}	2.3×10^{-6}	1.0×10^{-8}	9.4×10^{-4}	2.9×10^{-6}	2.2×10^{-2}
National Atomic Museum	1.2×10^{-4}	1.9×10^{-5}	3.6×10^{-5}	1.8×10^{-2}	3.3×10^{-8}	1.0×10^{-6}	2.1×1^{-6}	5.2×10^{-8}	7.2×10^{-3}	2.4×10^{-6}	2.5×10^{-2}
Pershing Park Housing	7.6×10^{-5}	1.4×10^{-5}	2.7×10^{-5}	1.4×10^{-2}	1.1×10^{-8}	5.3×10^{-7}	1.7×10^{-6}	3.2×10^{-8}	3.5×10^{-3}	1.1×10^{-6}	1.7×10^{-2}
Riding Club/Stables	5.1×10^{-4}	8.8×10^{-5}	1.8×10^{-4}	6.2×10^{-2}	5.5×10^{-9}	1.8×10^{-6}	5.5×10^{-6}	8.5×10^{-8}	4.5×10^{-4}	5.2×10^{-7}	6.3×10^{-2}
Sandia Base Elementary	7.8×10^{-5}	1.2×10^{-5}	2.3×10^{-5}	1.2×10^{-2}	1.3×10^{-8}	6.1×10^{-7}	2.5×10^{-6}	3.2×10^{-8}	4.1×10^{-3}	1.3×10^{-6}	1.7×10^{-2}
Sandia Federal Credit Union	1.3×10^{-4}	2.0×10^{-5}	3.8×10^{-5}	1.9×10^{-2}	4.1×10^{-8}	6.9×10^{-7}	2.1×10^{-6}	9.7×10^{-7}	1.2×10^{-2}	4.1×10^{-6}	3.1×10^{-2}
Shandiin Day Care Center	1.2×10^{-4}	1.8×10^{-5}	3.4×10^{-5}	1.7×10^{-2}	2.0×10^{-8}	9.7×10^{-7}	2.0×10^{-6}	3.5×10^{-8}	4.6×10^{-3}	1.9×10^{-6}	2.2×10^{-2}
Sunport (Bldg. 760)	1.4×10^{-4}	3.6×10^{-5}	7.0×10^{-5}	3.7×10^{-2}	1.6×10^{-8}	1.0×10^{-6}	3.2×10^{-6}	2.4×10^{-8}	1.7×10^{-3}	1.6×10^{-6}	3.9×10^{-2}
Sunport (Bldg. 1064)	1.1×10^{-4}	1.7×10^{-5}	3.2×10^{-5}	1.6×10^{-2}	1.1×10^{-8}	8.2×10^{-7}	2.8×10^{-6}	2.3×10^{-8}	2.0×10^{-3}	1.1×10^{-6}	1.8×10^{-2}
Technical Onsite Inspection Facility	1.9×10^{-4}	3.0×10^{-5}	5.9×10^{-5}	2.8×10^{-2}	3.1×10^{-7}	9.7×10^{-7}	2.7×10^{-6}	6.9×10^{-9}	3.9×10^{-3}	2.9×10^{-5}	3.3×10^{-2}
Veterans Affairs Medical Center	1.6×10^{-4}	2.3×10^{-5}	4.5×10^{-5}	2.5×10^{-2}	5.2×10^{-9}	7.9×10^{-7}	2.5×10^{-6}	1.4×10^{-8}	1.4×10^{-3}	5.1×10^{-7}	2.7×10^{-2}
Wherry Elementary School	9.8×10^{-5}	1.5×10^{-5}	2.8×10^{-5}	1.5×10^{-2}	1.0×10^{-8}	7.9×10^{-7}	2.5×10^{-6}	2.4×10^{-8}	2.9×10^{-3}	9.8×10^{-7}	1.8×10^{-2}
Zia Park Housing	1.2×10^{-4}	1.9×10^{-5}	3.7×10^{-5}	1.9×10^{-2}	2.2×10^{-8}	8.9×10^{-7}	2.9×10^{-6}	4.2×10^{-8}	3.9×10^{-3}	2.1×10^{-6}	2.4×10^{-2}
OFFSITE POTENTIAL MEI (mrem/yr)											
Albuquerque City Offices	1.9×10^{-4}	4.4×10^{-5}	5.4×10^{-5}	4.1×10^{-2}	5.5×10^{-9}	6.4×10^{-6}	2.2×10^{-5}	1.3×10^{-7}	1.0×10^{-2}	1.2×10^{-8}	5.1×10^{-2}
East Resident	1.2×10^{-5}	1.8×10^{-5}	3.4×10^{-6}	1.4×10^{-2}	1.5×10^{-11}	4.3×10^{-6}	1.7×10^{-5}	1.2×10^{-7}	9.5×10^{-3}	3.2×10^{-11}	2.4×10^{-2}
Eubank Gate Area (Bldg. 8895)	1.0×10^{-4}	3.3×10^{-5}	3.2×10^{-5}	2.8×10^{-2}	2.8×10^{-8}	4.9×10^{-6}	1.9×10^{-5}	1.9×10^{-7}	1.7×10^{-2}	6.1×10^{-8}	4.5×10^{-2}

Table D.2–7. Summary of Dose Estimates to Each of the SNL/NM Receptors from No Action Alternative Emissions (concluded)

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
Four Hills Subdivision	$1.2x10^{-4}$	$3.5x10^{-5}$	$3.6x10^{-5}$	$3.1x10^{-2}$	$8.6x10^{-9}$	$4.9x10^{-6}$	$1.9x10^{-5}$	$1.3x10^{-7}$	$1.0x10^{-2}$	$1.9x10^{-8}$	$4.1x10^{-2}$
Isleta Gaming Palace	$2.7x10^{-5}$	$2.0x10^{-5}$	$7.7x10^{-6}$	$1.7x10^{-2}$	$4.1x10^{-11}$	$4.6x10^{-6}$	$9.1x10^{-5}$	$1.2x10^{-7}$	$9.6x10^{-3}$	$9.0x10^{-11}$	$2.7x10^{-2}$
Northeast Resident	$5.3x10^{-5}$	$2.4x10^{-5}$	$1.6x10^{-5}$	$2.0x10^{-2}$	$8.3x10^{-10}$	$4.5x10^{-6}$	$1.8x10^{-6}$	$1.2x10^{-7}$	$9.6x10^{-3}$	$1.8x10^{-9}$	$3.0x10^{-2}$
Seismic Center (USGS)	$3.3x10^{-5}$	$2.1x10^{-5}$	$9.6x10^{-6}$	$1.7x10^{-2}$	$1.1x10^{-10}$	$4.4x10^{-6}$	$1.8x10^{-5}$	$1.2x10^{-7}$	$9.5x10^{-3}$	$2.3x10^{-10}$	$2.7x10^{-2}$
Tijeras Arroyo (West)	$2.7x10^{-4}$	$5.7x10^{-5}$	$7.8x10^{-5}$	$5.3x10^{-2}$	$7.9x10^{-9}$	$7.5x10^{-6}$	$2.4x10^{-5}$	$1.3x10^{-7}$	$1.0x10^{-2}$	$1.7x10^{-8}$	$6.3x10^{-2}$
POPULATION DOSE (person-rem/yr)	**$2.54x10^{-2}$**	**$5.35x10^{-3}$**	**$7.2x10^{-3}$**	**4.61**	**$2.1x10^{-7}$**	**$6.16x10^{-4}$**	**$3.24x10^{-3}$**	**$4.19x10^{-6}$**	**0.322**	**$4.5x10^{-7}$**	**5.0**

Sources: DOE 1997e, SNL/NM 1998a
ACRR: Annular Core Research Reactor
DP: Defense Programs
ECF: Explosive Components Facility
HCF: Hot Cell Facility
HERMES III: High-Energy Radiation Megavolt Electron Source III
KAFB: Kirtland Air Force Base
MEI: maximally exposed individual
Mo-99: molybdenum-99 and other medical isotopes production
mrem/yr: millirems per year
MWL: Mixed Waste Landfill
NGF: Neutron Generator Facility
rem: Roentgen equivalent, man
RITS: Radiographic Integrated Test Stand
RMWMF: Radioactive and Mixed Waste Management Facility
SPR: Sandia Pulsed Reactor
USGS: U.S. Geological Survey

Table D.2–8. Summary of Dose Estimates to each of the SNL/NM Receptors from Expanded Operations Alternative Emissions from each SNL/NM Facility[a]

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
ONSITE and/or SPECIAL POTENTIAL MEI (mrem/yr)											
Building 20706	4.6x10^{-4}	4.5x10^{-5}	1.3x10^{-4}	0.072	2.1x10^{-7}	7.8x10^{-7}	2.3x10^{-6}	1.0x10^{-7}	5.6x10^{-3}	9.3x10^{-6}	7.8x10^{-2}
Building 24499	3.0x10^{-4}	3.0x10^{-5}	8.6x10^{-5}	0.048	5.9x10^{-8}	6.0x10^{-7}	2.0x10^{-6}	7.3x10^{-8}	6.1x10^{-3}	2.6x10^{-6}	5.5x10^{-2}
Civil Engineering Research Facility (Bldg. 5701)	2.8x10^{-4}	2.8x10^{-5}	8.0x10^{-5}	0.039	1.5x10^{-9}	6.8x10^{-7}	4.4x10^{-6}	2.1x10^{-9}	1.5x10^{-4}	6.9x10^{-8}	4.0x10^{-2}
Child Development Center-East	3.2x10^{-4}	3.0x10^{-5}	8.6x10^{-5}	0.05	3.9x10^{-8}	8.3x10^{-7}	1.8x10^{-6}	2.9x10^{-8}	3.6x10^{-3}	1.7x10^{-6}	5.4x10^{-2}
Child Development Center-West	3.6x10^{-4}	3.3x10^{-5}	9.5x10^{-5}	0.061	6.0x10^{-9}	8.4x10^{-7}	2.1x10^{-6}	8.3x10^{-9}	7.3x10^{-4}	2.7x10^{-7}	6.2x10^{-2}
Coronado Club	3.2x10^{-4}	3.0x10^{-5}	8.7x10^{-5}	0.05	4.4x10^{-8}	6.3x10^{-7}	1.8x10^{-6}	3.2x10^{-8}	4.2x10^{-3}	1.9x10^{-6}	5.5x10^{-2}
Coyote Canyon Control Center	2.8x10^{-4}	2.7x10^{-5}	7.9x10^{-5}	0.039	1.2x10^{-9}	5.7x10^{-7}	4.0x10^{-6}	2.2x10^{-9}	1.6x10^{-4}	5.2x10^{-8}	4.0x10^{-2}
Golf Course Clubhouse	1.7x10^{-3}	1.8x10^{-4}	5.4x10^{-4}	0.23	6.2x10^{-8}	2.0x0^{-6}	4.7x10^{-6}	1.1x10^{-8}	6.7x10^{-4}	2.7x10^{-6}	2.3x10^{-1}
Golf Course Maintenance Area	1.1x10^{-3}	1.1x10^{-4}	3.3x10^{-4}	0.15	1.1x10^{-7}	1.5x10^{-6}	3.9x10^{-6}	1.7x10^{-8}	9.7x10^{-4}	4.9x10^{-6}	1.5x10^{-1}
Lovelace Respiratory Research Institute	2.7x10^{-4}	2.6x10^{-5}	7.4x10^{-5}	0.041	9.5x10^{-10}	5.5x10^{-7}	4.0x10^{-6}	1.8x10^{-9}	1.3x10^{-4}	4.2x10^{-8}	4.2x10^{-2}
Kirtland Elementary School	3.5x10^{-4}	3.3x10^{-5}	9.3x10^{-5}	0.06	5.2x10^{-9}	8.2x10^{-7}	2.1x10^{-6}	7.6x10^{-9}	7.3x10^{-4}	2.3x10^{-7}	6.1x10^{-2}
KAFB Firestation #4 (Bldg. 9002)	4.0x10^{-4}	4.0x10^{-5}	1.1x10^{-4}	0.058	4.6x10^{-10}	1.3x10^{-6}	9.8x10^{-6}	2.4x10^{-9}	1.8x10^{-4}	2.1x10^{-8}	5.9x10^{-2}
KAFB Landfill	6.0x10^{-4}	6.1x10^{-5}	1.8x10^{-4}	0.088	4.2x10^{-7}	9.8x10^{-7}	2.9x10^{-6}	5.8x10^{-8}	2.4x10^{-3}	1.8x10^{-5}	9.1x10^{-2}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	4.3x10^{-3}	4.2x10^{-4}	1.3x10^{-3}	0.50	3.0x10^{-8}	4.0x10^{-6}	7.5x10^{-6}	9.9x10^{-9}	7.4x10^{-4}	1.3x10^{-6}	5.1x10^{-1}

Table D.2–8. Summary of Dose Estimates to each of the SNL/NM Receptors from Expanded Operations Alternative Emissions from each SNL/NM Facility[a] (continued)

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
Loop Housing	2.9×10^{-4}	2.9×10^{-5}	8.2×10^{-5}	0.046	6.3×10^{-8}	6.0×10^{-7}	1.9×10^{-6}	5.8×10^{-8}	7.0×10^{-3}	2.8×10^{-6}	5.3×10^{-2}
Lovelace Hospital	2.6×10^{-4}	2.5×10^{-5}	7.2×10^{-5}	0.043	1.2×10^{-8}	7.2×10^{-7}	2.4×10^{-6}	1.3×10^{-8}	1.2×10^{-3}	5.4×10^{-7}	4.5×10^{-2}
Manzano Offices (Fire Station)	8.6×10^{-4}	8.7×10^{-5}	2.6×10^{-4}	0.11	7.6×10^{-9}	1.2×10^{-6}	4.9×10^{-6}	5.1×10^{-9}	3.5×10^{-4}	3.4×10^{-7}	1.1×10^{-1}
Maxwell Housing	4.1×10^{-4}	3.9×10^{-5}	1.1×10^{-4}	0.070	8.6×10^{-9}	9.0×10^{-9}	2.3×10^{-6}	1.0×10^{-8}	9.4×10^{-4}	3.8×10^{-7}	7.2×10^{-2}
National Atomic Museum	3.9×10^{-4}	3.7×10^{-5}	1.1×10^{-4}	0.061	9.5×10^{-8}	1.0×10^{-6}	2.1×10^{-6}	5.2×10^{-8}	7.2×10^{-3}	3.2×10^{-6}	6.9×10^{-2}
Pershing Park Housing	2.4×10^{-4}	2.8×10^{-5}	8.0×10^{-5}	0.047	3.2×10^{-8}	5.3×10^{-7}	1.7×10^{-6}	3.2×10^{-8}	3.5×10^{-3}	1.4×10^{-6}	5.1×10^{-2}
Riding Stables	1.6×10^{-3}	1.8×10^{-4}	5.3×10^{-4}	0.21	1.6×10^{-8}	1.8×10^{-6}	5.5×10^{-6}	8.5×10^{-8}	4.5×10^{-4}	6.9×10^{-7}	2.1×10^{-1}
Sandia Base Elementary	2.5×10^{-4}	2.4×10^{-5}	6.8×10^{-5}	0.039	3.8×10^{-8}	6.1×10^{-7}	2.5×10^{-6}	3.2×10^{-8}	4.1×10^{-3}	1.7×10^{-6}	4.3×10^{-2}
Sandia Federal Credit Union	4.0×10^{-4}	3.9×10^{-5}	1.1×10^{-4}	0.064	1.2×10^{-7}	6.9×10^{-7}	2.1×10^{-6}	9.7×10^{-8}	1.2×10^{-2}	5.4×10^{-6}	7.7×10^{-2}
Shandiin Day Care Center	3.7×10^{-4}	3.6×10^{-5}	1.0×10^{-4}	0.058	5.8×10^{-8}	9.7×10^{-7}	2.0×10^{-6}	3.5×10^{-8}	4.6×10^{-3}	2.5×10^{-6}	6.3×10^{-2}
Sunport (Bldg. 1064)	3.4×10^{-4}	3.3×10^{-5}	9.5×10^{-5}	0.055	3.2×10^{-8}	8.2×10^{-7}	2.8×10^{-6}	2.3×10^{-8}	2.0×10^{-3}	1.4×10^{-6}	5.7×10^{-2}
Sunport (Bldg. 760)	4.3×10^{-4}	7.1×10^{-5}	2.1×10^{-4}	0.12	4.7×10^{-8}	1.0×10^{-6}	3.2×10^{-6}	2.4×10^{-8}	1.7×10^{-3}	2.1×10^{-6}	1.2×10^{-1}
Technical Onsite Inspection Facility	6.1×10^{-4}	6.0×10^{-5}	1.8×10^{-4}	0.093	8.9×10^{-7}	9.7×10^{-7}	2.7×10^{-6}	6.9×10^{-9}	3.9×10^{-3}	3.8×10^{-5}	9.8×10^{-2}
Veterans Affairs Medical Center	5.0×10^{-4}	4.6×10^{-5}	1.3×10^{-4}	0.082	1.5×10^{-8}	7.9×10^{-7}	2.5×10^{-6}	1.4×10^{-8}	1.4×10^{-3}	6.8×10^{-7}	8.4×10^{-2}
Wherry Elementary School	3.1×10^{-4}	2.9×10^{-5}	8.4×10^{-5}	0.049	3.0×10^{-8}	7.9×10^{-7}	2.5×10^{-6}	2.4×10^{-8}	2.9×10^{-3}	1.3×10^{-6}	5.2×10^{-2}
Zia Park Housing	3.9×10^{-4}	3.8×10^{-5}	1.1×10^{-4}	0.062	6.4×10^{-8}	8.9×10^{-7}	2.9×10^{-6}	4.2×10^{-8}	3.9×10^{-3}	2.8×10^{-6}	6.6×10^{-2}

Table D.2–8. Summary of Dose Estimates to each of the SNL/NM Receptors from Expanded Operations Alternative Emissions from each SNL/NM Facility[a] (concluded)

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
OFFSITE POTENTIAL MEI (mrem/yr)											
Albuquerque City Offices	6.0×10^{-4}	8.910^{-5}	1.6×10^{-4}	0.14	1.6×10^{-8}	6.4×10^{-6}	2.2×10^{-5}	1.3×10^{-7}	1.0×10^{-2}	7.2×10^{-7}	1.5×10^{-1}
East Resident	3.7×10^{-5}	3.5×10^{-5}	1.0×10^{-5}	0.048	4.2×10^{-11}	4.3×10^{-6}	1.7×10^{-5}	1.2×10^{-7}	9.5×10^{-3}	1.9×10^{-9}	5.8×10^{-2}
Eubank Gate Area (Bldg. 8895)	3.3×10^{-4}	6.5×10^{-5}	9.5×10^{-5}	0.095	8.1×10^{-8}	4.9×10^{-6}	1.9×10^{-5}	1.9×10^{-7}	1.7×10^{-2}	3.6×10^{-6}	1.1×10^{-1}
Four Hills Subdivision	3.8×10^{-4}	7.0×10^{-5}	1.1×10^{-4}	0.10	2.5×10^{-8}	4.9×10^{-6}	1.9×10^{-5}	1.3×10^{-7}	1.0×10^{-2}	1.1×10^{-6}	1.1×10^{-1}
Isleta Gaming Palace	8.6×10^{-5}	4.0×10^{-5}	2.3×1^{-5}	0.056	1.2×10^{-10}	4.6×10^{-6}	2.1×10^{-5}	1.2×10^{-7}	9.6×10^{-3}	5.1×10^{-9}	6.6×10^{-2}
Northeast Resident	1.7×10^{-4}	4.8×10^{-5}	4.7×10^{-5}	0.068	2.4×10^{-9}	4.5×10^{-6}	1.8×10^{-5}	1.2×10^{-7}	9.6×10^{-3}	1.1×10^{-7}	7.8×10^{-2}
Seismic Center (USGS)	1.1×10^{-4}	4.2×10^{-5}	2.9×10^{-5}	0.058	3.1×10^{-10}	4.4×10^{-6}	1.8×10^{-5}	1.2×10^{-7}	9.5×10^{-3}	1.4×10^{-8}	6.8×10^{-2}
Tijeras Arroyo (West)	8.6×10^{-4}	1.1×10^{-4}	2.3×10^{-4}	0.18	2.3×10^{-8}	7.5×10^{-6}	2.4×10^{-5}	1.3×10^{-7}	1.0×10^{-2}	1.010^{-6}	1.9×10^{-1}
POPULATION DOSE (person-rem)	**0.0801**	**0.0107**	**0.0216**	**15.4**	**6.06×10^{-7}**	**6.16×10^{-4}**	**3.24×10^{-8}**	**4.19×10^{-6}**	**0.322**	**2.69×10^{-5}**	**15.8**

Sources: DOE 1997e, SNL/NM 1998a
ACRR: Annular Core Research Reactor
DP: Defense Programs
ECF: Explosive Components Facility
HCF: Hot Cell Facility
HERMES II: High-Energy Radiation Megavolt Electron Source II
KAFB: Kirtland Air Force Base
MEI: maximally exposed individual
Mo-99: molybdenum-99 and other medical isotopes production
mrem/yr: millirems per year
MWL: Mixed Waste Landfill
NGF: Neutron Generator Facility
rem: Roentgen equivalent, man
RITS: Radiographic Integrated Test Stand
RMWMF: Radioactive and Mixed Waste Management Facility
SPR: Sandia Pulsed Reactor
USGS: U.S. Geological Survey
[a] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the dose estimates under the Expanded Operations Alternative.

Table D.2–9. Summary of Dose Estimates to each of the SNL/NM Receptors from Reduced Operations Alternative Emissions from each SNL/NM Facility

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
ONSITE and/or SPECIAL POTENTIAL MEI (mrem/yr)											
Building 20706	4.4×10^{-5}	4.9×10^{-6}	0	2.2×10^{-3}	5.8×10^{-9}	7.8×10^{-7}	2.3×10^{-6}	1.0×10^{-8}	5.6×10^{-3}	1.2×10^{-6}	7.8×10^{-3}
Building 24499	2.9×10^{-5}	3.3×10^{-6}	0	1.4×10^{-3}	1.6×10^{-9}	6.0×10^{-7}	2.0×10^{-6}	7.3×10^{-9}	6.1×10^{-3}	3.3×10^{-7}	7.5×10^{-3}
Civil Engineering Research Facility (Bldg. 5701)	2.7×10^{-5}	3.1×10^{-6}	0	1.2×10^{-3}	4.2×10^{-11}	6.8×10^{-7}	4.4×10^{-6}	2.1×10^{-10}	1.5×10^{-4}	8.6×10^{-9}	1.4×10^{-3}
Child Development Center-East	3.0×10^{-5}	3.3×10^{-6}	0	1.5×10^{-3}	1.1×10^{-9}	8.3×10^{-7}	1.8×10^{-6}	2.9×10^{-9}	3.6×10^{-3}	2.1×10^{-7}	5.1×10^{-3}
Child Development Center-West	3.4×10^{-5}	3.6×10^{-6}	0	1.8×10^{-3}	1.7×10^{-10}	8.4×10^{-7}	2.1×10^{-6}	8.3×10^{-10}	7.3×10^{-4}	3.4×10^{-8}	2.6×10^{-3}
Coronado Club	3.0×10^{-5}	3.3×10^{-6}	0	1.5×10^{-3}	1.2×10^{-9}	6.3×10^{-7}	1.8×10^{-6}	3.2×10^{-9}	4.2×10^{-3}	2.4×10^{-7}	5.7×10^{-3}
Coyote Canyon Control Center	2.7×10^{-5}	2.9×10^{-6}	0	1.2×10^{-3}	3.3×10^{-11}	5.7×10^{-7}	4.0×10^{-6}	2.2×10^{-10}	1.6×10^{-4}	6.5×10^{-9}	1.4×10^{-3}
Golf Course Clubhouse	1.6×10^{-4}	2.0×10^{-5}	0	7.0×10^{-3}	1.7×10^{-9}	2.0×10^{-6}	4.7×10^{-6}	1.1×10^{-9}	6.7×10^{-4}	3.4×10^{-7}	7.9×10^{-3}
Golf Course Maintenance Area	1.0×10^{-4}	1.2×10^{-5}	0	4.4×10^{-3}	3.1×10^{-9}	1.5×10^{-6}	3.9×10^{-6}	1.7×10^{-9}	9.7×10^{-4}	6.1×10^{-7}	5.5×10^{-3}
Lovelace Respiratory Research Institute	2.6×10^{-5}	2.8×10^{-6}	0	1.2×10^{-3}	2.6×10^{-11}	5.5×10^{-7}	4.0×10^{-6}	1.8×10^{-10}	1.3×10^{-4}	5.3×10^{-9}	1.4×10^{-3}
Kirtland Elementary School	3.3×10^{-5}	3.6×10^{-6}	0	1.8×10^{-3}	1.4×10^{-10}	8.2×10^{-7}	2.1×10^{-6}	7.6×10^{-10}	7.3×10^{-4}	2.9×10^{-8}	2.5×10^{-3}
KAFB Firestation #4 (Bldg. 9002)	3.8×10^{-5}	3.7×10^{-6}	0	1.7×10^{-3}	1.3×10^{-11}	1.3×10^{-6}	9.8×10^{-6}	2.4×10^{-10}	1.8×10^{-4}	2.6×10^{-9}	1.9×10^{-3}
KAFB Landfill	5.7×10^{-5}	6.7×10^{-6}	0	2.6×10^{-3}	1.2×10^{-8}	9.8×10^{-7}	2.9×10^{-6}	5.8×10^{-9}	2.4×10^{-3}	2.3×10^{-6}	5.0×10^{-3}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	4.1×10^{-4}	4.6×10^{-5}	0	1.5×10^{-2}	8.3×10^{-10}	4.0×10^{-6}	7.5×10^{-6}	9.9×10^{-10}	7.4×10^{-4}	1.6×10^{-7}	1.6×10^{-2}
Loop Housing	2.8×10^{-5}	3.2×10^{-6}	0	1.4×10^{-3}	1.7×10^{-9}	6.0×10^{-7}	1.9×10^{-6}	5.8×10^{-9}	7.0×10^{-3}	3.5×10^{-7}	8.4×10^{-3}

Table D.2–9. Summary of Dose Estimates to each of the SNL/NM Receptors from Reduced Operations Alternative Emissions from each SNL/NM Facility (continued)

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
Lovelace Hospital	$2.5x10^{-4}$	$2.7x10^{-6}$	0	$1.3x10^{-3}$	$3.3x10^{-10}$	$7.2x10^{-7}$	$2.4x10^{-6}$	$1.3x10^{-9}$	$1.2x10^{-3}$	$6.8x10^{-8}$	$2.8x10^{-3}$
Manzano Offices (Fire Station)	$8.2x10^{-5}$	$9.5x10^{-6}$	0	$3.3x10^{-3}$	$2.1x10^{-10}$	$1.2x10^{-6}$	$4.9x10^{-6}$	$5.1x10^{-10}$	$3.5x10^{-4}$	$4.3x10^{-8}$	$3.8x10^{-3}$
Maxwell Housing	$3.9x10^{-5}$	$4.3x10^{-6}$	0	$1.2x10^{-3}$	$2.4x10^{-10}$	$9.0x10^{-7}$	$2.3x10^{-6}$	$1.0x10^{-9}$	$9.4x10^{-4}$	$4.8x10^{-8}$	$2.2x10^{-3}$
National Atomic Museum	$3.7x10^{-5}$	$4.0x10^{-6}$	0	$1.8x10^{-3}$	$2.6x10^{-9}$	$1.0x10^{-6}$	$2.1x10^{-6}$	$5.2x10^{-9}$	$7.2x10^{-3}$	$4.0x10^{-7}$	$9.0x10^{-3}$
Pershing Park Housing	$2..3x10^{-5}$	$3.1x10^{-6}$	0	$1.4x10^{-3}$	$8.9x10^{-10}$	$5.3x10^{-7}$	$1.7x10^{-6}$	$3.2x10^{-9}$	$3.5x10^{-3}$	$1.8x10^{-7}$	$4.9x10^{-3}$
Riding Club	$1.5x10^{-4}$	$2.0x10^{-5}$	0	$6.2x10^{-3}$	$4.4x10^{-10}$	$1.8x10^{-6}$	$5.5x10^{-6}$	$8.5x10^{-9}$	$4.5x10^{-4}$	$8.6x10^{-8}$	$6.8x10^{-3}$
Sandia Base Elementary	$2.4x10^{-5}$	$2.6x10^{-6}$	0	$1.2x10^{-3}$	$1.1x10^{-9}$	$6.1x10^{-7}$	$2.5x10^{-6}$	$3.2x10^{-9}$	$4.1x10^{-3}$	$2.1x10^{-7}$	$4.1x10^{-3}$
Sandia Federal Credit Union	$3.8x10^{-5}$	$4.3x10^{-6}$	0	$1.9x10^{-3}$	$3.3x10^{-9}$	$6.9x10^{-7}$	$2.1x10^{-6}$	$9.7x10^{-9}$	$1.2x10^{-2}$	$6.8x10^{-7}$	$1.4x10^{-2}$
Shandiin Day Care Center	$3.5x10^{-5}$	$3.9x10^{-6}$	0	$1.7x10^{-3}$	$1.6x10^{-9}$	$9.7x10^{-7}$	$2.0x10^{-6}$	$3.5x10^{-9}$	$4.6x10^{-3}$	$3.1x10^{-7}$	$6.3x10^{-3}$
Sunport (Bldg. 1064)	$3.2x10^{-5}$	$3.6x10^{-6}$	0	$1.6x10^{-3}$	$8.9x10^{-10}$	$8.2x10^{-7}$	$2.8x10^{-6}$	$2.3x10^{-9}$	$2.0x10^{-3}$	$1.8x10^{-7}$	$3.6x10^{-3}$
Sunport (Bldg. 760)	$4.1x10^{-5}$	$7.7x10^{-6}$	0	$3.7x10^{-3}$	$1.3x10^{-9}$	$1.0x10^{-6}$	$3.2x10^{-6}$	$2.4x10^{-9}$	$1.7x10^{-3}$	$2.6x10^{-7}$	$5.4x10^{-3}$
Technical Onsite Inspection Facility	$5.8x10^{-5}$	$6.5x10^{-6}$	0	$2.8x10^{-3}$	$2.5x10^{-8}$	$9.7x10^{-7}$	$2.7x10^{-6}$	$6.9x10^{-10}$	$3.9x10^{-3}$	$4.8x10^{-6}$	$6.8x10^{-3}$
Veterans Affairs Medical Center	$4.8x10^{-5}$	$5.0x10^{-6}$	0	$2.5x10^{-3}$	$4.2x10^{-10}$	$7.9x10^{-7}$	$2.5x10^{-6}$	$1.4x10^{-9}$	$1.4x10^{-3}$	$8.5x10^{-8}$	$4.0x10^{-3}$
Wherry Elementary School	$2.9x10^{-5}$	$3.2x10^{-6}$	0	$1.5x10^{-3}$	$8.3x10^{-10}$	$7.9x10^{-7}$	$2.5x10^{-6}$	$2.4x10^{-9}$	$2.9x10^{-3}$	$1.6x10^{-7}$	$4.5x10^{-3}$
Zia Park Housing	$3.7x10^{-5}$	$4.1x10^{-6}$	0	$1.9x10^{-3}$	$1.8x10^{-9}$	$8.9x10^{-7}$	$2.9x10^{-6}$	$4.2x10^{-9}$	$3.9x10^{-3}$	$3.5x10^{-7}$	$5.8x10^{-3}$

Table D.2–9. Summary of Dose Estimates to each of the SNL/NM Receptors from Reduced Operations Alternative Emissions from each SNL/NM Facility (concluded)

RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
OFFSITE POTENTIAL MEI (mrem/yr)											
Albuquerque City Offices	$5.7x10^{-4}$	$9.7x10^{-6}$	0	$4.1x10^{-3}$	$4.4x10^{-10}$	$6.4x10^{-6}$	$2.2x10^{-5}$	$1.3x10^{-8}$	$1.0x10^{-2}$	$9.0x10^{-8}$	$1.5x10^{-2}$
East Resident	$3.5x10^{-6}$	$3.8x10^{-6}$	0	$1.4x10^{-3}$	$1.2x10^{-12}$	$4.3x10^{-6}$	$1.7x10^{-5}$	$1.2x10^{-8}$	$9.5x10^{-3}$	$2.4x10^{-10}$	$1.1x10^{-2}$
Eubank Gate Area (Bldg. 8895)	$3.1x10^{-5}$	$7.1x10^{-6}$	0	$2.8x10^{-3}$	$2.2x10^{-9}$	$4.9x10^{-6}$	$1.9x10^{-5}$	$1.9x10^{-8}$	$1.7x10^{-2}$	$4.5x10^{-7}$	$2.0x10^{-2}$
Four Hills Subdivision	$3.6x10^{-5}$	$7.6x10^{-6}$	0	$3.1x10^{-3}$	$6.9x10^{-10}$	$4.9x10^{-6}$	$1.9x10^{-5}$	$1.3x10^{-8}$	$1.0x10^{-2}$	$1.4x10^{-7}$	$1.0x10^{-2}$
Isleta Gaming Palace	$8.2x10^{-6}$	$4.4x10^{-6}$	0	$1.7x10^{-3}$	$3.3x10^{-12}$	$4.6x10^{-6}$	$2.1x10^{-5}$	$1.2x10^{-8}$	$9.6x10^{-3}$	$6.4x10^{-10}$	$1.1x10^{-2}$
Northeast Resident	$1.6x10^{-5}$	$5.2x10^{-6}$	0	$2.0x10^{-3}$	$6.6x10^{-11}$	$4.5x10^{-6}$	$1.8x10^{-5}$	$1.2x10^{-8}$	$9.6x10^{-3}$	$1.4x10^{-8}$	$1.2x10^{-2}$
Seismic Center (USGS)	$1.0x10^{-5}$	$4.6x10^{-6}$	0	$1.7x10^{-3}$	$8.6x10^{-12}$	$4.4x10^{-6}$	$1.8x10^{-5}$	$1.2x10^{-8}$	$9.5x10^{-3}$	$1.8x10^{-9}$	$1.1x10^{-2}$
Tijeras Arroyo (West)	$8.2x10^{-5}$	$1.2x10^{-5}$	0	$5.3x10^{-3}$	$6.4x10^{-10}$	$7.5x10^{-6}$	$2.4x10^{-5}$	$1.3x10^{-8}$	$1.0x10^{-2}$	$1.3x10^{-7}$	$1.5x10^{-2}$
POPULATION DOSE (person-rem/yr)	**$7.6x10^{-3}$**	**$1.2x10^{-3}$**	**0**	**0.461**	**$1.7x10^{-8}$**	**$6.16x10^{-4}$**	**$3.24x10^{-3}$**	**$4.19x10^{-7}$**	**0.322**	**$3.4x10^{-6}$**	**0.80**

Sources: DOE 1997e, SNL/NM 1998a
ACRR: Annular Core Research Reactor
DP: Defense Programs
ECF: Explosive Components Facility
HCF: Hot Cell Facility
HERMES III: High-Energy Radiation Megavolt Electron Source III
KAFB: Kirtland Air Force Base
MEI: maximally exposed individual
Mo-99: molybdenum-99 and other medical isotopes production
mrem/yr: millirems per year
MWL: Mixed Waste Landfill
NGF: Neutron Generator Facility
rem: Roentgen equivalent, man
RITS: Radiographic Integrated Test Stand
RMWMF: Radioactive and Mixed Waste Management Facility
SPR: Sandia Pulsed Reactor
USGS: U.S. Geological Survey

Table D.2–10. Calculated Dose Assessment Results for SNL/NM Operations Under No Action, Expanded Operations, and Reduced Operations Alternatives

DOSE TO RECEPTOR	LOCATION	ALTERNATIVE		
		NO ACTION	EXPANDED OPERATIONS[a]	REDUCED OPERATIONS
TOTAL DOSE MEI	KUMMSC	0.15 mrem/yr	0.51 mrem/yr	NA
	Eubank Gate Building 8895	NA	NA	0,02 mrem/yr
COLLECTIVE DOSE TO POPULATION	Within 50-mi radius	5.0 person-rem/yr	15.8 person-rem/yr	0.80 person-rem/yr

Sources: SNL/NM 1998a, DOE 1997e
KUMMSC: Kirtland Underground Munitions and Maintenance Storage Complex
MEI: maximally exposed individual
mi: miles
mrem/yr: millirems per year
NA: not applicable
[a] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the dose assessment results under the Expanded Operations Alternative.

APPENDIX E – HUMAN HEALTH AND WORKER SAFETY

E.1 INTRODUCTION

E.1.1 Purpose

This appendix describes the methods used to assess potential human health impacts associated with chemical exposures, radiation exposures, and worker safety issues due to the Sandia National Laboratories/New Mexico (SNL/NM) operations described under each of the alternatives: No Action, Expanded Operations, and Reduced Operations. Human health impacts were addressed using the sliding scale approach described in the U.S. Department of Energy's (DOE's) *Recommendations for the Preparation of Environmental Assessments and Environmental Impacts* (DOE 1993b). Human health risks were provided to represent the potential for adverse health effects and were compared among the alternatives.

All significant exposure pathways were evaluated. The analysis focused on evaluating impacts at specific receptor locations from air emissions associated with routine operations. The analysis presented potential health effects applicable to workers, public receptors in the SNL/NM vicinity, and the population within 50 mi of SNL/NM. Potentially sensitive individuals were also considered by assessing exposures and health risks at specific receptor locations in the SNL/NM vicinity.

E.1.2 Objective

The objective of this risk analysis was to evaluate the potential risks associated with human exposure to environmental media (that is, groundwater, air, or other such environmental media) that may be affected by radiological materials and other chemical constituents used in SNL/NM facility operations. Radionuclide and chemical constituents may be transferred to environmental media by way of routine air emissions from stacks, sporadic air emissions from open burning, transportation of radiological materials, or accidental release. When there is the potential for human contact with the affected medium, it is referred to as a complete exposure pathway. The Site-Wide Environmental Impact Statement (SWEIS) identified the air pathway as the primary complete exposure pathway that had the potential to transport materials directly from SNL/NM to locations where human receptors may be exposed directly through inhalation. The secondary exposure pathways identified included ingestion of crops contaminated by deposition of radiological airborne materials and livestock products from animals that ingested contaminated crops. Chemical and radiological contamination existing in the environment (such as soil and groundwater) at SNL/NM were also evaluated as potential transport pathways related to SNL/NM operations.

Estimated indicators of potential risk, or detriment, to human health were summarized both quantitatively and qualitatively in the following terms: fatal cancer risks, nonfatal cancers, latent cancer fatalities (LCFs), hazard indexes (HIs), individual excess lifetime cancer risks (ELCRs), and genetic disorders. The quantitative values were calculated based on actual and/or modeled data for contaminants transported in these media and the subsequent possible levels of human exposure to them.

The risk scenarios that were analyzed included

- inhalation of chemically contaminated air at specific receptor locations, including onsite, offsite, and specific receptor locations under visitor, residential, and hypothetical worst-case exposure scenarios;
- inhalation of radiologically contaminated air at specific receptor locations, including onsite, offsite, and specific receptor locations, and at the maximally exposed individual (MEI) (normal operations) receptor location;
- ingestion of radiologically contaminated agricultural produce and animal products due to radiological air releases within the 50-mi region of influence (ROI) and at the MEI (normal operations);
- external radiation exposure from radionuclide emissions and subsequent material deposition onto the ground, including plume and groundshine; and
- external radiation exposure from the transportation of radioactive materials within the 50-mi ROI.

E.2 BACKGROUND

E.2.1 Environmental Setting

Due to its location, any environmental releases from SNL/NM operations would have the potential to affect members of the public. Specifically, impacts to air quality, water quality, and other environmental resources necessary for maintaining public health are at issue for human health and worker safety.

Affected areas or receptors pertinent to the human health and worker safety assessment included all individuals or populations potentially exposed to routine radionuclide and chemical releases from SNL/NM, as well as workers who are potentially affected by their routine work duties.

E.2.2 Environmental Impacts Sources

SNL/NM encompasses hundreds of different facilities and conducts a multitude of tasks within these facilities. For purposes of the SWEIS, specific facilities related to the main activities at SNL/NM were examined in detail to determine impacts to the environment due to alternative operations of these facilities. The assumptions provided for selected facilities were used to formulate data representative of impacts to human health under each of the three alternatives.

The human health impacts assessment focused on the selected facilities that were determined to contribute the majority of the releases of chemicals and radiological contaminants to the environment. The largest contributors of chemical air emissions were located in Technical Area (TA)-I. The largest contributors of radiological air emissions were in TAs-IV and -V. The outdoor test facilities within Kirtland Air Force Base (KAFB) on land surrounding SNL/NM were responsible for the sporadic air emissions caused by open burning and explosives testing. Chemical emission sources evaluated included Buildings 858, Microsystems and Engineering Sciences Applications (MESA) Complex, 878, 905, 870, 897, and 893 in TA-I and 6580 in TA-V. Radiological emission facility sources evaluated included Buildings 6588, 6920, 6590, 6580, 905, 970, and 870 in TAs-I, -II, -III, -IV, and -V.

E.3 DATA EVALUATION

E.3.1 Data Sources

Data outputs from the following resource area impact analyses were used in preparing the human health and worker safety analysis:

- Radiological Air Quality
- Nonradiological Air Quality
- Hydrology, Geology, and Soils
- Transportation and Waste Generation

Table E.3–1 identifies the specific data and the sources used in conducting the human health and worker safety analysis under each of the alternatives.

E.3.2 Screening Analysis To Determine Chemicals of Concern

The SNL/NM Chemical Information System (CIS) database, CheMaster database, and the Hazardous Chemical Purchases Inventory (HCPI) database are the sources of information used to identify chemicals of concern (COCs) for impacts to human health by way of the air release pathway. These databases contain thousands of entries identifying chemical products used at SNL/NM. Solids, liquids, gases, and common cleaners and paints are included in these databases. All possible chemical sources at SNL/NM are evaluated for the potential to routinely release chemical air emissions to the environment. Only chemicals in large enough use at SNL/NM and with certain specific chemical properties are considered to have the potential to be emitted to the environment as routine building air emissions (see Appendix D, Section D.1.3, for details on the chemical screening process).

In summary, the chemical screening process involves a progressive series of steps to select chemical pollutants of concern. Methods involved conservative, as well as more rigorous, process engineering estimates of air emissions. This approach, consistent with U.S. Environmental Protection Agency (EPA) guidance, focuses detailed analyses only on those chemicals that are routinely emitted (occurring daily from ongoing normal operations at SNL/NM) and have a reasonable chance of being a health concern.

Emissions of COCs remaining after the screening process described in Appendix D were referred for an assessment of potential effects on human health. COC lists for each alternative containing both carcinogens and noncarcinogens from facility operations are in Tables E.3–2 through E.3–4. Table E.3–3 includes information regarding the MESA Complex configuration, if implemented. Chemicals with human health dose-response information are part of the quantitative health risk assessment. A reference dose (RfD) associates exposure to a chemical to a human health effect. Several EPA database reference sources containing dose-response information for chemical constituents were searched. If no inhalation dose-response information was identified for a chemical, that chemical was qualitatively evaluated. None were identified that would affect the final health risk values. Because of specific chemical properties (not an inhalation health hazard, not persistent in the environment, not in large quantity), it was reasonable to screen these chemicals from the assessment (Appendix D, Section D.1). Specifically, these chemicals did not pose a chronic exposure health threat. This overall method used

Table E.3–1. Data Used in Human Health Consequence Analyses

PARAMETER	SOURCE
WORKER SAFETY (Appendix E)	
Total number of SNL/NM FTEs predicted under each alternative	*SNL/NM Facility Safety Information Document* *Environmental Information Document*
RADIOLOGICAL AIR QUALITY (Appendix D)	
Radiological doses (mrem) at each selected receptor location (offsite and onsite) and the MEI under each alternative	Output from radiological air quality analysis (*CAP88-PC*)
Collective population dose (person-rem) for 50-mi for each alternative	Output from radiological air quality analysis (*CAP88-PC*)
Dose/risk conversion factors (LCF/10^6 person-rem)	Literature (NCRP)
NONRADIOLOGICAL AIR QUALITY (Appendix D)	
Annual average concentrations (mg/m^3) of COCs at selected receptor locations (offsite and onsite) and the maximum COC concentrations under each alternative Annual average concentrations (mg/m^3) of carcinogenic air pollutants at the radiological MEI receptor location under each alternative	Output from air quality analysis (*ISCST3*)
Inhalation exposure parameters (duration [yr], frequency [hr/day], breathing rate [m^3/hr], risk factors [mg/kg/day]) for each receptor	Literature (EPA *Exposure Factors Handbook*)
Air quality impacts from open burning activities at SNL/NM under each alternative	Output from air quality analysis (*OBODM*)
HYDROLOGY/GEOLOGY/SOILS (Appendix B and Chapter 5)	
Highest concentration (mg/L) of chemicals or (pCi/L) of radiological contaminants at any affected drinking water supply wells to occur within 10 years The "peak" contaminant concentrations (mg/L) and timeframe (yr) for it to occur at these wells	Output from hydrology/geology/soils analysis (No impacts reported)
Summary of water quality (concentrations of constituents above water quality standards) in any affected spring, stream, or arroyo under each alternative	Output from hydrology/geology/soils analysis (No impacts reported)
Summary of soil contaminant levels (mg/kg) where concentrations show impacts under each alternative	Output from hydrology/geology/soils analysis (No impacts reported)
Ingestion exposure parameters (duration [yr], frequency [days/yr], intake fraction [%],intake factors [mg/kg/day], ingestion rates [L/day]) for each receptor	Literature (EPA *Exposure Factors Handbook*)
Dose/risk conversion factors (LCF/10^6 person-rem)	Literature (NCRP)

Table E.3–1. Data Used in Human Health Consequence Analyses (concluded)

PARAMETER	SOURCE
TRANSPORTATION (Appendix G)	
Population collective dose (mrem) during routine radiological materials transportation activities within the 50-mile ROI under each alternative	Output from transportation analysis (*RADTRAN4*)
MATERIAL INVENTORY (Appendix A)	
Quantities of chemicals purchased in key facilities projected for each alternative	SNL/NM selected facility source documents

Sources: BEIR V 1990; DOE 1997e; EPA 1989, 1995a, 1996a, 1996b; ICRP 1991; SNL/NM 1996n, 1997a, 1998a
CAP88-PC: Clean Air Assessment Package
COC: chemical of concern
EPA: U.S. Environmental Protection Agency
FTE: full-time equivalent
hr/day: hours per day
ISCST3: Industrial Source Complex Short-Term Model, Version 3
LCF: latent cancer fatality
L/day: liters per day
m^3/hr: cubic meter per hour
MEI: maximally exposed individual
mg/kg: milligrams per kilogram
mg/kg/day: milligrams per kilogram per day
mg/L: milligrams per liter
mg/m^3: milligrams per cubic meter
mi: miles
mrem: millirem
NCRP: National Council on Radiation Protection and Measurement
OBODM: Open Burn/Open Detonation Model
pCi/L: picocuries per liter
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
yr: year

for selecting COCs, combined with conservative exposure and intake parameters, captures the potential health risks to receptors. Exposure assessment analyses are explained in Section E.5.4, and final risk results are presented in Section E.6.3.

Annual average exposure point concentrations at receptor locations for each COC were calculated (modeled using the industrial Source Complex Short-term Model, Version 3 [ISCST3]) and presented under the No Action Alternative in Table E.3–2, under the Expanded Operations Alternative (with or without the MESA Complex configuration) in Table E.3–3, and under the Reduced Operations Alternative in Table E.3–4, including chemical exposure point concentrations (per burn day) derived for the Lurance Canyon Burn Site presented in Table E.3–5. The exposure point concentrations for the Lurance Canyon Burn Site did not change for each alternative, but rather human health risk varied based on the number of burns per year (see Appendix D, Section D.1).

The list of COCs varied slightly among the alternatives due to results of the chemical screening process. Under each alternative, specific quantities of each chemical were estimated and emissions were projected. Emissions of smaller amounts of chemicals under the Reduced Operations Alternative eliminated some of the COCs, because they no longer exceeded the screening threshold.

In addition to calculating health risk at each receptor location, maximum chemical exposures to the public and noninvolved worker were calculated. The maximum annual average concentrations of each COC were estimated (using *ISCST3*) for the human health risk assessment. These highest concentrations potentially occurring at the nearest SNL/NM boundary to the source were summed, even though these maximum locations varied. This "hypothetical worst-case" exposure scenario was used to provide a perspective on an upper-bound health risk from chemicals for members of the public. Concentrations at the center of TA-I were considered the worst concentrations that could expose the onsite noninvolved worker. The noninvolved worker risk was based on an 8-hour work day, whereas risk to the hypothetical offsite worst-case member of the public used a 24-hour residential exposure scenario.

Lurance Canyon Burn Site air quality data were evaluated and discussed in Appendix D, Section D.1. Of the 89 chemicals detected from open burning activities, those with dose-response information were used in the assessment of potential human health impacts. The exposure point concentrations presented in Table E.3–5 were associated with open burning activities and used to assess health risk at the Four Hills Subdivision receptor location. Because these concentrations were modeled to the nearest site boundary to the burn site, actual risk at the specified receptor location in the Four Hills Subdivision area would be lower.

SNL/NM also has ambient air volatile organic compound (VOC) monitoring information available. This information was used in a presentation of health

Table E.3–2. Average Annual Concentrations (mg/m³) of Chemicals of Concern at Selected Public Receptors – No Action Alternative

CHEMICALS OF CONCERN	BUILDING SOURCE	MAXIMUM OFFSITE CONCENTRATION[a]	CENTER OF TA-I[b]	CHILD DEVELOPMENT CENTER-EAST	CHILD DEVELOPMENT CENTER-WEST	CORONADO CLUB	GOLF COURSE	KIRTLAND ELEMENTARY SCHOOL	KAFB HOUSING (Zia Park Housing)	KUMMSC	LOVELACE HOSPITAL
1,2-Dichloroethane (Ethylene Dichloride)	893	$9.85x10^{-7}$	$2.36x10^{-6}$	$5.09x10^{-8}$	$1.10x10^{-8}$	$7.84x10^{-8}$	$2.08x10^{-8}$	$1.13x10^{-8}$	$6.52x10^{-8}$	$1.36x10^{-8}$	$1.80x10^{-8}$
1,4-Dichloro-2-butene	897	$1.68x10^{-7}$	$1.84x10^{-7}$	$4.05x10^{-9}$	$9.36x10^{-10}$	$4.77x10^{-9}$	$2.87x10^{-9}$	$9.31x10^{-10}$	$3.67x10^{-9}$	$1.88x10^{-9}$	$1.41x10^{-9}$
Acrylonitrile	897	$2.74x10^{-7}$	$3.00x10^{-7}$	$6.59x10^{-9}$	$1.53x10^{-9}$	$7.77x10^{-9}$	$4.68x10^{-9}$	$1.52x10^{-9}$	$5.99x10^{-9}$	$3.06x10^{-9}$	$2.29x10^{-9}$
Trichloromethane (Chloroform)	897 6580	$1.10x10^{-5}$	$9.98x10^{-6}$	$1.35x10^{-7}$	$3.85x10^{-8}$	$1.56x10^{-7}$	$1.84x10^{-7}$	$3.79x10^{-8}$	$1.28x10^{-7}$	$1.67x10^{-7}$	$5.52x10^{-8}$
Dichloromethane (Methylene chloride)	878 870	$2.18x10^{-4}$	$2.95x10^{-4}$	$7.82x10^{-6}$	$1.62x10^{-6}$	$9.43x10^{-6}$	$4.28x10^{-6}$	$1.63x10^{-6}$	$5.51x10^{-6}$	$2.64x10^{-6}$	$2.58x10^{-6}$
Formaldehyde	878	$4.88x10^{-7}$	$1.05x10^{-6}$	$2.96x10^{-8}$	$6.14x10^{-9}$	$4.08x10^{-8}$	$1.16x10^{-8}$	$6.39x10^{-9}$	$3.75x10^{-8}$	$7.60x10^{-9}$	$1.05x10^{-8}$
Trichloroethylene	878 897	$4.61x10^{-5}$	$9.21x10^{-5}$	$2.54x10^{-6}$	$5.31x10^{-7}$	$3.46x10^{-6}$	$1.05x10^{-6}$	$5.51x10^{-7}$	$3.15x10^{-6}$	$6.87x10^{-7}$	$9.01x10^{-7}$

Table E.3–2. Average Annual Concentrations (mg/m³) of Chemicals of Concern at Selected Public Receptors – No Action Alternative (concluded)

CHEMICALS OF CONCERN	BUILDING SOURCE	NATIONAL ATOMIC MUSEUM	RIDING STABLES	SANDIA BASE ELEMENTARY	SHANDIIN DAY CARE CENTER	ISLETA GPAMING PALACE	VETERANS AFFAIRS MEDICAL CENTER	WHERRY ELEMENTARY SCHOOL
1,2-Dichloroethane (Ethylene Dichloride)	893	2.18×10^{-7}	1.29×10^{-8}	5.31×10^{-8}	1.04×10^{-7}	1.87×10^{-8}	2.31×10^{-8}	4.21×10^{-8}
1,4-Dichloro-2-butene	897	7.21×10^{-9}	1.73×10^{-9}	4.46×10^{-9}	4.89×10^{-9}	2.58×10^{-9}	1.66×10^{-9}	3.05×10^{-9}
Acrylonitrile	897	1.17×10^{-8}	2.82×10^{-9}	7.27×10^{-9}	7.97×10^{-9}	4.21×10^{-9}	2.71×10^{-9}	4.97×10^{-9}
Trichloromethane (Chloroform)	897 6580	2.33×10^{-7}	9.46×10^{-8}	1.45×10^{-7}	1.64×10^{-7}	1.65×10^{-7}	6.32×10^{-8}	1.06×10^{-7}
Dichloromethane (Methylene chloride)	878 870	1.71×10^{-5}	2.69×10^{-6}	8.60×10^{-6}	1.07×10^{-5}	3.85×10^{-6}	3.09×10^{-6}	5.71×10^{-6}
Formaldehyde	878	1.22×10^{-7}	7.61×10^{-9}	4.00×10^{-8}	5.95×10^{-8}	1.05×10^{-8}	1.37×10^{-8}	2.17×10^{-8}
Trichloroethylene	878 897	1.01×10^{-5}	6.82×10^{-7}	3.39×10^{-6}	4.97×10^{-6}	9.45×10^{-7}	1.16×10^{-6}	1.87×10^{-6}

Source: EPA 1995a
ITSCST3: Industrial Source Complex Short-Term Model, Version 3
KAFB: Kirtland Air Force Base
KUMMSC: Kirtland Underground Munitions and Maintenance Storage Complex
mg/m³: milligrams per cubic meter

TA: technical area
[a] These concentrations are the maximum offsite concentrations used to evaluate the hypothetical worst-case exposure scenario to the public.
[b] These concentrations are used to represent potential maximum onsite concentrations to evaluate risk to noninvolved workers.
Note: Calculations were made using *ISCST3*, then converted to annual dose average in mg/m³.

Table E.3–3 Average Annual Concentrations (mg/m³) of Chemicals of Concern at Selected Public Receptors – Expanded Operations Alternative

CHEMICALS OF CONCERN	BUILDING SOURCE	MAXIMUM OFFSITE CONCENTRATION[a]	CENTER OF TA-I[b]	CHILD DEVELOPMENT CENTER-EAST	CHILD DEVELOPMENT CENTER-WEST	CORONADO CLUB	GOLF COURSE	KIRTLAND ELEMENTARY SCHOOL	KAFB HOUSING (Zia Park Housing	KUMMSC	LOVELACE HOSPITAL
1,2-Dichloroethane (Ethylene dichloride)[c]	893	1.97×10^{-6}	4.70×10^{-6}	1.02×10^{-7}	2.20×10^{-8}	1.56×10^{-7}	4.14×10^{-8}	2.26×10^{-8}	1.30×10^{-7}	2.72×10^{-8}	3.60×10^{-8}
1,4-Dichloro-2-butene	897	1.68×10^{-7}	1.84×10^{-7}	4.05×10^{-9}	9.36×10^{-10}	4.77×10^{-9}	2.87×10^{-9}	9.31×10^{-10}	3.67×10^{-9}	1.88×10^{-9}	1.41×10^{-9}
Acrylonitrile	897	2.74×10^{-7}	3.00×10^{-7}	6.59×10^{-9}	1.53×10^{-9}	7.77×10^{-9}	4.68×10^{-9}	1.52×10^{-9}	5.99×10^{-9}	3.06×10^{-9}	2.29×10^{-9}
Trichloromethane (Chloroform)	897 6580	9.48×10^{-6}	8.87×10^{-6}	1.32×10^{-7}	3.59×10^{-8}	1.53×10^{-7}	1.59×10^{-7}	3.54×10^{-8}	1.23×10^{-7}	1.39×10^{-7}	5.20×10^{-8}
Dichloromethane (Methylene chloride)	878 870	2.20×10^{-4}	3.01×10^{-4}	7.97×10^{-6}	1.65×10^{-6}	9.64×10^{-6}	4.34×10^{-6}	1.66×10^{-6}	7.71×10^{-6}	2.68×10^{-6}	2.64×10^{-6}
Formaldehyde	878	6.49×10^{-7}	1.40×10^{-6}	3.94×10^{-8}	8.18×10^{-9}	5.43×10^{-8}	1.55×10^{-8}	8.51×10^{-9}	4.99×10^{-8}	1.01×10^{-8}	1.40×10^{-8}
Trichloroethylene	878 897	5.91×10^{-5}	1.20×10^{-4}	3.33×10^{-6}	6.95×10^{-7}	4.55×10^{-6}	1.36×10^{-6}	7.21×10^{-7}	4.15×10^{-6}	8.89×10^{-7}	1.18×10^{-6}

Table E.3–3 Average Annual Concentrations (mg/m³) of Chemicals of Concern at Selected Public Receptors – Expanded Operations Alternative (concluded)

CHEMICALS OF CONCERN	BUILDING SOURCE	NATIONAL ATOMIC MUSEUM	RIDING STABLES	SANDIA BASE ELEMENTARY	SHANDIIN DAY CARE CENTER	ISLETA GAMING PALACE	VETERANS AFFAIRS MEDICAL CENTER	WHERRY ELEMENTARY SCHOOL
1,2-Dichloroethane (Ethylene Dichloride)[c]	893	$4.36x10^{-7}$	$2.57x10^{-8}$	$1.06x10^{-7}$	$2.08x10^{-7}$	$3.73x10^{-8}$	$4.61x10^{-8}$	$8.40x10^{-8}$
1,4-Dichloro-2-butene	897	$7.21x10^{-9}$	$1.73x10^{-9}$	$4.46x10^{-9}$	$4.89x10^{-9}$	$2.58x10^{-9}$	$1.66x10^{-9}$	$3.05x10^{9}$
Acrylonitrile	897	$1.17x10^{-8}$	$2.82x10^{-9}$	$7.27x10^{-9}$	$7.97x10^{-9}$	$4.21x10^{-9}$	$2.71x10^{-9}$	$4.97x10^{-9}$
Trichloromethane (Chloroform)	897 6580	$2.29x10^{-7}$	$8.40x10^{-8}$	$1.42x10^{-7}$	$1.60x10^{-7}$	$1.44x10^{-7}$	$5.99x10^{-8}$	$1.03x10^{-7}$
Dichloromethane (Methylene chloride)	878 870	$1.77x10^{-5}$	$2.73x10^{-6}$	$8.81x10^{-6}$	$1.10x10^{-5}$	$3.91x10^{-6}$	$3.16x10^{-6}$	$5.83x10^{-6}$
Formaldehyde	878	$1.62x10^{-7}$	$1.01x10^{-8}$	$5.33x10^{-8}$	$7.92x10^{-8}$	$1.39x10^{-8}$	$1.82x10^{-8}$	$2.89x10^{-8}$
Trichloroethylene	878 897	$1.33x10^{-5}$	$8.84x10^{-7}$	$4.46x10^{6}$	$6.55x10^{-6}$	$1.22x10^{-6}$	$1.53x10^{-6}$	$2.45x10^{-6}$

Source: EPA 1995a
ITSCST3: Industrial Source Complex Short-Term Model, Version 3
KAFB: Kirtland Air Force Base
KUMMSC: Kirtland Underground Munitions and Maintenance Storage Complex
mg/m³: milligrams per cubic meter
TA: technical area
[a] These concentrations are the maximum offsite concentrations used to evaluate the hypothetical worst-case exposure scenario to the public.
[b] These concentrations are then used to represent potential maximum onsite concentrations used to evaluate risk to noninvolved workers.
[c] If implemented for the Microsystems and Engineering Sciences Applications (MESA) Complex configuration for the Expanded Operations Alternative, this chemical of concern would no longer exist at the MESA Complex and would no longer fail the screening process.
Note: Calculations were made using *ISCST3*, then converted to annual average in mg/m³.

Table E.3–4 Average Annual Concentrations (mg/m³) of Chemicals of Concern at Selected Public Receptors – Reduced Operations Alternative

CHEMICALS OF CONCERN	BUILDING SOURCE	MAXIMUM OFFSITE CONCENTRATION[a]	CENTER OF TA-I[b]	CHILD DEVELOPMENT CENTER-EAST	CHILD DEVELOPMENT CENTER-WEST	CORONADO CLUB	GOLF COURSE	KIRTLAND ELEMENTARY SCHOOL	KAFB HOUSING (Zia Park Housing)	KUMMSC	LOVELACE HOSPITAL
1,2-Dichloroethane (Ethylene Dichloride)	893	$7.05x10^{-7}$	$2.36x10^{-6}$	$1.27x10^{-8}$	$2.31x10^{-9}$	$1.96x10^{-8}$	$2.86x10^{-9}$	$2.10x10^{-9}$	$1.32x10^{-8}$	$2.21x10^{-9}$	$3.98x10^{-9}$
1,4-Dichloro-2-butene	897	$2.04x10^{-7}$	$1.69x10^{-7}$	$3.47x10^{-9}$	$7.54x10^{-10}$	$4.03x10^{-9}$	$1.56x10^{-9}$	$5.84x10^{-10}$	$2.48x10^{-9}$	$1.68x10^{-9}$	$1.26x10^{-9}$
Acrylonitrile	897	$3.33x10^{-7}$	$2.76x10^{-7}$	$5.65x10^{-9}$	$1.23x10^{-9}$	$6.57x10^{-9}$	$2.53x10^{-9}$	$9.51x10^{10}$	$4.04x10^{-9}$	$2.74x10^{-9}$	$2.04x10^{-9}$
Formaldehyde	878	$3.24X10^{-7}$	$7.03x10^{-7}$	$1.97x10^{-8}$	$2.84x10^{-9}$	$2.72x10^{-8}$	$4.40x10^{-9}$	$3.09x10^{-9}$	$1.78x10^{-8}$	$3.04x10^{-9}$	$4.92x10^{-9}$
Dichloromethane (Methylene Chloride)	870	$3.21x10^{-4}$	$2.80x10^{-4}$	$7.39x10^{-6}$	$1.38x10^{-6}$	$8.22x10^{-6}$	$2.39x10^{-6}$	$1.03x10^{-6}$	$4.90x10^{-6}$	$1.66x10^{-6}$	$2.30x10^{-6}$
Trichloroethylene	878 897	$3.45x10^{-5}$	$6.34x10^{-5}$	$1.73x10^{-6}$	$2.59x10^{-7}$	$2.35x10^{-6}$	$4.17x10^{-7}$	$2.72x10^{-7}$	$1.53x10^{-6}$	$3.14x10^{-7}$	$4.46x10^{-7}$

Table E.3–4 Average Annual Concentrations (mg/m^3) of Chemicals of Concern at Selected Public Receptors – Reduced Operations Alternative (concluded)

CHEMICALS OF CONCERN	BUILDING SOURCE	NATIONAL ATOMIC MUSEUM	RIDING STABLES	SANDIA BASE ELEMENTARY	SHANDIIN DAY CARE CENTER	ISLETA GAMING PALACE	VETERANS AFFAIRS MEDICAL CENTER	WHERRY ELEMENTARY SCHOOL
1,2-Dichloroethane (Ethylene Dichloride)	893	$3.79x10^{-8}$	$1.82x10^{-9}$	$1.53x10^{-8}$	$1.98x10^{-8}$	$2.58x10^{-9}$	$4.50x10^{-9}$	$1.05x10^{-8}$
1,4-Dichloro-2-butene	897	$6.19x10^{-9}$	$7.85x10^{-10}$	$4.51x10^{-9}$	$3.60x10^{-9}$	$1.40x10^{-9}$	$1.13x10^{-9}$	$2.63x10^{-9}$
Acrylonitrile	897	$1.01x10^{-8}$	$1.28x10^{-9}$	$7.34x10^{-9}$	$5.86x10^{-9}$	$2.28x10^{-9}$	$1.83x10^{-9}$	$4.28x10^{-9}$
Formaldehyde	878	$5.52x10^{-8}$	$2.65x10^{-9}$	$3.11x10^{-8}$	$2.72x10^{-8}$	$3.96x10^{-9}$	$6.81x10^{-9}$	$1.36x10^{-8}$
Dichloromethane (Methylene Chloride)	870	$1.43x10^{-5}$	$1.32x10^{-6}$	$1.08x10^{-5}$	$7.29x10^{-6}$	$2.15x10^{-6}$	$2.03x10^{-6}$	$5.29x10^{-6}$
Trichloroethylene	878	$4.68x10^{-6}$	$2.45x10^{-7}$	$2.68x10^{-6}$	$2.32x10^{-6}$	$3.76x10^{-7}$	$5.92x10^{-7}$	$1.19x10^{-6}$

Source: EPA 1995a
ITSCST3: Industrial Source Complex Short-Term Model, Version 3
KAFB: Kirtland Air Force Base
KUMMSC: Kirtland Underground Munitions and Maintenance Storage Complex
mg/m^3: milligrams per cubic meter
TA: technical area

[a] These concentrations are the maximum offsite concentrations used to evaluate the hypothetical worst-case exposure scenario to the public.
[b] These concentrations are the used to represent potential maximum onsite concentrations used to evaluate risk to noninvolved workers.
Note: Calculations were made using *ISCST3*, then converted to annual average in mg/m^3.

Table E.3–5. Chemicals of Concern Exposure Point Concentrations from the Lurance Canyon Burn Site used for Health Risk Analysis Under Each Alternative[a]

CHEMICALS OF CONCERN	CONCENTRATION[b] (mg/m^3)
1,1,2-Trichloroethane	4.95×10^{-8}
1,2,4-Trichlorobenzene	1.68×10^{-6}
1,2,4-Trimethylbenzene	1.17×10^{-7}
1,2-Dichloroethane	2.93×10^{-9}
1,2-Dichloropropane	2.10×10^{-10}
1,3,5-Trimethylbenzene	2.26×10^{-8}
1, 3-Butadiene	2.01×10^{-7}
2-Butanone	3.35×10^{-9}
Acetaldehyde	5.45×10^{-9}
Benzene	1.68×10^{-6}
Bis(Chloroethyl)ether	4.19×10^{-9}
Chloromethane	1.26×10^{-9}
Dichlorodifluromethane	7.88×10^{-9}
Ethylbenzene	2.93×10^{-7}
Hexachloro-1,3-butadiene	1.93×10^{-9}
Hexane (n)	5.70×10^{-9}
Dichloromethane (methylene chloride)	1.01×10^{-10}
Methyl Isobutyl Ketone	7.04×10^{-9}
Methylcyclohexane	7.46×10^{-8}
Styrene	2.43×10^{-7}
Toluene	2.77×10^{-7}
Trichloroethylene	2.60×10^{-9}
Vinyl Chloride	1.84×10^{-8}

Source: EPA 1995a
mg/m^3: milligrams per cubic meter
μg/m^3: micrograms per cubic meter
EPA: U.S. Environmental Protection Agency
Note: Eighty-nine chemicals are known to be released in small quantities from the burning of JP-8 fuel. Only those with EPA reference doses are used in the calculation of health risk.
[a] Concentrations used in health risk analysis for the Four Hills Subdivision receptor location. Concentrations remain constant. The number of burns per year are 10 for the No Action Alternative, 58 for the Expanded Operations Alternative, and 5 for the Reduced Operations Alternative. If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the number of burns per year for the Expanded Operations Alternative.
[b] Annual average air concentrations (in mg/m^3) used in health risk analysis derived from Table D.1–31, 8-hour average concentration in μg/m^3 from the burning of 1,000 gal of JP-8.

risks, because it provides some perspective on this topic and is derived from actual environmental concentrations. Because these environmental data cannot be tied to SNL/NM only, the information is presented in the cumulative impacts section. Maximum concentrations of chemicals detected by SNL/NM ambient air VOC monitoring stations in 1996 were used for assessing cumulative human health impacts (Table E.3–6). A long-term exposure scenario, using these exposure point concentrations, results in a conservative estimate of potential cumulative human health impacts in the SNL/NM vicinity, because the maximum concentrations were actually detected at different monitoring stations and during different monitoring times throughout 1996 (SNL 1997d).

Table E.3–6. Maximum Air Concentrations of Chemicals Detected by SNL/NM Volatile Organic Compound Monitoring Stations used to Assess Cumulative Human Health Impacts

CHEMICALS OF CONCERN	CONCENTRATION[a] (mg/m^3)
Benzene	3.57×10^{-4}
Carbon tetrachloride	1.50×10^{-4}
Chloromethane	1.91×10^{-4}
Dichlorodifluoromethane	6.22×10^{-4}
Dichloromethane	5.98×10^{-4}
Ethylbenzene	1.19×10^{-4}
n-Hexane	1.95×10^{-4}
Tetrachloroethene	5.70×10^{-5}
Toluene	7.83×10^{-4}
1,1,1-Trichloroethane	4.88×10^{-2}
Trichloroethylene	1.31×10^{-4}
Trichlorofluoromethane	3.11×10^{-4}

Source: SNL 1997d
mg/m^3: milligrams per cubic meter
μg/m^3: micrograms per cubic meter
EPA: U.S. Environmental Protection Agency
VOC: volatile organic compound
SNL/NM: Sandia National Laboratories/New Mexico
[a] Maximum annual average air concentrations (in mg/m^3) derived from data in Table 4.9–4, from 8-hour average concentrations in μg/m^3.
Note: Thirty VOCs were detected by SNL/NM VOC monitoring stations. This table contains only those with EPA reference dose values that can be used in the health risk analysis.

E.4 TOXICITY ASSESSMENT

The purpose of the toxicity assessment dose response is to identify the potential adverse health effects a COC may cause and to define the relationship between the dose of a COC and the likelihood and/or magnitude of an adverse effect (response). For the risk assessment process, the EPA characterizes adverse effects as carcinogenic or noncarcinogenic (potential effects other than cancer). Dose-response relationships are defined by the EPA for oral exposure and for exposure by inhalation. Oral dose-response values are also used for dermal exposures because the EPA has not yet developed values for this route of exposure. Combining the results of the dose-response assessment with information on the magnitude of potential human exposure provides an estimate, usually very conservative, of potential risk. Current dose-response values developed by the EPA are used in this risk assessment.

Section 4.1 describes the EPA's approach for developing noncarcinogenic dose-response values. Section 4.2 describes the carcinogenic dose-response relationships developed by the EPA. Sources of the published dose-response values used in this risk assessment include the EPA's Integrated Risk Information System (IRIS) (EPA 1998a), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997b), and the EPA National Center for Environmental Assessment (NCEA, formerly ECAO) (NCEA 1998).

E.4.1 Toxicity Information for Noncarcinogenic Effects

Compounds with known or potential noncarcinogenic effects are assumed to have a dose below which no adverse effect occurs or, conversely, above which an adverse effect may be seen. This dose is called the threshold dose. An estimate of the true threshold dose is called a No Observed Adverse Effect Level (NOAEL). The lowest dose at which an adverse effect occurs is called a Lowest Observed Adverse Effect Level (LOAEL). By applying uncertainty factors to the NOAEL or the LOAEL, RfDs for subchronic and chronic exposures to chemicals with noncarcinogenic effects have been developed by the EPA. The uncertainty factors account for uncertainties associated with the dose-response relationship such as the effects of using an animal study to derive a human dose-response value, extrapolating from high to low doses, and evaluating sensitive subpopulations. Generally, a 10-fold factor is used to account for each of these uncertainties; thus, the total uncertainty factor can range from 10 to 10,000. In addition, an uncertainty factor or modifying factor of up to 10 can be used to account for "inadequacies in the database." For chemicals with noncarcinogenic effects, an RfD provides reasonable certainty that no noncarcinogenic health effects are expected to occur even if daily exposures were to occur at the RfD level for a lifetime. RfDs and exposure doses are expressed in units of milligrams of chemical per kilogram body weight per day (mg/kg-day).

The dose-response information for the COCs with potential noncarcinogenic effects for the inhalation route of exposure is summarized in Tables E.4–1 and E.4–2. For each chemical, the chemical abstract system (CAS) number, the chronic dose-response value, and the reference for the dose-response value are presented.

E.4.2 Toxicity Information for Carcinogenic Effects

The underlying regulatory assumption for risk assessment for compounds with known potential carcinogenic effects is that no threshold dose exists. In other words, the compound has the potential to cause cancer at any level of exposure. This assumption requires that risk characterization evaluates finite levels of risk associated with each non-zero dose. The EPA extrapolates dose-response relationships observed at the relatively high doses used in animal studies to the low dose levels encountered by humans in environmental situations. For carcinogenic effects, human data relating chemical exposure to a specific cancer response are rare. More frequently, animal toxicological data are available. The mathematical models assume no threshold and use both animal and human data (where available) to develop a potency estimate for a given compound. The potency estimate, called a cancer slope factor (CSF) is expressed in units of $(mg/kg\text{-}day)^{-1}$. For the inhalation pathway, the CSF can be expressed as an air concentration factor called the unit risk factor.

Tables E. 4–3 and E. 4–4 summarize the inhalation dose-response information developed by the EPA for potentially carcinogenic COCs identified at the SNL/NM site. The tables provide the CAS number, the CSF, the unit risk factor, and a reference for each chemical. A chemical can have both carcinogenic and noncarcinogenic impacts. Carcinogenic impacts generally have a higher overall risk than noncarcinogenic risks, and, although both types of risks cannot be compared directly, action levels for cancer-causing compounds are generally lower.

Table E.4–1. Dose-Response Information for Potential Noncarcinogenic Chemicals of Concern from Facilities

CHEMICALS OF CONCERN	CAS NUMBER	INHALATION RfD (mg/kg-day)	REFERENCE
1,2-Dichloroethane	107-06-2	1.40×10^{-3}	NCEA 1998
1,4-Dichloro-2-butene	764-41-0	NA	IRIS (EPA 1998a)
Acrylonitrile	107-13-1	5.71×10^{-4}	IRIS (EPA 1998a); HEAST (EPA 1997b)
Trichloromethane (chloroform)	67-66-3	8.60×10^{-5}	IRIS (EPA 1998a)
Dichloromethane (methylene chloride)	75-09-2	8.57×10^{-1}	EPA (EPA 1998a)
Formaldehyde	50-00-0	NA	IRIS (EPA 1998a)
Trichloroethylene	79-01-6	NA	IRIS (EPA 1998a)

Sources: EPA 1997b, 1998a; NCEA 1998
CAS: Chemical Abstract Service
IRIS: Integrated Risk Information System, an online computer database of toxicological information (EPA 1998a)
HEAST: Health Effects Assessment Summary Tables, published annually by the EPA (EPA 1997b)
mg/kg-day: milligrams per kilogram per day
NA: Not applicable; no noncarcinogenic dose-response information
NCEA: National Center for Environmental Assessment (formerly ECAO) (NCEA 1998)
RfD: reference dose

Table E.4–2. Dose-Response Information for Potential Noncarcinogenic Chemicals of Concern from Lurance Canyon Burn Site

CHEMICALS OF CONCERN	CAS NUMBER	EPA CARCINOGEN CLASS	INHALATION CSF $(mg/kg\text{-}day)^{-1}$	INHALATION UNIT RISK $(\mu g/m^3)^{-1}$	REFERENCE
1,2 - Dichloroethane	107-06-2	B2	9.10×10^{-2}	2.6×10^{-5}	IRIS (EPA 1998a)
1,4-Dichloro-2-butene	764-41-0	NF	9.30	2.66×10^{-3}	IRIS (EPA 1998a)
Acrylonitrile	107-13-1	B1	2.38×10^{-1}	6.80×10^{-5}	IRIS (EPA 1998a)
Trichloromethane (chloroform)	67-66-3	B2	8.05×10^{-2}	2.3×10^{-5}	IRIS (EPA 1998a)
Dichloromethane (methylene chloride)	75-09-2	B2	1.65×10^{-3}	4.70×10^{-7}	IRIS (EPA 1998a)
Formaldehyde	50-00-0	B1	4.55×10^{-2}	1.3×10^{-5}	IRIS (EPA 1998a)
Trichloroethylene	79-01-6	B2-C	6.00×10^{-3}	1.71×10^{-6}	NCEA 1998

Sources: EPA 1997b, 1998a; NCEA 1998
CAS: Chemical Abstracts Service
CSF: Cancer Slope Factor
EPA: U.S. Environmental Protection Agency
HEAST: Health Effects Assessment Summary Tables, published annually by the EPA (EPA 1997b)
IRIS: Integrated Risk Information System, an online computer database of toxicological information (EPA 1998a)
mg/kg-day: milligrams per kilogram per day
NA: Not Applicable, no noncarcinogenic dose response information
NCEA: National Center for Environmental Assessment (formerly ECAO) (NCEA 1998).

Table E.4–3. Dose-Response Information for Potential Carcinogenic Chemicals of Concern from Facilities

CHEMICALS OF CONCERN	CAS NUMBER	EPA CARCINOGEN CLASS	INHALATION CSF $(mg/kg\text{-}day)^{-1}$	INHALATION UNIT RISK $(\mu g/m^3)^{-1}$	REFERENCE
1,2 - Dichloroethane	107-06-2	B2	9.10×10^{-2}	2.6×10^{-5}	IRIS (EPA 1998a)
1,4-Dichloro-2-butene	764-41-0	NF	9.30	2.66×10^{-3}	IRIS (EPA 1998a)
Acrylonitrile	107-13-1	B1	2.38×10^{-1}	6.80×10^{-5}	IRIS (EPA 1998a)
Trichloromethane (chloroform)	67-66-3	B2	8.05×10^{-2}	2.3×10^{-5}	IRIS (EPA 1998a)
Dichloromethane (methylene chloride)	75-09-2	B2	1.65×10^{-3}	4.70×10^{-7}	IRIS (EPA 1998a)
Formaldehyde	50-00-0	B1	4.55×10^{-2}	1.3×10^{-5}	IRIS (EPA 1998a)
Trichloroethylene	79-01-6	B2-C	6.00×10^{-3}	1.71×10^{-6}	NCEA 1998

Sources: EPA 1997b, 1998a; NCEA 1998
CAS: Chemical Abstracts Service
CSF: Cancer Slope Factor
EPA: U.S. Environmental Protection Agency

IRIS: Integrated Risk Information System, an online computer database of toxicological information (EPA 1998a).
NCEA: National Center for Environmental Assessment (formerly ECAO) (NCEA 1998).
mg/kg-day: milligrams per kilogram per day
$\mu g/m^3$: micrograms per cubic meter
NF: not found

Table E.4–4. Dose-Response Information for Potential Carcinogenic Chemicals of Concern from Lurance Canyon Burn Site

CHEMICALS OF CONCERN	CAS NUMBER	EPA CARCINOGEN CLASS	INHALATION CSF $(mg/kg\text{-}day)^{-1}$	REFERENCE
1,1,2-Trichloroethane	79-00-5	C	5.6×10^{-2}	IRIS (EPA 1998a)
1,2-Dichloroethane	107-06-2	B2	9.10×10^{-2}	NCEA 1998
1,2-Dichloropropane	78-87-5	NA	NA	IRIS (EPA 1998a)
1,2,4 Trichlorobenzene	120-82-1	NA	NA	IRIS (EPA 1998a)
1,2,4-Trimethylbenzene	95-63-6	NA	NA	NCEA 1998
1,3 - Butadiene	106-99-0	B2	9.8×10^{-1}	IRIS (EPA 1998a)
1,3,5-Trimethylbenzene	108-67-8	NA	NA	IRIS (EPA 1998a)
Acetaldehyde	75-07-0	B2	7.7×10^{-3}	IRIS (EPA 1998a)
Benzene	71-43-2	A	2.9×10^{-2}	IRIS (EPA 1998a)
Bis (2-chloroethyl) ether	111-44-4	B2	1.16	IRIS (EPA 1998a)
Chloromethane	74-87-3	D	6.3×10^{-3}	HEAST (EPA 1997b)
Dichlorodifluoromethane	75-71-8	NA	NA	IRIS (EPA 1998a)
Dichloromethane (methylene chloride)	75-09-2	B2	1.65×10^{-3}	IRIS (EPA 1998a); HEAST (EPA 1997b)
Ethylbenzene	100-41-4	NA	NA	IRIS (EPA 1998a)
Hexachlorobutadiene	87-68-3	C	7.8×10^{-2}	IRIS (EPA 1998a)
Hexane (n)	110-54-3	NA	NA	IRIS (EPA 1998a)
2-butanone	78-93-3	NA	NA	IRIS (EPA 1998a)
Methyl Isobutyl Ketone	108-10-1	NA	NA	IRIS (EPA 1998a)
Methlycyclohexane	108-87-2	NA	NA	IRIS (EPA 1998a)
Styrene	100-42-5	NA	NA	IRIS (EPA 1998a)

Table E.4–4. Dose-Response Information for Potential Carcinogenic Chemicals of Concern from Lurance Canyon Burn Site (concluded)

CHEMICALS OF CONCERN	CAS NUMBER	EPA CARCINOGEN CLASS	INHALATION CSF $(mg/kg\text{-}day)^{-1}$	REFERENCE
Toluene	108-88-3	NA	NA	IRIS (EPA 1998a)
Trichloroethylene	79-01-6	B2-C	6.00×10^{-3}	NCEA 1998
Vinyl Chloride	75-01-4	A	3.0×10^{-1}	HEAST (EPA 1997b)

Sources: EPA 1997b, 1998a; NCEA 1998
CAS: Chemical Abstracts Service
CSF: Cancer Slope Factor
EPA: U.S. Environmental Protection Agency
HEAST: Health Effects Assessment Summary Tables, published annually by the EPA (EPA 1997b)
IRIS: Integrated Risk Information System, an online computer database of toxicological information (EPA 1998a)
mg/kg-day: milligrams per kilogram per day
NA: Not Applicable, no noncarcinogenic dose response information
NCEA: National Center for Environmental Assessment (formerly ECAO) (NCEA 1998).
$\mu g/m^3$: micrograms per cubic meter
Note: No chemical screening was done for chemicals from burn activities; all chemicals with EPA dose-response information are evaluated.

E.5 EXPOSURE ASSESSMENT

E.5.1 Exposure Setting (Current and Potential Future Operating Levels)

Chapter 2 of the SWEIS described the operating levels for SNL/NM used to analyze environmental impacts. This information provided the basis for determining the levels of subsequent risks to human health from those impacts. The *SNL/NM Facility and Safety Information Document* also contains descriptions of operating levels for selected facilities (SNL/NM 1998a).

If implemented, the MESA Complex configuration was considered in the exposure setting for the Expanded Operations Alternative as identified in the text and corresponding tables.

E.5.2 Exposure Pathways

An exposure pathway must be complete in order to be evaluated for health risk. This means that an environmental contaminant must be present at the receptor location to be considered a complete exposure pathway. Health effects were evaluated for each alternative only for those transport pathways determined to represent the major exposure pathways. The following measurement endpoints were assessed:

- estimates of noncancer health risk from potential exposures to routine noncarcinogenic chemical releases based on predicted exposure-point concentrations from air emissions and air quality;
- estimates of excess lifetime cancer risk to an individual from carcinogenic chemical releases based on predicted exposure-point concentrations from air emissions and air quality;
- total number of LCFs in the ROI population and increased risk of fatal cancer to an individual from potential exposures to routine radiological releases based on predicted exposure-point concentrations from air emissions and air quality;
- total number of nonfatal cancers and genetic disorders from potential exposures to routine radiation releases based on predicted exposure-point concentrations from air emissions and air quality;
- total number of LCFs in the ROI population due to exposure from the transportation of radiological materials;
- estimates of the number of physical injuries/illnesses based on the total number of workers under each alternative and the 5-year average injury/illness rate derived for SNL/NM (1992-1996);
- estimates of workers' increased lifetime risk of fatal cancer from radiological exposures based on the total number of radiation workers extrapolated from changes in the total number of workers under each alternative, multiplied by the historic (average for 1992-1996) SNL/NM radiation worker dose rates; and
- the pathways determined not to expose people, including groundwater, surface water, and soils/dust (see Sections 5.3.3, 5.4.3, 5.5.3, and Appendix B).

E.5.3 Receptor Characterization

Sixteen core receptor locations were consistent among the evaluations for impacts due to routine operations, chemical and radiological emissions, and potential facility accidents at SNL/NM. These receptor locations were selected based on a review of historic National Emissions Standards for Hazardous Air Pollutants (NESHAP) compliance reports, which discuss the location of the MEI member of public and take into consideration that the general public and Air Force personnel have access to SNL/NM. Other factors taken into account include information contained in the *SNL/NM Facility Source Documents* (SNL/NM 1998a), receptor locations in close proximity to the sources, the nearest site boundary in the prevailing wind directions, and the presence of potentially sensitive receptors such as children, the sick, and the elderly. Included are two receptor locations of public concern representing the Four Hills Subdivision and the Isleta Gaming Palace, which are farther away from SNL/NM. These sixteen receptor locations are listed below.

- Child Development Center-East
- Child Development Center-West
- Coronado Club
- Four Hills Subdivision
- Golf Course
- Kirtland Elementary School
- KAFB Housing (Zia Housing)
- Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)
- Lovelace Hospital

- National Atomic Museum
- Riding Stables
- Sandia Base Elementary School
- Shandiin Day Care Center
- Isleta Gaming Palace
- Veterans Affairs Medical Center (Hospital)
- Wherry Elementary School

In addition to these receptor locations, the specific evaluations of chemical air emissions, radiological air emissions, and facility accidents each included additional receptor locations unique to the needs of the resource area in order to complete their analyses of impacts (see discussions in radiological air, chemical air, and accident analyses).

Chemical receptor locations were selected according to the locations accessible to members of the public in the SNL/NM vicinity (see discussion in Section 5.3.8). Both potential long-term and short-term exposures were considered to cover the range of exposure possibilities (that is, a permanent residence or a visitor scenario, respectively). The EPA has coined the phrase "reasonable maximum exposure" (RME) when general default exposure assumptions are used that tend to fall within the upper 90th confidence interval of the arithmetic mean (statistically upper-bound value of the range). The central tendency or average exposure values would be those that fall within the 50th percentile of the statistical range. Based on statistical averages, average exposure assumptions would be those that would tend to occur most frequently. Therefore, to account for the most plausible type of exposures as well as exposures that may be more frequent or constant than the norm, both the RME and an average exposed individual (AEI) were considered. The presence of potentially special receptors, such as children, at these locations was also considered.

Based on professional judgement, various receptor locations were selected, including the onsite location for noninvolved workers, as the most likely areas where exposures might occur. Because exposure concentrations vary with distance and direction, based on transport by way of the air pathway, the receptor locations selected encompassed a wide range of areas where potential exposures might occur. Limited historical chemical air emissions data prevent the estimation of an MEI location as was done for radiological air releases. Instead, exposure assumptions were determined based on the range of potential exposures (the AEI and RME) that may occur at each location. Table E.5–1 identifies the exposure parameters used to determine the chemical intake for the potential RME and AEI receptors at the selected locations and the hypothetical worst-case exposure scenario.

A hypothetical worst-case residential RME/AEI receptor scenario was included in the exposure assessment that considers exposure to the maximum concentrations that may be considered from any source. This scenario may be distinguished from the other scenarios, because the transport to a given location is not considered, but rather, the maximum air concentration of any given COC is assumed to be inhaled by the RME and AEI hypothetical resident. This exposure scenario was used to estimate an upper-bound potential health risk value under each alternative.

Radiological receptor locations were developed from historic analyses performed as required annually by the *Clean Air Act* (CAA) and NESHAP (Appendix D). Years of data analysis provide a good estimate of the MEI and its location. A subset of the known NESHAP receptor locations was selected to include the highest exposure dose locations, and the same locations were analyzed for chemical exposures.

It is reasonable to assess an individual composite cancer risk using the radiological MEI risk at the KUMMSC and the chemical cancer risk at the same location. To capture the potential highest risk from chemicals, another assessment of an individual composite cancer risk was derived by summing the cancer risk from a hypothetical worst-case chemical exposure scenario and the radiological MEI (KUMMSC) cancer risk. Because this exposure is hypothetical and would not occur, this was a conservative mathematical assessment to provide a bounding of the health risk value. This assessment did not represent a specific receptor location in the SNL/NM vicinity.

E.5.4 Chemical Exposure and Chemical Intake

This section provides the methodology and equations used to calculate potential chemical exposure doses used to assess carcinogenic and noncarcinogenic health risks.

A risk assessment computer application called *SmartRISK* is used to calculate the estimated receptor intake of the COCs (SmartRISK 1996). *SmartRISK* uses the following standard EPA equations (EPA 1989) for calculating the intake of media (soil, water, or air) or the quantity of a medium taken into the body through an exposure route:

Table E.5–1. Exposure Parameters Used to Evaluate Human Health Risk from Chemicals

PARAMETER	AEI VALUE	SOURCE/RATIONALE	RME VALUE	SOURCE/RATIONALE
AIR PATHWAY-SPECIFIC PARAMETERS				
Inhalation Rate (m^3/day)				
Onsite Worker	1.1 (m^3/hr)	Worker involved in light activity [a]	1.5 (m^3/hr)	Average outdoor worker activity [a]
Visitor & Resident:				
Child Age: 1-6	8.7 (m^3/day)	Average daily rate for children [a]	8.7 (m^3/day)	Average daily rate for children [a]
Adult Age: 7-30	15.2 (m^3/day)	Daily adult inhalation rate for long-term exposure[a]	15.2 (m^3/day)	Daily adult inhalation rate for long-term exposure[a]
Inhalation Exposure Time (hours/day)				
Onsite Worker	1 (hours/day)	Assumption	4 (hours/day)	Assumption
Visitor & Resident:				
Child Aged: 1-6	1.75 (hours/day)	50th percentile of time playing outdoors[a]	6.25 (hours/day)	95th percentile of time playing outdoors[a]
Adult Aged: 7-30	1.44 (hours/day)	50th percentile of time spent outdoors[a]	7.25 (hours/day)	95th percentile of time spent outdoors[a]
GENERAL PARAMETERS				
Exposure Frequency (days/year)				
Visitor	40	Typical time spent outdoors [a]	165	School year minus 3 weeks vacation
Onsite Worker	40	Typical time spent outdoors [a]	250	5 days/week for 50 weeks [a]
Resident:				
Child Aged: 1-6	120	6 day/week for 20 weeks [a]	350	7 days/week for 50 weeks [a]
Adult Aged: 7-30	40	2 day/week for 20 weeks [a]	350	7 days/week for 50 weeks [a]
Exposure Duration (years)				
Visitor	1	Assumption	6	Assumption
Onsite Worker	6.6	Median job tenure value [a]	25	Upper range job tenure value [a]
Resident:				
Child Aged: 1-6	6	Child from birth through age 6 [a]	6	Child from birth through age 6 [a]
Adult Aged: 7-30	9	Average length of time at a single residence [a]	24	For combination with child to equal 30 years [a]
Body Weight (kg)				
Onsite Worker	70	Mean weight adult male [a]	70	Mean weight adult male [a]
Visitor & Resident:				
Child Aged: 1-6	15	Mean weight child, age 6 [a]	15	Mean weight child, age 6 [a]
Adult Aged: 7-30	70	Mean weight adult male [a]	70	Mean weight adult male [a]

Source: EPA 1989, 1996a
AEI: average exposed individual
kg: kilogram

m^3: cubic meter
RME: reasonable maximum exposure
[a] Values recommended by the EPA in the *United States Environmental Protection Agency Exposure Factors Handbook 1996*

$$\text{Media Intake (concentration/kg body weight/day)} = \frac{(C \times IR \times EF \times ED)}{(BW \times AT)}$$

(Eq. E.5-1)

Where: C = Concentration within given medium (for example, mg/kg (soil); mg/L (water); or mg/m^3 (air))
IR = Intake Rate (for example, ingestion in mg/day (soil); L/day (water); or inhalation in m^3/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (days) (Averaging time is a lifetime for carcinogens and is the exposure duration for noncarcinogens.)

Calculation of chemical intake requires multiplying the media exposure concentration of each chemical by the media intake factor derived for the exposure route. Inadvertent contact with soil or water and exposure to air would require inclusion of the exposure time (ET) (hours/day) in the numerator. Appropriate conversion factors are applied when needed.

The equation for Chronic Daily Intake (CDI) is used to estimate a receptor's potential intake from exposure to a compound with noncarcinogenic effects. According to the EPA, the chemical exposure dose should be calculated by averaging over the period of time for which the receptor is assumed to be exposed (EPA 1989). For compounds with potential carcinogenic effects, however, the equation for Lifetime Average Daily Dose (LADD) for chemicals is employed to estimate potential exposures. In accordance with the EPA, the LADD is calculated by averaging the assumed exposure over the receptor's lifetime. Therefore, in the following formulas for estimating a receptor's average daily dose from chemicals (both lifetime and chronic) only the averaging time (AT) used differs for the calculation of CDI for noncarcinogens versus calculation of the LADD for carcinogens. The chemical intake (CDI and LADD) was expressed as milligrams of chemical per kilogram of body weight per day (m/kg-day).

The following general equation was used for calculating the intake of chemicals through the inhalation exposure route:

$$\text{Chemical Intake}_i \text{ (mg/kg-day) (CDI or LADD)} = \frac{C_i \times IR \times ET \times EF \times ED}{BW \times AT}$$

(Eq. E.5-2)

Where: C_i = Air exposure concentration of chemical i (mg/m^3)
IR = Inhalation Rate (m^3/hour)
ET = Exposure Time (hours/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (days) (Averaging time is a lifetime for carcinogens and is the exposure duration for noncarcinogens.)

An integrated adult-plus-child risk calculation is used to better estimate chronic exposures over a person's lifetime (SmartRISK 1996). The equation takes into account the timeframe when a child's exposure parameters apply and the timeframe when adult exposure parameters apply. A total of 30 years is the exposure duration for the RME integrated calculation, while a total of 15 years is the exposure duration for the AEI integrated calculation. The integrated risk assessment equation used by *SmartRISK* for inhalation exposure was:

$$\text{Chemical Intake}_i \text{ (mg/kg-day)} = \frac{\dfrac{C_i \times IR_c \times ET_c \times EF_c \times FC_c}{BW_c} \times ED_c + \dfrac{C_i \times IR_a \times ET_a \times EF_a \times FC_a}{BW_a} \times ED_a}{AT_c + AT_a}$$

(Eq. E.5-3)

Where: Ci = Air exposure concentration of chemical i (mg/m^3)
IR_c (c=child) = Inhalation Rate (m^3/hr)
ET = Exposure Time (hours/day)
EF_c = Exposure Frequency (days/year)
FC_c = Fraction from Contaminated Source
BW_c = Body Weight (kg)
ED_c = Exposure Duration (years)
AT_c = Averaging Time (days) (Averaged over a lifetime for carcinogens or the exposure duration for noncarcinogens.)
IR_a (a=adult) = Inhalation Rate (m^3/hour)

ET_a = Exposure Time (hours/day)
EF_a = Exposure Frequency (days/year)
FC_a = Fraction from Contaminated Source
BW_a = Body Weight (kg)
ED_a = Exposure Duration (years)
AT_a = Averaging Time (days) (Averaged over a lifetime for carcinogens or the exposure duration for noncarcinogens.)

Chemical intake is used to estimate health risk, which is representative of the potential for adverse health effects. Health risk is estimated as either a noncarcinogenic HI or carcinogenic excess lifetime cancer risk (EPA 1989). The EPA chemical-specific toxicity dose-response values convert intake to health risk using equations explained further in the risk characterization section of this appendix (Section E.6.1.3).

E.5.5 Radiological Exposure Doses

Radiological doses to the maximally exposed member of the public and to the general population are calculated by the *Clean Air Assessment Package* (*CAP88-PC*) model from the radionuclide air emissions (see Appendix D, Section D.2). Dose is converted to individual MEI and population cancer risks using the appropriate health risk estimators for excess LCF and for excess nonfatal cancers and genetic disorders, as discussed in the risk characterization section of this appendix (Section E.6.1.3).

E.6 RISK CHARACTERIZATION

E.6.1 Analytical Methods Summary

Other resource area consequence analysis results provide input to the human health risk assessment. The "annual average" air concentrations of specific chemicals at specific receptor locations are modeled using *ISCST3* (EPA 1995a) (see Appendix D, Section D.1). The *Multimedia Environmental Pollutant Assessment System* (*MEPAS*) was used in the hydrology analysis to model the concentration of contaminants in groundwater at specific drinking water wells and springs (PNL 1995) (see Appendix B). General population doses due to transportation of radiological materials were modeled using *RADTRAN* (see Appendix G). Radiological doses from air emissions were modeled using *CAP88-PC* (DOE 1997e) (see Appendix D, Section D.2). Only those modeling results showing an environmental impact were used to further evaluate potential human exposures and risks to human health.

E.6.1.1 Worker Safety

Impacts were measured for both the involved and noninvolved worker populations at SNL/NM. Radiological impacts for the involved worker are evaluated using the dosimetry data available for the 1996 base year. These dosimetry data include the total collective individual and worker population doses, maximum individual worker dose, and number of radiation-badged workers. For the 1996 base year and for each alternative, SNL/NM has estimated total full-time equivalents (FTEs) (SNL/NM 1997b, 1998a). The number of radiation workers under each alternative is estimated by multiplying the total FTEs by the 1996 base-year ratio of radiation workers to total FTEs. Worker doses are estimated based on the radiation dose per radiation worker, multiplied by the total number of radiation workers.

The method used to estimate changes in the collective worker radiation dose is based on the change in number of radiation-badged workers under each alternative. This method is used because of the lack of workload adjustment factors available for a laboratory environment. In a research and development laboratory environment, workload is not as easily quantified as in a manufacturing environment. Therefore, estimates of the change in workforce size are used as a workload adjustment. This method assumes that the annual average dose to the radiation-badged worker and the ratio (number of radiation-badged workers/total number of SNL/NM workers) remain consistent with 1996 data. It is realized, however, that the estimated changes in workforce in radiation facilities may not occur as predicted by the alternatives (due to changes in operational efficiencies). However, it is expected that deviations from the current annual average radiation-badged worker dose and the relative number of radiation-badged workers will balance, and predictions of collective dose and subsequent health risk will not be affected.

Nonradiological impacts to the involved worker were evaluated using the illness/injury data available from 1992 through 1996 (SNL/NM 1997b, 1998a). Physical injury and illness rates (5-year average), derived from historic data (1992 through 1996), were used as multiplying factors to estimate the number of physical injuries and illnesses for each alternative based on the number of workers for each alternative.

Potential air pathway exposures to the noninvolved worker were modeled at the center of TA-I for chemicals and at the KUMMSC for radiation. Routine chemical air releases at SNL/NM were modeled using *ISCST3* to predict potential exposures to receptors located onsite in the center of TA-I, as representative of potential maximum exposures to the noninvolved worker. Air quality at this receptor location was compared to applicable occupational limits, such as the occupational exposure limits (OELs) for chemicals or the radiological dose limits of 5 rem/year to the worker and 100 mrem/year to a member of the public. Health impacts for noninvolved workers were calculated as they were for all other receptor locations.

E.6.1.2 Risk Characterization of Chemical Exposure

Risk characterization is the step in the risk assessment process that combines the results of the exposure assessment and the dose-response assessment for each COC to estimate the potential for carcinogenic and noncarcinogenic human health risks from chronic exposure to that COC. This section summarizes the results of the risk characterization for each of the receptor locations and the hypothetical worst-case residential exposure scenario evaluated in the chemical aspect of this risk assessment.

The risks for carcinogenic and noncarcinogenic COCs are characterized in different ways. Risks from chemicals with possible carcinogenic action are derived from the conservative assumption that a no-threshold mechanism exists, whereas risks from chemicals with possible other toxic actions may have a threshold (a dose below which few individuals would be affected). Because of these different approaches, it has become common to refer to COCs as carcinogens and noncarcinogens. Thus, under the no-threshold assumption, it is possible to simply characterize an exposure as above or below a specified RfD. A chemical can be both toxic and a carcinogen. In that case, both assessments are performed for that COC.

The potential for exposure to COCs to result in adverse noncarcinogenic health effects is estimated for each receptor by comparing the CDI for each COC (derived in Section E.5.4) with the RfD for that COC (presented in Section E.4). The resultant ratio, which is unitless, is known as the Hazard Quotient (HQ) for that COC. The HQ is calculated using the following formula:

$$HQ = (CDI)/(RfD)$$

(Eq. E.6–1)

Where: RfD = Reference Dose
CDI = Chronic Daily Intake
HQ = Hazard Quotient

Chemical-specific hazard quotient values for multiple noncarcinogenic chemicals are summed to get a total HI (see formula below).

$$\text{Total HI} = \Sigma^i_n HQ_i$$

(Eq. E.6–2)

Where: i = chemical "i"
n = total number of chemicals
$\Sigma^i_n = HQ_1 + HQ_2 + HQ_3 \ldots HQ_n$

A total HI of less than 1 indicates that no adverse noncarcinogenic health effects are expected to occur as a result of that receptor's potential chronic exposure to the COCs at SNL/NM, even if all COCs assessed are additive in their toxicity. An HI greater than 1 indicates the need to revisit the data to determine which of the COCs are truly additive in their toxicity. This is accomplished by assuming additivity only among chemicals with similar toxic mechanisms or toxic endpoints. An HI less than 1 for probable additive substances again indicates it is unlikely that an adverse additive effect will occur. HIs above 1 do not necessarily signify an effect will occur, but do suggest that the possibility exists. This possibility does not increase linearly with values greater than 1.

The purpose of carcinogenic risk characterization is to estimate the likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of chronic exposures to COCs released to the air from SNL/NM. This likelihood is a function of the dose of a COC (LADD) (derived in Section E.5.4) and the CSF (presented in Section E.4) for that COC.

The relationship between the ELCR and the estimated LADD of a COC may be expressed as [ELCR = $e^{-(CSFxLADD)}$]. When the product of the CSF and the LADD is much greater than 1, the ELCR approaches 1 (100 percent probability); however, when the product is less than 0.01 (1 chance in 100) the equation can be closely approximated by multiplying the LADD by the CSF to determine the ELCR to the individual as shown in the following formula:

$$\text{ELCR} = (\text{CSF})\ (\text{LADD})$$

(Eq. E.6-3)

Where: LADD= Lifetime Average Daily Dose
CSF = Cancer Slope Factor
ELCR = Excess Lifetime Cancer Risk (increased lifetime risk) from chemicals

Chemical-specific ELCR values for carcinogenic chemicals are also summed to determine the Total ELCR of all chemicals combined from all pathways, as shown below.

$$\text{Total ELCR} = \Sigma^{i}_{n}\text{ELCR}_{I}$$

(Eq. E.6-4)

Where: $\Sigma^{i}_{n} = \text{ELCR}_1 + \text{ELCR}_2 + \text{ELCR}_3 + \ldots \text{ELCR}_n$

The product of the CSF and the LADD is unitless and provides an upper-bound estimate of the potential lifetime carcinogenic risk associated with a receptor's exposure to the COC by way of the inhalation pathway. ELCRs are calculated for each potentially carcinogenic COC. A total ELCR of less 1×10^{-6} (one extra chance in one million) for a given receptor is considered to be below the EPA's target risk range. The EPA's target risk range for individual cancer risks is 1×10^{-4} to 1×10^{-6} that an exposed individual would develop an excess cancer in a lifetime (EPA 1989, 40 CFR Part 300).

Risks from chemicals are presented separately for each receptor location, the hypothetical worst-case scenarios, and the Lurance Canyon Burn Site (Four Hills Subdivision receptor location) (Section E.6.3).

E.6.1.3 Risk Characterization of Radiation Exposure

Radiation exposure and its consequences are of concern to the general public. Radiation can cause a variety of ill-health effects in people. The most significant ill-health effect is the induction of cancer fatalities due to radiation exposure. This effect is referred to as "latent" cancer fatalities because the cancer and subsequent death may take many years to develop. In addition, radiation exposure may also cause nonfatal cancers and genetic disorders.

The National Research Council's committee on the Biological Effects of Ionizing Radiation (BEIR) has prepared several reports to advise the government on the health consequences of radiation exposure. BEIR V provided health risk estimators that have been adopted by the National Council on Radiological Protection and Measurements (NCRP) (BEIR V 1990). These risk estimators are 500 excess latent fatal cancers per million person-rem for the general public and 400 excess latent fatal cancers per million person-rem for workers. The higher risk estimator for the general public reflects the inclusion of sensitive population groups, such as children. Based on recommendations of the International Commission on Radiological Protection (ICRP 1991), the health risk estimators for nonfatal cancer and genetic disorders among the general public are 20 percent (100 per million person-rem) and 26 percent (130 per million person-rem), respectively, of the fatal cancer risk estimator of 500 latent fatal cancers per million person-rem. For workers, they are both 20 percent (80 per million person-rem) of the fatal cancer risk estimator of 400 latent fatal cancers per million person-rem.

The risk of fatal cancer to the MEI is determined by multiplying the risk estimator of 500 per million person-rem with the calculated total MEI dose (rem) from all pathways.

$$\text{Risk of fatal cancer from annual exposure} = \left(\frac{500}{10^6\,\text{person}-\text{rem}}\right)\times\begin{pmatrix}\text{total}\\\text{MEI}\\\text{annual}\\\text{dose}\\\text{(mrem)}\end{pmatrix}\frac{1\text{rem}}{1{,}000\text{mrem}}$$

(Eq. E.6-5)

Similarly, the risk of a fatal cancer to a worker is determined by multiplying the risk estimator of 400 per million person-rem with the calculated total individual worker dose (rem). The number of LCFs in the general population or in the workforce is determined by multiplying 500 latent fatal cancers per million person-rem with the calculated collective population dose (person-rem), or 400 latent fatal cancers per million person-rem with the calculated collective workforce dose (person-rem), respectively.

$$\text{Total number of fatal cancers in general population from annual exposure} = \left(\frac{500}{10^6\,\text{person}-\text{rem}}\right)\times\left(\begin{matrix}\text{annual}\\ \text{collective}\\ \text{dose(person}-\text{rem)}\end{matrix}\right)$$

or

$$\text{Total number of fatal cancers in worker population from annual exposure} = \left(\frac{400}{10^6\,\text{person}-\text{rem}}\right)\times\left(\begin{matrix}\text{annual}\\ \text{worker}\\ \text{population}\\ \text{collective}\\ \text{dose}\\ \text{(person}-\text{rem)}\end{matrix}\right)$$

(Eq. E.6–6)

Using the same calculated doses, the nonfatal cancer and genetic disorders are calculated by multiplying the dose to the public by 100 nonfatal cancers and 130 genetic effects per million person-rem, respectively, and by multiplying the dose to workers by 80 nonfatal and 80 genetic effects per million person-rem, respectively. The summary of doses and corresponding health impacts (to the MEI and population) per year of operation are presented in Table E.6–1. A summary of doses and corresponding risk of fatal cancers for individuals at specific receptor locations is presented in Table E.6–2.

E.6.1.4 Composite Cancer Risk

The calculated lifetime excess cancer risks are further considered in deriving a "composite" cancer risk at specific receptor locations where exposure to both carcinogenic chemicals and radiological components may occur simultaneously. Because genetic disorders are only calculated for radiological exposures, a composite human health risk is not appropriate. Therefore, these effects are presented independently.

The composite cancer risk for an individual member of the public, due to both chemical and radiological exposures at the same location, is derived two ways. First, to capture the maximum potential radiation dose, the MEI radiological annual increased lifetime cancer risk was converted to a long-term exposure by multiplying by 30 years. This is consistent with the exposure duration used for assessing the adult/child integrated chemical exposures (Section E.5.5). Then, the MEI radiological fatal (lifetime) cancer risk was added to the ELCR due to chemical exposure at that location (KUMMSC).

In other words, the ELCR from chemicals is summed with excess LCF risk from radiation after the radiological LCF risk is presented as a long-term exposure (annual LCF x 30-year duration) using the following equation:

$$\text{Composite cancer risk} = (\text{Total ELCR}) + (\text{MEI LCF} \times 30\ \text{yr})$$

(Eq. E6–7)

Where: ELCR = Excess Lifetime Cancer Risk from Chemicals
MEI LCF = Increased Lifetime Risk of Latent Cancer Fatality to the Radiological MEI from a 1-year dose

Second, to capture the potential maximum chemical exposure, composite cancer risk was derived by adding the upper-bound (hypothetical worst-case exposure scenario) chemical ELCR to the MEI radiological cancer risk. This was an implausible scenario because these exposures would not occur at the same location. A conservative assessment captured the upper-bound chemical risk and upper-bound composite risk.

For the possible additive effects of exposures to radiation by way of the air pathway and the transportation of radiological materials within the ROI, the risk of LCF to the population along the transportation route within the ROI due to the routine transportation of radiological materials was summed with the LCF to the total population within the ROI from routine air releases of radionuclides. Ten percent of the annual collective population dose (off-link and on-link) from all transportation activities was used to derive the LCFs from transportation activities within the 50-mi ROI population (see Appendix G). Ten percent of the risk from transportation was summed with the ROI population LCFs from routine air emissions to get a total number of LCFs applicable to those in the ROI along the transportation route (see Sections 5.3.8, 5.4.8, and 5.5.8).

Overall, the total risks of cancer due to SNL/NM operations can be put in perspective. The U.S. national cancer rate is that between 20 percent and 25 percent of the population will develop cancer in their lifetime (ACS 1997).

Table E.6–1. Summary of Calculated Annual Radiation Doses and Health Effects per Year of the Operation to the MEI and General Population

ALTERNATIVE	MEI (KUMMSC)				POPULATION			
	DOSE (mrem/yr)	RISK OF FATAL CANCER	RISK OF NONFATAL CANCER	RISK OF GENETIC DISORDERS	COLLECTIVE DOSE (person-rem)	TOTAL FATAL CANCERS	TOTAL NONFATAL CANCERS	TOTAL GENETIC DISORDERS
No Action	0.15	7.5×10^{-8}	1.5×10^{-8}	2.0×10^{-8}	5.0 (0.55)[a]	2.5×10^{-3}	5.0×10^{-4}	6.5×10^{-4}
Expanded Operations[b]	0.51	2.6×10^{-7}	5.1×10^{-8}	6.6×10^{-8}	15.8 (1.62)[a]	7.9×10^{-3}	1.6×10^{-3}	2.1×10^{-3}
Reduced Operations	0.016	8.0×10^{-9}	1.6×10^{-9}	2.1×10^{-9}	0.80 (0.101)[a]	4.0×10^{-4}	8.0×10^{-5}	1.0×10^{-4}

Source: DOE 1997e
MEI: maximally exposed individual
KUMMSC: Kirtland Underground Munitions and Maintenance Storage Complex
mrem/year: millirem per year
rem: Roentgen equivalent, man
[a] Portion of dose due to ingestion of crops and livestock
[b] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the annual radiation doses and health effects under the Expanded Operation Alternative.
Note: Calculated by *CAP88-PC*

Table E.6–2. Summary of Radiation Doses and Health Effects at Specific Receptor Locations Under Each Alternative

RECEPTOR LOCATION	NO ACTION		EXPANDED OPERATIONS[a]		REDUCED OPERATIONS	
	DOSE (mrem/yr)	RISK OF CANCER FATALITY	DOSE (mrem/yr)	RISK OF CANCER FATALITY	DOSE (mrem/yr)	RISK OF CANCER FATALITY
Child Development Center-East	1.8×10^{-2}	9.0×10^{-9}	5.4×10^{-2}	2.7×10^{-8}	5.1×10^{-3}	2.6×10^{-9}
Child Development Center-West	1.9×10^{-2}	9.5×10^{-9}	6.2×10^{-2}	3.1×10^{-8}	2.6×10^{-3}	1.3×10^{-9}
Coronado Club	2.0×10^{-2}	1.0×10^{-8}	5.5×10^{-2}	2.8×10^{-8}	5.7×10^{-3}	2.9×10^{-9}
Four Hills Subdivision	4.1×10^{-2}	2.1×10^{-8}	1.1×10^{-1}	5.5×10^{-8}	1.0×10^{-2}	5.0×10^{-9}
Golf Course (clubhouse)	7.2×10^{-2}	3.6×10^{-8}	2.3×10^{-1}	1.2×10^{-7}	7.9×10^{-3}	4.0×10^{-9}
Kirtland Elementary School	1.9×10^{-2}	9.5×10^{-9}	6.1×10^{-2}	3.1×10^{-8}	2.5×10^{-3}	1.3×10^{-9}
KAFB Housing (Zia Park Housing)	2.4×10^{-2}	1.2×10^{-8}	6.6×10^{-2}	3.3×10^{-8}	5.8×10^{-3}	2.9×10^{-9}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	1.5×10^{-1}	7.5×10^{-8}	5.1×10^{-1}	2.6×10^{-7}	1.6×10^{-2}	8.0×10^{-9}
Lovelace Hospital	1.4×10^{-2}	7.0×10^{-9}	4.5×10^{-2}	2.3×10^{-8}	2.8×10^{-3}	1.4×10^{-9}
National Atomic Museum	2.5×10^{-2}	1.3×10^{-8}	6.9×10^{-2}	3.5×10^{-8}	9.0×10^{-3}	4.5×10^{-9}
Riding Stables	6.3×10^{-2}	3.2×10^{-8}	2.1×10^{-1}	1.1×10^{-7}	6.8×10^{-3}	3.4×10^{-9}
Sandia Base Elementary School	1.7×10^{-2}	8.5×10^{-9}	4.3×10^{-2}	2.2×10^{-8}	4.1×10^{-3}	2.1×10^{-9}
Shandiin Day Care Center	2.2×10^{-2}	1.1×10^{-8}	6.3×10^{-2}	3.2×10^{-8}	6.3×10^{-3}	3.2×10^{-9}
Isleta Gaming Palace	2.7×10^{-2}	1.4×10^{-8}	6.6×10^{-2}	3.3×10^{-8}	1.1×10^{-2}	5.5×10^{-9}
Veterans Affairs Medical Center	2.7×10^{-2}	1.4×10^{-8}	8.4×10^{-2}	4.2×10^{-8}	4.0×10^{-3}	2.0×10^{-9}
Wherry Elementary School	1.8×10^{-2}	9.0×10^{-9}	5.2×10^{-2}	2.6×10^{-8}	4.5×10^{-3}	2.3×10^{-9}

Source: DOE 1997e
mrem/yr: millirems per year
KAFB: Kirtland Air Force Base
[a] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the annual radiation doses and health effects at specific receptor locations under the Expanded Operations Alternative.
Note: Calculation made using *CAP88-PC*

E.6.2 Assumptions

The following facts and assumptions were integrated into the human health and worker safety impacts assessment:

- Human health impacts from accidents were expressed as impacts per accident, not as impacts per year. Therefore, they were not added to the human health impacts from routine operations. Impacts from accidents are presented independently.
- Modeling for carcinogenic hazardous air pollutant emissions addressed the same receptor locations addressed for radiological air emissions, as well as other receptor locations specific to chemical emissions, to allow for the composite risk assessment.
- Drinking contaminated groundwater was not a completed exposure pathway.
- The reference-person used to evaluate risk to human health was the standard adult/child receptor, based on the available toxicity criteria that have conservative uncertainty factors integrated into them in order to protect of a wide range of human receptors.
- Workers' doses from transportation activities involving radioactive materials were collectively covered in historic dosimetry data. A separate estimate of transportation worker doses was not presented.
- Drinking surface water was not a completed exposure pathway.
- The soil pathway (inhalation, ingestion) was not a completed exposure pathway for nonradiological contaminants. Estimates of radiological impacts by way of soils were modeled by *CAP88-PC* (DOE 1997e).
- The total collective population radiation dose calculated by *CAP88-PC* for radiation exposures took into account all environmental pathways directly and indirectly associated with air emissions (such as ingestion of locally grown crops and livestock).

E.6.3 Risk Results

Tables E.6–3 through E.6–8 present risk results to human health from chemical air emissions and radiological air emissions under each of the three alternatives. The Expanded Operations Alternative, Table E.6–4 and E.6–7, includes risk results to human health for the MESA Complex configuration, if implemented.

E.6.4 Uncertainty

Within the risk assessment process, assumptions must be made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less scientific support. Every assumption introduces some degree of uncertainty into the risk assessment process. Conservative assumptions are made throughout the risk assessment to ensure the protection of public health. Therefore, when all of the assumptions are added together, it is much more likely that risks are overestimated rather than underestimated (EPA 1989).

The assumptions that introduce the greatest amount of uncertainty in the risk assessment are discussed in this section. They are discussed in general terms because, for most of the assumptions, there is not enough information to assign them a numerical value that can be factored in the calculation of risk estimates.

E.6.4.1 Uncertainties of Data Evaluation and Selection of Chemicals of Potential Concern

Information on both fugitive and stack emissions chemicals is combined with measures of their potential toxicities to obtain a subset of chemical constituents for evaluation in the risk assessment. Uncertainty is introduced in two principal areas during this step: emission estimates and selection of the COCs. Overall, the data evaluation process overestimates site risks.

The data used to develop the risk assessment were estimated emissions from various facility sources at SNL/NM and from the Lurance Canyon Burn Site. Uncertainties associated with emission estimation or in data collection may lead to over or underestimation of corresponding risk estimates. The emission estimation was modeled by *ISCST3* (EPA 1995a) using conservative parameters and assumptions (Appendix D). The emission estimates from the Lurance Canyon Burn Site assume that a resident would be located at the nearest eastern site boundary (closer than the actual distance to the Four Hills Subdivision) and that burn activities take place up to 58 times per year (Expanded Operations Alternative with or without MESA). Therefore, due to the conservative nature of the data evaluated in the risk assessment, the overall effect on the risk assessment is an overestimation of risk.

In the selection of COCs, the individual building quantities of hazardous air pollutants, toxic air pollutants, and volatile organic compounds were screened using a threshold emission value (TEV) calculated from the

Table E.6–3. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
RESIDENTIAL SCENARIOS			
Upper-Bound Value[a]	Adult	0.01/<0.01	$1.4x10^{-7}/5.8x10^{-9}$
	Child	0.02/<0.01	$5.3x10^{-8}/5.1x10^{-9}$
Four Hills Subdivision[b]	Adult	<0.01/<0.01	$3.7x10^{-11}/2.3x10^{-11}$
	Child	<0.01/<0.01	$1.5x10^{-11}/1.5x10^{-11}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.6x10^{-9}/1.7x10^{-11}$
	Child	<0.01/<0.01	$1.1x10^{-9}/1.3x10^{-11}$
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$6.7x10^{-10}/7.0x10^{-12}$
	Child	<0.01/<0.01	$4.7x10^{-10}/5.3x10^{-12}$
WORKER SCENARIOS			
Center of TA-I[c]	Adult	<0.01/<0.01	$8.9x10^{-8}/6.9x10^{-10}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	Adult	<0.01/<0.01	$3.8x10^{-10}/4.0x10^{-12}$
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$6.1x10^{-10}/6.9x10^{-12}$
Child Development Center-West	Child	<0.01/<0.01	$1.2x10^{-10}/1.4x10^{-12}$
Coronado Club	Adult	<0.01/<0.01	$1.1x10^{-9}/1.1x10^{-11}$
	Child	<0.01/<0.01	$7.4x10^{-10}/8.4x10^{-12}$
Golf Course (clubhouse)	Adult	<0.01/<0.01	$3.8x10^{-10}/3.9x10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$1.0x10^{-10}/1.1x10^{-12}$
Lovelace Hospital	Adult	<0.01/<0.01	$3.0x10^{-10}/3.1x10^{-12}$
	Child	<0.01/<0.01	$2.1x10^{-10}/2.3x10^{-12}$
National Atomic Museum	Adult	<0.01/<0.01	$1.8x10^{-9}/1.9x10^{-11}$
	Child	<0.01/<0.01	$1.3x10^{-9}/1.4x10^{-11}$
Riding Stables	Adult	<0.01/<0.01	$3.0x10^{-10}/3.0x10^{-12}$
Sandia Base Elementary School	Child	<0.01/<0.01	$8.2x10^{-10}/9.3x10^{-12}$
Shandiin Day Care Center	Child	<0.01/<0.01	$6.9x10^{-10}/7.8x10^{-12}$
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$2.9x10^{-10}/3.0x10^{-12}$
Wherry Elementary School	Child	<0.01/<0.01	$4.6x10^{-10}/5.2x10^{-12}$

Source: SmartRISK 1996
RME: Reasonable Maximum Exposure
AEI: Average Exposed Individual
TA: technical area
KAFB: Kirtland Air Force Base
[a] Upper-bound risk values based on SNL/NM building air emissions.
[b] Four Hills Subdivision receptor location impacts are based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions.
[c] Receptor location selected for proximity to chemical air emission sources.

Table E.6–4. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the Expanded Operations Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI (WITH MESA)
RESIDENTIAL SCENARIOS			
Upper-Bound Value[a]	Adult	0.01/<0.01	$1.4 \times 10^{-7}/5.8 \times 10^{-9}$ ($1.1 \times 10^{-7}/4.3 \times 10^{-9}$)
	Child	0.02/<0.01	$5.3 \times 10^{-8}/5.0 \times 10^{-9}$ ($3.9 \times 10^{-8}/3.7 \times 10^{-9}$)
Four Hills Subdivision[b]	Adult	<0.01/<0.01	$2.1 \times 10^{-10}/1.3 \times 10^{-11}$ ($2.1 \times 10^{-10}/1.3 \times 10^{-11}$)
	Child	<0.01/<0.01	$8.5 \times 10^{-10}/8.5 \times 10^{-11}$ ($8.5 \times 10^{-10}/8.5 \times 10^{-11}$)
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.7 \times 10^{-9}/1.7 \times 10^{-11}$ ($4.3 \times 10^{-10}/4.4 \times 10^{-12}$)
	Child	<0.01/<0.01	$1.2 \times 10^{-9}/1.3 \times 10^{-11}$ ($3.0 \times 10^{-10}/3.4 \times 10^{-12}$)
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$7.8 \times 10^{-10}/8.0 \times 10^{-12}$ ($7.2 \times 10^{-10}/7.4 \times 10^{-12}$)
	Child	<0.01/<0.01	$5.4 \times 10^{-10}/6.1 \times 10^{-12}$ ($5.0 \times 10^{-10}/5.7 \times 10^{-12}$)
WORKER SCENARIOS			
Center of TA-I[c]	Adult	<0.01/<0.01	$9.4 \times 10^{-8}/7.3 \times 10^{-10}$ ($7.9 \times 10^{-8}/6.1 \times 10^{-10}$)
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	Adult	<0.01/<0.01	$4.5 \times 10^{-10}/4.7 \times 10^{-12}$ ($3.3 \times 10^{-10}/3.4 \times 10^{-12}$)
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$7.2 \times 10^{-10}/8.1 \times 10^{-12}$ ($5.0 \times 10^{-10}/5.6 \times 10^{-12}$)
Child Development Center-West	Child	<0.01/<0.01	$1.5 \times 10^{-10}/1.7 \times 10^{-12}$ ($1.1 \times 10^{-10}/1.3 \times 10^{-12}$)
Coronado Club	Adult	<0.01/<0.01	$1.2 \times 10^{-9}/1.3 \times 10^{-11}$ ($8.8 \times 10^{-10}/9.0 \times 10^{-12}$)
	Child	<0.01/<0.01	$8.7 \times 10^{-10}/9.8 \times 10^{-12}$ ($6.1 \times 10^{-10}/6.9 \times 10^{-12}$)
Golf Course (clubhouse)	Adult	<0.01/<0.01	$4.4 \times 10^{-10}/4.5 \times 10^{-12}$ $4.8 \times 10^{-10}/4.9 \times 10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$4.0 \times 10^{-11}/4.5 \times 10^{-13}$ ($3.5 \times 10^{-11}/3.9 \times 10^{-13}$)
Lovelace Hospital	Adult	<0.01/<0.01	$3.5 \times 10^{-10}/3.6 \times 10^{-12}$ ($2.5 \times 10^{-10}/2.6 \times 10^{-12}$)
	Child	<0.01/<0.01	$2.5 \times 10^{-10}/2.8 \times 10^{-12}$ ($1.8 \times 10^{-10}/2.0 \times 10^{-12}$)

Table E.6–4. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the Expanded Operations Alternative (concluded)

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI (WITH MESA)
National Atomic Museum	Adult	<0.01/<0.01	$2.1x10^{-9}/2.1x10^{-11}$ ($1.7x10^{-9}/1.8x10^{-11}$)
	Child	<0.01/<0.01	$1.4x10^{-9}/1.6x10^{-11}$ ($1.2x10^{-9}/1.4x10^{-11}$)
Riding Stables	Adult	<0.01/<0.01	$3.0x10^{-10}/3.1x10^{-12}$ ($2.8x10^{-10}/2.9x10^{-12}$)
Sandia Base Elementary School	Child	<0.01/<0.01	$9.7x10^{-10}/1.1x10^{-11}$ ($5.8x10^{-10}/6.5x10^{-12}$)
Shandiin Day Care Center	Child	<0.01/<0.01	$7.9x10^{-10}/9.0x10^{-12}$ ($7.1x10^{-10}/8.0x10^{-12}$)
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$3.4x10^{-10}/3.5x10^{-12}$ ($3.0x10^{-10}/3.1x10^{-12}$)
Wherry Elementary School	Child	<0.01/<0.01	$5.4x10^{-10}/6.1x10^{-12}$ ($3.7x10^{-10}/4.2x10^{-12}$)

Source: SmartRISK 1996
RME: Reasonable Maximum Exposure
AEI: Average Exposed Individual
TA: technical area
KAFB: Kirtland Air Force Base
MESA: Microsystems and Engineering Sciences Applications

[a] Upper-bound risk values based on SNL/NM building air emissions.
[b] Four Hills Subdivision receptor location impacts are based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions, therefore, no change due to MESA Complex.
[c] Receptor location selected for proximity to chemical air emissions sources.

Table E.6–5. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the Reduced Operations Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
RESIDENTIAL SCENARIOS			
Upper-Bound Value[a]	Adult	<0.01/<0.01	$9.5x10^{-8}/3.8x10^{-9}$
	Child	<0.01/<0.01	$3.5x10^{-8}/3.3x10^{-9}$
Four Hills Subdivision	Adult	<0.01/<0.01	$1.8x10^{-11}/1.1x10^{-11}$
	Child	<0.01/<0.01	$7.4x10^{-12}/7.4x10^{-12}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.7x10^{-10}/1.7x10^{-12}$
	Child	<0.01/<0.01	$1.2x10^{-10}/1.3x10^{-12}$
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$3.6x10^{-10}/3.8x10^{-12}$
	Child	<0.01/<0.01	$2.5x10^{-10}/2.9x10^{-12}$
WORKER SCENARIOS			
Center of TA-I	Adult	<0.01/<0.01	$5.7x10^{-8}/4.4x10^{-10}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	Adult	<0.01/<0.01	$1.8x10^{-10}/1.8x10^{-12}$
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$3.4x10^{-10}/3.9x10^{-12}$
Child Development Center-West	Child	<0.01/<0.01	$6.7x10^{-11}/7.6x10^{-13}$
Coronado Club	Adult	<0.01/<0.01	$5.9x10^{-10}/6.0x10^{-12}$
	Child	<0.01/<0.01	$4.1x10^{-10}/4.6x10^{-12}$
Golf Course (clubhouse)	Adult	<0.01/<0.01	$1.9x10^{-10}/1.9x10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$5.5x10^{-11}/6.2x10^{-13}$
Lovelace Hospital	Adult	<0.01/<0.01	$1.6x10^{-10}/1.7x10^{-12}$
	Child	<0.01/<0.01	$1.1x10^{-10}/1.3x10^{-12}$
National Atomic Museum	Adult	<0.01/<0.01	$9.9x10^{-10}/1.0x10^{-11}$
	Child	<0.01/<0.01	$6.9x10^{-10}/7.8x10^{-12}$
Riding Stables	Adult	<0.01/<0.01	$9.7x10^{-11}/1.0x10^{-12}$
Sandia Base Elementary School	Child	<0.01/<0.01	$4.7x10^{-10}/5.3x10^{-12}$
Shandiin Day Care Center	Child	<0.01/<0.01	$3.7x10^{-10}/4.2x10^{-12}$
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$1.6x10^{-10}/1.6x10^{-12}$
Wherry Elementary School	Child	<0.01/<0.01	$2.5x10^{-10}/2.8x10^{-12}$

Source: SmartRISK 1996
RME: Reasonable Maximum Exposure
AEI: Average Exposed Individual
TA: technical area
KAFB: Kirtland Air Force Base

[a] Upper-bound risk values based on SNL/NM building air emissions.
[b] Four Hills Subdivision receptor location impacts are based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions.
[c] Receptor location selected for proximity to chemical air emission sources.

Table E.6–6. Human Health Impacts in the Vicinity of SNL/NM from Radiological Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	$9.0x10^{-9}$
Child Development Center-West	$9.5x10^{-9}$
Coronado Club	$1.0x10^{-8}$
Four Hills Subdivision	$2.1x10^{-8}$
Golf Course	$3.6x10^{-8}$
Kirtland Elementary School	$9.5x10^{-9}$
KAFB Housing (Zia Park Housing)	$1.2x10^{-8}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	$7.5x10^{-8}$
Lovelace Hospital	$7.0x10^{-9}$
National Atomic Museum	$1.3x10^{-8}$
Riding Stables	$3.2x10^{-8}$
Sandia Base Elementary School	$8.5x10^{-9}$
Shandiin Day Care Center	$1.1x10^{-8}$
Isleta Gaming Palace	$1.4x10^{-8}$
Veterans Affairs Medical Center	$1.4x10^{-8}$
Wherry Elementary School	$9.0x10^{-9}$

Source: DOE 1997e
KAFB: Kirtland Air Force Base
Note: Calculations made by *CAP88-PC*

Table E.6–7. Human Health Impacts in the Vicinity of SNL/NM from Radiological Air Emissions Under the Expanded Operations Alternative[a]

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	$2.7x10^{-8}$
Child Development Center-West	$3.1x10^{-8}$
Coronado Club	$2.8x10^{-8}$
Four Hills Subdivision	$5.5x10^{-8}$
Golf Course	$1.2x10^{-7}$
Kirtland Elementary School	$3.1x10^{-8}$
KAFB Housing (ZIA Park Housing)	$3.3x10^{-8}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	$2.6x10^{-7}$
Lovelace Hospital	$2.3x10^{-8}$
National Atomic Museum	$3.5x10^{-8}$
Riding Stables	$1.1x10^{-7}$
Sandia Base Elementary School	$2.2x10^{-8}$
Shandiin Day Care Center	$3.2x10^{-8}$
Isleta Gaming Palace	$3.3x10^{-8}$
Veterans Affairs Medical Center	$4.2x10^{-8}$
Wherry Elementary School	$2.6x10^{-8}$

Source: DOE 1997e
KAFB: Kirtland Air Force Base
[a] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the radiological air emissions under the Expanded Operations Alternative.
Note: Calculations made by *CAP88-PC*

Table E.6–8. Human Health Impacts in the Vicinity of SNL/NM from Radiological Air Emissions Under the Reduced Operations Alternative

RECEPTOR LOCATION	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	2.6×10^{-9}
Child Development Center-West	1.3×10^{-9}
Coronado Club	2.9×10^{-9}
Four Hills Subdivision	5.0×10^{-9}
Golf Course	4.0×10^{-9}
Kirtland Elementary School	1.3×10^{-9}
KAFB Housing (ZIA Park Housing)	2.9×10^{-9}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	8.0×10^{-9}
Lovelace Hospital	1.4×10^{-9}
National Atomic Museum	4.5×10^{-9}
Riding Stables	3.4×10^{-9}
Sandia Base Elementary School	2.1×10^{-9}
Shandiin Day Care Center	3.2×10^{-9}
Isleta Gaming Palace	5.5×10^{-9}
Veterans Affairs Medical Center	2.0×10^{-9}
Wherry Elementary School	2.3×10^{-9}

Source: DOE 1997e
KAFB: Kirtland Air Force Base
Note: Calculations made by *CAP88-PC*

health guidelines (OEL unit risk factors) protective of human health. Estimates of chemical quantities released as routine air emissions and exceeding the TEVs were considered to be the COCs. If a chemical constituent did not have a published health guideline, the constituent could not be considered a COC. Some assumptions were made, such as, the chemical was controlled under Occupational Safety and Health Administration regulations at the facility; material safety data sheets were available for worker protection, as necessary; and chronic exposures offsite would not be anticipated. Furthermore, the requirement of establishing a health guideline is to handle potentially hazardous chemicals. If no health guideline exists, the assumption was made that the hazards may be low relative to the chemical's use. These assumptions for the selection of COCs may underestimate the contribution from the nonregulated pollutants to the overall risk estimates.

In addition, some potential COCs (those not screened out by the air quality analysis) did not have dose-response toxicity RfDs available. These chemicals could not be included in the calculation of either noncarcinogenic or carcinogenic health risks. However, these were qualitatively assessed for potential health effects, but were not associated with chronic health effects. Chromium trioxide and 1, 4-dioxane were identified as routine air emissions but toxicity information does not identify them as an inhalation health risk. Although these chemicals are toxic by ingestion, health risks for them through the air pathway were unidentifiable, and they were screened from the COC list. This type of uncertainty potentially may underestimate risk, but not in all cases.

E.6.4.2 Uncertainties in Dose-Response Assessment

Dose-response values are usually based on limited toxicological data. For this reason, a large margin of safety is built into estimates of both carcinogenic and noncarcinogenic risks. There are two major areas of uncertainty in the dose-response assessment: 1) animal to human extrapolation; and 2) high to low dose extrapolation (laboratory studies use high doses and actual environmental exposures occur at low doses). Two major contributors to uncertainty in the dose-response assessment are the necessity (usually) of extrapolating effects on humans from tests on laboratory animals and extrapolating effects observed at high doses to those likely at low doses. Further, data are often limited to one or a few studies. For these reasons, a large margin of safety is built into the factors used to estimate both cancer and noncancer risks, such as setting the human "safe" exposure level a thousand times lower than that actually measured for a laboratory animal. These safety factors make it much more likely that risks will be overestimated than underestimated. The large margin of safety in the dose-response values also accounts for the uncertainties that may be associated with chemical interaction. According to the EPA, the simplistic approach of assuming additive effects of chemicals is generally appropriate, unless potentially high risks exist (EPA 1989).

E.6.4.3 Uncertainties in Exposure Assessment

Exposure point concentrations were estimated and exposure doses were calculated. Exposure point concentrations are the estimated concentrations of chemicals to which humans outdoors may be exposed. A range of exposures at different locations was evaluated in the risk assessment. The RME assumptions were conservative and were likely to overestimate potential SNL/NM site risks. The AEI exposure assumptions were not likely to either overestimate or underestimate potential site risks.

E.6.4.4 Uncertainties in Risk Characterization

The risk of adverse human health effects depends on estimated levels of exposure and dose-response relationships. Two important additional sources of uncertainty are introduced in this phase of the risk assessment: 1) the evaluation of potential exposure to more than one chemical, and 2) the presence of subpopulations that may be particularly sensitive.

Once exposure to and risk from each of the selected chemicals was calculated, the total risk posed by the site was determined by combining the health risk contributed by each chemical. Threshold (noncarcinogenic) effects were added together, as represented by the total HI, unless there was evidence that the chemicals being studied act synergistically (result in a response that is greater than expected) or antagonistically (result in a response that is less than expected) with each other (Klaassen et al. 1986). The same practice was used for potential carcinogenic effects. According to the EPA's *Risk Assessment Guidance for Superfund Sites* (EPA 1989), when total cancer risks are less than 0.1, the simplistic approach of additive risks is appropriate. Additionally, because cancer slope factors are based on upper 95th values, and because upper 95th percentiles of probability distributions are not strictly additive, the total cancer risk estimates might become artificially more conservative as risks from a number of different carcinogens are summed (EPA 1989). For virtually all combinations of chemicals potentially released from the SNL/NM facility, there was little or no evidence of interaction. Therefore, it was assumed that carcinogenic effects may be added together. This uncertainty may cause an underestimation or overestimation of risk.

The health risks estimated in the risk characterization apply to the various locations where air concentrations are estimated or at locations where potential receptors are assumed to be located. Some people will always be more sensitive than the average person and, therefore, will be at greater risk. However, dose-response values used to calculate risk take into account potentially sensitive individuals. Therefore, it is unlikely that this source of uncertainty contributes significantly to the overall uncertainty of the risk assessment.

E.7 WORKER IMPACTS

E.7.1 Nonradiological Injury/Illness Rates

Health impacts from environmental releases of hazardous or radiological materials from SNL/NM operations are not the primary risk to workers. Routine operations at SNL/NM are conducted according to extensive worker health and safety requirements. These requirements control worker exposures to chemicals and radionuclides to the greatest extent possible. The more significant worker health impacts to assess are the risks from industrial accidents, injuries, and illnesses. Therefore, for the general SNL/NM worker population, physical injury and illness rates and radiological dose rates to the radiation workers were evaluated. The number of SNL/NM worker nonfatal occupational injuries/illnesses were calculated under each alternative.

The 5-year average nonfatal occupational injury/illness rate for 100 workers (or 200,000 hours) and the 5-year average SNL/NM worker population size were used to determine the number of SNL/NM worker nonfatal occupational injuries/illnesses per year for the entire SNL/NM workforce under each alternative. It was assumed the 5-year average rate would remain constant for all alternatives and, based on numbers of workers only, the total number of illnesses/injuries would vary. The SNL/NM worker nonfatal occupational injury/illness rates shown in Section 4.10 were used to calculate the 5-year average (1992-1996) SNL/NM nonfatal occupational injury/illness rate of 3.5. The annual 1992 to 1996 SNL/NM worker population values provided in the SNL/NM *Environmental Information Document* (SNL/NM 1997a) were used to calculate the 5-year SNL/NM worker population average of 8,463 (see Table E.7–1).

Conservative calculations were made in estimating the SNL/NM worker population for each alternative. A percentage factor was assigned for each alternative and was directly related to an increase or decrease in the number of SNL/NM workers for each alternative (see Sections 5.3.12, 5.4.12. and 5.5.12). The 5-year SNL/NM worker population average was multiplied by the percentage factor for each alternative to obtain the

Table E.7–1. SNL/NM Five-Year Average (1992-1996) Illness/Injury Rate

DATA ITEMS	YEAR					5-year Average
	1992	1993	1994	1995	1996	
Annual SNL/NM Worker Population Size	8,589	8,608	8,561	8,522	8,033	**8,463**
Annual SNL/NM Nonfatal Occupational Injury/Illness Rate	2.3	4.1	3.8	3.5	3.8	**3.5**

Sources: See Table 4.10–2, SNL/NM 1997a
SNL/NM: Sandia National Laboratories/New Mexico

number of workers that were either added to or subtracted from (percent increase or decrease) the 5-year average SNL/NM worker population under each alternative (see Table E.7–2).

The estimated SNL/NM worker population under each alternative was multiplied by the SNL/NM 5-year average nonfatal occupational injury/illness rate (per 100 workers) to obtain the total number of nonfatal occupational injuries/illnesses per year for the entire SNL/NM workforce for each alternative (see Table E.7–2).

E.7.2 Radiological Worker Doses/Health Risk

To evaluate the potential radiological impacts to SNL/NM employees for each alternative, the base year, 1996, was chosen by SNL/NM as most appropriate, based on reported worker-dose data from 1992 through 1996 (see Table 4.10–1). The selection process considered availability of data including material inventories, planned activities for each alternative, consistency with other resource areas that also established 1996 as the base year, and facility-based knowledge used in projecting operating levels for each alternative as reflected in the *SNL/NM Facility Source Documents* (SNL/NM 1998a). SNL/NM-projected operating levels contained in the *SNL/NM Facility Source Documents* include levels of radioactive materials to be processed and emitted as well as numbers of employees for facilities under all three alternatives.

The selection of the base year started with a review of the DOE annual occupational exposure report, which covers

Table E.7–2. Calculated Nonfatal Occupational Injuries/Illnesses per Year for SNL/NM Workforce by Alternative

DATA ITEMS	5-YEAR AVERAGE[a]	NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
SNL/NM Worker Population Size Predicted Under Each Alternative	8,463	8,886 (5% Increase)[b]	9,309 (10% Increase)[b]	8,209 (3% Decrease)[b]
SNL/NM Nonfatal Occupational Injury/Illness Rate (per 100 workers or 200,000 hrs) 5-year Average (1992-1996)	3.5	3.5	3.5	3.5
Total Number of Nonfatal Occupational Injuries/Illnesses for the Entire SNL/NM Workforce Predicted Under Each Alternative	296[c]	311[c]	326[c]	287[c]

Source: See Tables 5.3.12–1, 5.4.12–1, 5.5.12–1, and 4.10–2
[a] From Table E.7–1.
[b] Increase or decrease in the worker population above or below the 5-year average derived from 1992-1996 data (see Table E.7–1).
[c] Number of injuries/illnesses under each alternative = (population size) (5-year average injury/illness rate)/100 workers
Note: If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the nonfatal occupied injuries/illnesses per year under the Expanded Operations Alternative.

the measurable doses to individuals (includes all DOE, contractors, and visitors) by field office/operations by site/facility. The report on worker doses includes doses for all of SNL (including SNL/NM and SNL operations in California and at Tonopah, Nevada), Kirtland Air Force Base, Lovelace Respiratory Research Institute, and Ross Aviation. The analysis focused on exposures to radiation workers, which is consistent with the facility-based approach used in the *SNL/NM Facility Source Documents*. The term "radiation worker" is defined as a person having received an exposure of 10 mrem/yr or higher. The information provided by SNL/NM, based on their Radiation Exposure Monitoring System (REMS) data for the years 1992 through 1996, was considered and summarized in Table 4.10–1 for radiation worker average dose, maximum dose, and collective worker dose. The year 1996 was considered as a reasonable baseline, and the radiological operations were considered more representative of future operations compared to the years 1992 through 1995. The radiation worker doses for the 1996 base year were then used for future projections for worker doses under each of the alternatives.

SNL/NM provided the number of radiation workers and total FTEs for 1996. Because 1996 is considered representative for radiological operations in the future, the average worker dose and maximum worker dose are considered representative and consistent with 1996, and collective worker dose is projected based on change in radiation workers under each alternative. Annually, projected worker doses would likely fluctuate due to changes in operations, changes in prioritizing tests or other activities, changes in operating levels, and changes in personnel. At this time and based on the assumptions presented in the *SNL/NM Facility Source Documents*, the total worker doses projected over a 10-year period would likely bound impacts. Regardless, SNL/NM would continue to mitigate exposures through existing administrative controls such as shielding, remote operations, and multiple shifts to keep individual worker dose as low as reasonably achievable.

The SNL/NM REMS database dose information for 1996 presented the total collective worker dose of 12 person-rem, with a maximum individual worker dose of 845 mrem. The database also reported the total number of radiation-badged workers, those having an exposure dose greater than 10 mrem, as 258 out of a total monitored workforce of 18,750 (SNL/NM, contract employees, visitors). Based on this information, an average radiation-badged worker dose calculated for 1996 was 47 mrem/yr (12 x 1,000/258). Because only those badges with a 10-mrem or greater detected dose were used by REMS to calculate the average, maximum, and collective worker dose rates, only those badged workers were considered in the analysis as radiation-badged workers. Therefore, impacts to workers from radiation did not apply to nonradiation workers with badges because they did not have a detection of at least 10 mrem. The maximum worker dose and average worker dose were assumed to remain consistent with data assessed for the base year of 1996. Therefore, these values remained the same for all alternatives (Section E.6.1.1).

For each of the alternatives and for the base year of 1996, total FTEs were reported for radiation facilities (SNL/NM 1998a). There were 772 radiation facility FTEs for the base year of 1996, 1,068 radiation facility FTEs under the No Action Alternative, 1,192 radiation facility FTEs under the Expanded Operations Alternative, and 655 radiation facility FTEs under the Reduced Operations Alternative. From this information, a ratio of radiation-badged workers to total FTEs for the 1996 base year was calculated to be 0.334 (258/772). The number of radiation-badged workers was then estimated as 360 under the No Action Alternative, 400 under the Expanded Operations Alternative, and 220 under the Reduced Operations Alternative, assuming the same ratio of 0.334. The annual workforce collective dose was estimated by multiplying the average worker dose of 47 mrem by 360, 400, and 220 to obtain the collective dose under each alternative.

The health impacts to these projected workers were calculated and are presented in Tables E.7–3, E.7–4, and E.7–5 and summarized in Table E.7–6.

Table E.7–3. Radiation Doses (TEDE[a]) and Health Impacts to Workers from SNL/NM Operations Under the No Action Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY
Annual Average Individual Worker Dose (mrem/year)	47[b]	1.9×10^{-5}
Annual Maximum Worker Dose (mrem/year)	845[b]	3.4×10^{-4}
Annual Workforce Collective Dose (person-rem/year)	17	6.8×10^{-3} [c]

Source: SNL/NM 1997k
mrem: millirem
[a] Average measured Total Effective Dose Equivalent (TEDE) means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] Annual average individual worker dose and maximum worker dose are expected to remain consistent with 1996 data.
[c] This represents the number of latent cancer fatalities in the workforce.
Note: Because not all badged workers are radiation workers, "radiation workers" means those badges with greater than 10 mrem measurements used in the calculations.

Table E.7–4. Radiation Doses (TEDE[a]) and Health Impacts to Workers from SNL/NM Operations Under the Expanded Operations Alternative[b]

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY
Annual Average Individual Worker Dose (mrem/year)	47[c]	1.9×10^{-5}
Annual Maximum Worker Dose (mrem/year)	845[c]	3.4×10^{-4}
Annual Workforce Collective Dose (person-rem/year)	19	7.6×10^{-3} [d]

Source: SNL/NM 1997k
mrem: millirem
[a] Average measured Total Effective Dose Equivalent (TEDE) means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the radiation doses and health impacts to workers under the Exanded Operations Alternative.
[c] Annual average individual worker dose and maximum worker dose are expected to remain consistent with 1996 data.
[d] This represents the number of latent cancer fatalities.
Note: Because not all badged workers are radiation workers, "radiation workers" means those badges with greater than 10 mrem measurements used in the calculations.

Table E.7–5. Radiation Doses (TEDE[a]) and Health Impacts to Workers from SNL/NM Operations Under the Reduced Operations Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY
Annual Average Individual Worker Dose (mrem/year)	47[b]	1.9×10^{-5}
Annual Maximum Worker Dose (mrem/year)	845[b]	3.4×10^{-4}
Annual Workforce Collective Dose (person-rem/year)	10	4.0×10^{-3} [c]

Source: SNL/NM 1997k
mrem: millirem
[a] Average measured Total Effective Dose Equivalent (TEDE) means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] Annual average individual worker dose and maximum worker dose are expected to remain consistent with 1996 data.
[c] This represents the number of latent cancer fatalities.
Note: Because not all badged workers are radiation workers, "radiation workers" means those badges with greater than 10 mrem measurements used in the calculations.

Table E.7–6. Summary of Calculated Radiation Doses and Health Effects to Workers Under Each Alternative

ALTERNATIVE	INDIVIDUAL WORKER				WORKER POPULATION			
	DOSE (mrem/yr)	RISK OF FATAL CANCER	RISK OF NONFATAL CANCER	RISK OF GENETIC DISORDERS	COLLECTIVE DOSE (person-rem)	TOTAL FATAL CANCERS	TOTAL NONFATAL CANCERS	TOTAL GENETIC DISORDERS
No Action	47	1.9×10^{-5}	3.8×10^{-6}	3.8×10^{-6}	17	6.8×10^{-3}	1.4×10^{-3}	1.4×10^{-3}
Expanded Operations[a]	47	1.9×10^{-5}	3.8×10^{-6}	3.8×10^{-6}	19	7.6×10^{-3}	1.5×10^{-3}	1.5×10^{-3}
Reduced Operations	47	1.9×10^{-5}	3.8×10^{-6}	3.8×10^{-6}	10	4.0×10^{-3}	8.0×10^{-4}	8.0×10^{-4}

Sources: SNL/NM 1997k, 1998a
mrem: millirem
yr: year
[a] If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the radiation doses and health effects to workers under the Exanded Operations Alternative.

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APPENDIX F – ACCIDENTS

F.1 INTRODUCTION

This appendix documents the accident evaluations performed for the Sandia National Laboratories/ New Mexico (SNL/NM) Site-Wide Environmental Impact Statement (SWEIS) for operational, external, and natural phenomena accidents that have the potential for causing injury or fatality to workers or the public. It discusses potential accidents and impacts caused by the release of radioactive or hazardous chemical materials, explosions, earthquakes, and airplane crashes into SNL/NM facilities. It also discusses accident scenarios, source terms, and the origin or derivation of data used in the evaluations.

F.1.1 *National Environmental Policy Act* Requirements for Accident Impact Analysis

The U.S. Department of Energy's (DOE's) guidelines for the preparation of *National Environmental Policy Act* (NEPA) documents and the analysis of accident impacts have been defined (DOE 1993b) and were followed during the preparation of the SNL/NM SWEIS. The guidelines allow for a graded approach that analyzes accidents at a level of detail that is consistent with potential accident impacts. Indicators of potential accident impacts include the amounts of hazardous materials, existence of highly energetic forces, number of persons in the vicinity, and effectiveness of features that would mitigate an accident's occurrence, progression, and consequences to people and the environment.

The DOE requires that potential hazards be considered if they can lead to accidents that are reasonably foreseeable; that is, there is a mechanism for their occurrence and their probability of occurrence is generally greater than one chance in a million per year. Accidents that are less frequent may also be considered if they could result in high consequences and provide information important to decision-making.

The DOE's guidelines do not require that all potential accidents be evaluated, but do require evaluation of a sample of reasonably foreseeable accidents to demonstrate the range of potential impacts. The range should include both low-frequency–high-consequence and high-frequency–low-consequence events. An example of the former event would be an airplane crash into a facility containing radioactive materials, and an example of the latter event would be a laboratory spill of a small amount of a hazardous chemical.

F.1.2 Identification and Selection of Potential Accidents

The existence of hazardous conditions and potential accidents was determined through an investigative process that derived relevant information from facility experts, facility tours, and safety documentation.

- *Facility experts*—Meetings, discussions, and written communications with personnel familiar with facility operations, hazardous conditions, safety documentation, and mitigating features provided a basis for determination of potential accidents and direction of further inquiry.
- *Facility tours*—Facilities, in which operations were identified as having hazardous conditions and the potential for accidents affecting people and the environment, were toured to gain an understanding of the mechanisms that could cause an accident, existing mitigating features that would limit accident consequences, and factors needed for the development of accident scenarios.
- *Safety documentation*—The DOE requires those facilities, containing hazardous materials with the potential for accidents that could impact workers and the public, conduct safety studies and maintain documentation that ensures operations are conducted in a safe manner. Applicable documents such as safety analysis reports (SARs), safety assessments (SAs), hazard assessments (HAs), monitoring reports, and NEPA documents were reviewed.

The information and data obtained during these activities were used extensively for assessing hazards at SNL/NM facilities, identifying potential accidents, developing accident scenarios, and estimating accident impacts.

F.1.3 Screening Facilities

An initial screening of all facilities performed by SNL/NM provided a list of facilities to be addressed in the SWEIS (see Section 2.3 of this SWEIS and SNL/NM 1998a). The accident team screened this list of facilities further to eliminate those that, relative to other facilities, had low or no potential for accidents involving hazardous materials and impacting people and the environment. Additionally, based on discussions with facility experts, facility tours, and reviews of safety documents, some facilities, which were eliminated in the initial screening, were added to the accident team's list because of their hazardous material inventory and potential for accident impacts involving radioactive materials, chemicals, and explosives.

F.1.4 Accident Evaluation

Facilities subject to accident evaluation were placed into one of four groups as follows:

- *Group 1*—Facilities in this group were determined to have the highest potential accident impacts and required modeling and analysis to provide a uniform basis for the evaluation of alternatives. These facilities are generally addressed in Sections F.2, F.3, F.5, and F.7. In addition, the potential for an airplane crash into a facility containing hazardous materials was also analyzed and is described in Section F.4.
- *Group 2*—Facilities in this group were determined to have a high potential for accident impacts but were not modeled or analyzed, as was done for facilities in Group 1, because these facilities were similar to the facilities analyzed in Group 1 with respect to amounts and types of hazardous inventory and accident impacts and were, therefore, adequately represented by the Group 1 facilities. Accelerator facilities in Technical Area (TA)-IV, activities involving explosives in TAs-I and -II, and facilities containing hazardous chemicals in TAs-I, -II, and -III are examples of facilities in this group. Section F.6 provides additional information on the hazards and potential accidents associated with Group 2 facilities.
- *Group 3*—Facilities in this group were determined to have a lower potential for accident impacts compared to Group 1, have been previously evaluated for accident impacts, and have suitable documentation describing their accident impacts. These facilities and their potential accident impacts are generally addressed in Section F.6.
- *Group 4*—Facilities in this group were determined to have a lower potential for accident impacts compared to Group 3, based on discussions with facility experts, facility tours, and/or available documentation. Safety documentation was not required for these facilities, as it was required for facilities in the first three groups.

As indicated, accident impacts were analyzed for the facilities in Group 1. The analyses used computer codes such as the *MELCOR Accident Consequence Code System, Version 2 (MACCS)* (see Section F.2) for modeling the airborne dispersion of radiological materials and the *Areal Location of Hazardous Atmospheres (ALOHA)* code (see Section F.3) for the airborne dispersion of hazardous chemicals. Other formulas and techniques were used for estimating airplane crash probabilities (see Section F.4) and effects of explosions (see Section F.5). All analyses for Group 1 facilities were performed in a manner that produced mean (also referred to as average) consequences in a conservative manner. For this SWEIS, average values of input parameters were used when known. If the value of an input parameter was uncertain, a value that produced the most conservative effect was used. This combination of values yields a "realistic conservative" analysis. The analyses performed by SNL/NM for Groups 2 and 3 facilities varied according to facility preferences and requirements and reflected either average or worst-case values. The analyses for the Groups 2 and 3 facilities used various methods that are described in their supporting documentation.

F.1.5 Measures of Accident Impacts

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 latent cancer fatalities (LCFs). The dose-to-LCF conversion factors used were 5.0×10^{-4} LCFs per rem (or person-rem) and 4.0×10^{-4} LCFs per rem, respectively, for the public and workers. For chemical releases, the impacts were evaluated in terms of chemical concentrations in relation to environmental response planning guidelines (ERPG) levels for specified workers and the public (AIHA 1997). For explosions, the impacts were evaluated in terms of expected damage and injury as a function of distance from the explosion. Airplane crash probabilities for various facilities were estimated and used as events leading to the potential release of chemical and radioactive materials.

Dose units and LCFs are indications of an accident's consequences without regard to the probability that the accident will occur. The risk associated with an accident is normally calculated by taking the mathematical product of an accident's consequences and its probability of occurrence. Accident probabilities (sometimes referred to as frequencies) are identified in the SWEIS wherever they are known and applicable. In many cases, the accident probability is expressed as a range to indicate a level of uncertainty in the actual value. Risks are generally not shown but may be calculated as stated above.

F.1.6 Human Receptors

The impacts of accidents were measured in terms of the effects for the following six types of human receptors:

- members of the public located at 14 onsite locations such as schools, playgrounds, golf course, and family residences;
- a hypothetical member of the public circumferentially located at the 16 compass points of the Kirtland Air Force Base (KAFB) site boundary;
- a maximally exposed individual (MEI), which is the receptor with the highest mean exposure among the first two types of receptors;
- a noninvolved worker at 100 m or at a fence line or boundary, whichever is closer to the point of an accidental release;
- the offsite population, out to a distance of 50 mi, and
- involved workers (generally in the immediate vicinity of the accident).

Although there are many other locations on the site and off the site, these last four receptors and receptor locations will bound the impacts to any other receptor or receptor location.

F.1.7 Nonhuman Environmental Impacts

Any accidental release of radioactive or chemical materials could affect the nonhuman elements of the environment, such as surface water and groundwater, historical and archeological sites, and animals and their habitat. Brush fires and oil spills are examples of accidents that could have these effects. The SWEIS identifies the potential for these occurrences but does not analyze their impacts. The DOE has requirements and procedures in place for responding to an incident that could affect the environment. In such an event, an assessment of the contamination and damage would be made and corrective actions would be taken to minimize the impacts and to clean up the affected areas.

F.1.8 Uncertainties and their Effects

The estimates of impacts and probabilities can be affected by unavoidable uncertainties in the analyses. These uncertainties can be attributed to modeling techniques, amounts of hazardous materials, estimates of health effects of exposures to hazardous materials, accident scenario definitions, meteorology data, population estimates, and similar causes.

Several actions have been taken to minimize the effects of uncertainties on decision-making. The methodology used for accident analysis has received peer review and approval. The *MACCS* and *ALOHA* computer codes used for modeling the dispersion of radioactive and chemical releases respectively are accepted by the DOE and are also routinely used for this purpose by other agencies and industry.

Completed analyses receive peer and technical review to ensure accuracy and conformance with requirements. In the event of uncertainty and/or variability in input data and information, conservative assumptions have been made, such as using the largest inventory, which have the effect of overestimating the impacts of accidents. Similarly, in many instances, no credit is taken for mitigating actions, such as evacuation, which also has the effect of overestimating accident impacts.

The method of analysis provides an incremental assessment of impacts among the alternatives. Because the SWEIS does not estimate the total impacts or risks of accidents, this approach to uncertainty provides adequate information for the relative comparison of alternatives. Thus, to the extent that any analysis results contains the effects of uncertainties, the effects are uniformly applicable to each alternative thereby providing an accurate basis for comparison and decision-making.

F.1.9 Data Sources

Information and data on the safety of SNL/NM facilities are contained in referenced documents such as SARs, SAs, HAs, process hazard surveys (PHSs), NEPA documents, and facility safety and information documents (FSIDs). These documents differ in the level and method of analysis, reflecting the differences in hazards among the facilities. In addition, a chemical database known as CheMaster was used to provide chemical inventories for three facilities. Table F.1–1 presents a list of facilities for which existing documentation was reviewed and evaluated for potential use in the SWEIS.

Table F.1–1. Listing of Facilities, Documentation Reviewed, and Type of Evaluations Performed

BUILDING		REFERENCE	TYPE OF EVALUATION PERFORMED				
NAME	NUMBER		RADIOLOGICAL	CHEMICAL	EXPLOSION	AIRCRAFT CRASH	SEISMIC
Steam Plant	*605*	SNL/NM 1998a					
Center For National Security and Arms Control	*810*	SNL 1993, TtNUS 1998k, Zamorski 1998					
Systems Research and Development	*823*	SNL/NM 1998a, SNL/NM 1995i, SNL/NM 1996v		◆			◆
Weapons Production Primary Standards Laboratory[a]	*827*	SNL/NM 1998u					
Photovoltaic Systems Evaluation Laboratory	*833*	Sanchez-Brown & Wolf 1994, SNL 1995f, SNL/NM 1996y, SNL/NM 1996c					
Microelectronics Development Laboratory	*858*	SNL 1995a, SNL/NM 1993a, SNL/NM 1998a, SNL/NM 1998g, SNL/NM 1996w, TtNUS 1998k		◆	◆	◆	◆
Microsystems and Engineering Sciences Applications Complex	*No Number*	SNL 1996b		◆		◆	◆
Production Primary Standards Laboratory[a]	*864*	SNL/NM 1997z					

Table F.1–1. Listing of Facilities, Documentation Reviewed, and Type of Evaluations Performed (continued)

BUILDING		REFERENCE	TYPE OF EVALUATION PERFORMED				
NAME	NUMBER		RADIOLOGICAL	CHEMICAL	EXPLOSION	AIRCRAFT CRASH	SEISMIC
Industrial Hygiene Instrumentation Laboratory	*869*	SNL 1995g, SNL/NM 1998e		◆			◆
Neutron Generator Facility	*870*	DOE 1994a, DOE 1994d, Scientech 1994, Scientech 1995, SNL/NM 1993c, SNL/NM 1996l SNL/NM 1998a, SNL/NM 1998o, TtNUS 1998k	◆			◆	◆
Advanced Manufacturing Processes Laboratory	*878*	SNL 1994c, SNL 1994e, SNL/NM 1998a, TtNUS 1998k		◆		◆	◆
Computing Building	*880*	SNL 1995d		◆			
Photovoltaic Device Fabrication Laboratory	*883*	SNL 1995f, SNL/NM 1998a, TtNUS 1998k		◆			
6-MeV Tandem Van Der Graaf Generator	*884*	SNL/NM 1998a		◆			
Ion Beam Materials Research Laboratories	*884*	SNL/NM 1994f SNL/NM 1998a		◆			◆
Lightning Simulation Facility	*888*	SNL 1994d, SNL/NM 1995a, SNL/NM 1998a, SNL/NM n.d. (a)		◆			◆

Table F.1–1. Listing of Facilities, Documentation Reviewed, and Type of Evaluations Performed (continued)

BUILDING		REFERENCE	TYPE OF EVALUATION PERFORMED				
NAME	NUMBER		RADIOLOGICAL	CHEMICAL	EXPLOSION	AIRCRAFT CRASH	SEISMIC
Hazardous Waste Management Facility	*958*	SNL/NM 1998a, TtNUS 1998k				◆	
Excimer Laser Processing Laboratory[a]	*960*	DOE n.d. (a), Bendure 1995, SNL/NM 1998a					
Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA)[a]	*961*	SNL/NM 1998a					
Advanced Pulsed Power Research Module[a]	*963*	SNL/NM 1996q, SNL/NM 1998a					
High Power Microwave Laboratory[a]	*963*	SNL/NM 1995c, SNL/NM 1998a					
Repetitive High Energy Pulsed Power Unit II[a] *(RHEPP II)*	*963*	SNL/NM 1996d, SNL/NM 1998a					
High-Energy Radiation Megavolt Electron Source III (HERMES III) Accelerator[a]	*970*	SNL/NM 1996b, SNL/NM 1998a					
Sandia Accelerator & Beam Research Experiment (SABRE)[a]	*970*	SNL/NM 1995t, SNL/NM 1998a					

Table F.1–1. Listing of Facilities, Documentation Reviewed, and Type of Evaluations Performed (continued)

BUILDING NAME	BUILDING NUMBER	REFERENCE	TYPE OF EVALUATION PERFORMED: RADIOLOGICAL	CHEMICAL	EXPLOSION	AIRCRAFT CRASH	SEISMIC
Hazardous Waste Management Facility	*958*	SNL/NM 1998a, TtNUS 1998k				◆	
Excimer Laser Processing Laboratory[a]	*960*	DOE n.d. (a), Bendure 1995, SNL/NM 1998a					
Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA)[a]	*961*	SNL/NM 1998a					
Advanced Pulsed Power Research Module[a]	*963*	SNL/NM 1996q, SNL/NM 1998a					
High Power Microwave Laboratory[a]	*963*	SNL/NM 1995c, SNL/NM 1998a					
Repetitive High Energy Pulsed Power Unit II[a] *(RHEPP II)*	*963*	SNL/NM 1996d, SNL/NM 1998a					
High-Energy Radiation Megavolt Electron Source III (HERMES III) Accelerator[a]	*970*	SNL/NM 1996b, SNL/NM 1998a					
Sandia Accelerator & Beam Research Experiment (SABRE)[a]	*970*	SNL/NM 1995t, SNL/NM 1998a					

Table F.1–1. Listing of Facilities, Documentation Reviewed, and Type of Evaluations Performed (continued)

BUILDING		REFERENCE	TYPE OF EVALUATION PERFORMED				
NAME	NUMBER		RADIOLOGICAL	CHEMICAL	EXPLOSION	AIRCRAFT CRASH	SEISMIC
Saturn Accelerator[a]	981	SNL/NM 1988					
Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)[a]	981	SNL/NM 1995s, SNL/NM 1998a					
Z-Machine	983	SNL/NM 1996s, SNL/NM 1998a, TtNUS 1998k	◆	◆		◆	◆
Repetitive High Energy Pulsed Power Unit I[a] *(RHEPP I)*	986	SNL/NM 1995r, SNL/NM 1998a					
Drop/Impact Complex[a]	6510	DOE n.d. (a), SNL/NM 1998a					
Centrifuge Complex[a]	6520	DOE n.d. (a), SNL/NM 1998a					
Radiant Heat Facility[a]	6538	DOE n.d. (a), DOE 1996d, Laskar 1997a, Walker 1996b					
Hot Cell Facility	6580	DOE 1996b, SNL/NM 1995e, SNL/NM 1998a, TtNUS 1998k	◆				◆
Hammermill	6583	SNL/NM 1998a					

Table F.1–1. Listing of Facilities, Documentation Reviewed, and Type of Evaluations Performed (continued)

BUILDING		REFERENCE	TYPE OF EVALUATION PERFORMED				
NAME	NUMBER		RADIOLOGICAL	CHEMICAL	EXPLOSION	AIRCRAFT CRASH	SEISMIC
Annular Core Research Reactor	*6588*	DOE 1996b, Schmidt 1998, SNL 1992b, SNL 1995e, SNL 1996d, SNL/NM 1997d, SNL/NM 1998a, TtNUS 1998k	◆				◆
Gamma Irradiation Facility	*6588*	SNL/NM 1995m, SNL/NM 1998a, TtNUS 1998k	◆				
Sandia Pulsed Reactor	*6593*	SNL/NM 1995v, SNL/NM 1996k, SNL/NM 1998a, TtNUS 1998k	◆				◆
Exterior Intrusion Sensor Field[a]	*6600A*	SNL/NM 1993b, SNL/NM 1994b, SNL/NM 1998a, TtNUS 1998k					
Liquid Metal Processing Laboratory[a]	*6630*	SNL 1996b, SNL/NM 1998a					
Thermal Treatment Facility[a]	*6715*	DOE n.d. (a), SNL/NM 1998a, TtNUS 1998k					
Sled Track Complex	*6740*	DOE n.d. (a), SNL/NM 1993d, SNL/NM 1997x, SNL/NM 1998a			◆		

Table F.1–1. Listing of Facilities, Documentation Reviewed, and Type of Evaluations Performed (concluded)

BUILDING		REFERENCE	TYPE OF EVALUATION PERFORMED				
NAME	NUMBER		RADIOLOGICAL	CHEMICAL	EXPLOSION	AIRCRAFT CRASH	SEISMIC
Terminal Ballistics Complex[a]	*6750*	SNL/NM 1994e, SNL/NM 1998a, TtNUS 1998k					
Radioactive and Mixed Waste Management Facility	*6920*	DOE 1993a, SNL/NM 1991, SNL/NM 1994c, SNL/NM 1998a, TtNUS 1998k	◆	◆	◆	◆	
Containment Technology Test Facility-West[a]	*9800*	Emerson 1992, SNL/NM 1998a					
Aerial Cable Facility	*9831*	Roybal 1996, SNL/NM 1995q, SNL/NM 1998a	◆		◆		
Explosives Application Laboratory[a]	*9930*	SNL/NM 1998a, SNL/NM n. d. (e)					
High-Explosive Assembly Building[a]	*9967*	SNL/NM 1998a, SNL/NM 1998n					
National Solar Thermal Test Facility[a]	*9980*	Harris 1992, SNL/NM 1996t, SNL/NM 1998a, TtNUS 1998k					
Manzano Waste Storage Facilities	*Various*	SNL/NM 1997q, SNL/NM 1998a	◆				◆
Lurance Canyon Burn Site[a]		SNL/NM 1998a, SNL/NM n.d. (f)					

Source: Original
MeV: million electron volt
[a] Existing safety documentation was reviewed for these facilities but no accident evaluations were performed because the accident impacts to the environment or to humans were less than those from the selected facilities.

F.2 RADIOLOGICAL ACCIDENTS

F.2.1 Introduction

Section F.2 describes the radiological accident analysis for the SNL/NM SWEIS. It begins with a discussion of the general methodology and accident scenario-independent data used for the radiological accident analysis (Sections F.2.2 through F.2.4). This is followed by separate subsections for TA-I and TA-II (Section F.2.5), TA-IV (Section F.2.6), TA-V (Section F.2.7), and the Manzano Waste Storage Facilities (Section F.2.8). Each subsection discusses the selection of accident scenarios, specific analysis assumptions, and results.

Accident scenario identifiers, or codes, were established for each radiological accident scenario that was analyzed for the SWEIS. These codes were used primarily in the tables of input data and also served as a positive means of identifying the scenarios. The codes were generally based on letters from the facility names and mode of operation (for example, AM scenarios are accidents at the Annular Core Research Reactor [ACRR], operating in the medical isotopes production configuration). The codes are discussed in detail in Sections F.2.5.1, F.2.6.1, F.2.7.1, and F.2.8.1.

F.2.2 Consequence Analysis Methodology

This section summarizes the methodology that was used to analyze postulated radiological accident scenarios for SNL/NM facilities and activities. This methodology describes the general process that was followed for source-term derivation and consequence (radiation dose) analysis, including models and computer codes that were used. The uncertainties associated with the selection of the values for the various parameters that affect the source term and the consequence analyses are also discussed.

F.2.2.1 Source Term Determination

The source terms and consequences identified in the SNL/NM safety documents were used for the initial review of SNL/NM facilities and accident scenarios and selection of accident scenarios. Sections F.2.5, F.2.6, F.2.7, and F.2.8 discuss the accident selection process and describe the selected accident scenarios for specific areas. These accident scenarios were modeled for the SWEIS and consequences were determined.

Accident source terms were obtained from various facility references that have different bases and assumptions. In order to present and compare accident impacts for facilities and alternatives on a uniform basis, the reference source terms were revised, or normalized, so that the amounts of radioactive material released used the same bases and assumptions. The differences in assumptions in reference documents were evident in the inconsistencies among facilities with respect to the models and assumptions used to determine the material at risk (MAR), damage ratio (DR), airborne release fraction (ARF) x respirable fraction (RF), and leak path factor (LPF). With respect to the LPF, assumptions (such as in-facility transport and filtration) were inconsistent from facility to facility because of facility-specific considerations.

For each accident selected, a source term was calculated using the 5-factor formula in DOE-HDBK-3010-94 (DOE 1994b). That is, the source term (also referred to as the building source term) was calculated based on the following equation:

$$\text{Source Term} = MAR \times DR \times ARF \times RF \times LPF \qquad \text{(Eq. F.2-1)}$$

Where:

- MAR = the material at risk;
- DR = the damage ratio, which is fraction of the MAR that is affected by the postulated accident scenario;
- ARF = the airborne release fraction, as specified by DOE-BK-3010-94;
- RF = the respirable fraction of airborne material (<10 micrometers aerodynamic equivalent diameter); and
- LPF = the leak path factor (or fraction of airborne respirable radioactive material that leaves the facility or building).

The source terms calculated for the SWEIS analysis were based on the following general assumptions:

- The MAR was based on the SNL/NM safety documentation and interviews with operating personnel to clarify uncertainties in the data. For all radiological accident scenarios, the MAR represents the maximum inventory of material that is at risk from the given accident scenario. As such, it represents the upper bound of the MAR for each facility/process affected by the postulated accident scenario. It is important to note that, under most circumstances, the accident scenarios selected from the SNL/NM safety documentation represent not only the bounding scenarios for the facility, but also a set of bounding assumptions with respect to the release.

- The DR was based on estimates presented in the SNL/NM safety documentation (for example, number of fuel elements affected by the accident scenario). The SWEIS assumed that all the DRs were 1.0, thus representing an extremely conservative assumption with respect to the impact of the energy of the postulated release on the MAR.
- The ARF and RF were obtained for various postulated accident scenarios directly from DOE-HDBK-3010-94. The ARFxRF represented the bounding values in the handbook.
- The LPF was assumed to be 1.0 for all accident scenarios at all facilities other than the ACRR. For ACRR accident scenarios, the LPF was assumed to be 1.0 for scenarios with a release originating outside the reactor pool. An LPF of 1.0 assumes that all airborne respirable radioactive material leaves the facility or building without any filtration, plate-out, or deposition during in-facility transport.
- For ACRR accident scenarios with a release of radioactive material originating in the reactor pool, an additional factor was used to determine the amount of radioactive material released from the pool to the reactor building. This factor, the decontamination factor (DF), accounts for the radioactive material absorbed in the pool water and not released into the building. For these scenarios, no further reduction was assumed between the pool surface and the building release point. The LPF for these scenarios is given by the equation 1.0/DF. For mechanical failure events (for example, fuel cladding ruptures), a DF of 1.0 was used for noble gases, 100 for halogens, and 1,400 for particulates. This translates to a release from the building of 100 percent of the noble gases, 1 percent of the halogens, and 0.071 percent of the particulates that are released from the source (for example, the ACRR fuel). These same DF values were used in the ACRR SAR for the limiting event accident. They were developed in the report entitled, *Annular Core Research Reactor (ACRR) Postulated Limiting Event Initial and Building Source Terms*, SAND91-057 (SNL 1992b). For accident scenarios that cause a very energetic release, such as a large reactivity insertion, more conservative, upper bound DF values were used for the SWEIS analysis. A DF of 1.0 was used for all fission products and actinides. Although the referenced report (SNL 1992b) supports the 1.0/100/1,400 DFs for even a very energetic release, lower DFs were chosen to bound the release. This assumption also introduces a distinction in pool absorption capability between low energy and very high energy events.

These factors are discussed further in Section F.2.3.5 and, for specific TA-V scenarios, in Section F.2.7.

Because the values for each of the five factor parameters in Equation F.2–1 represent bounding values for each of these variables, the values of the source term for each of the postulated accident scenarios represent, by default, bounding source terms.

F.2.2.2 Consequence Analysis

This section identifies the assumptions, uncertainties, models, and computer codes that were used to determine the consequences from postulated accident scenarios.

All radiological consequences were determined using the *MACCS2* computer code (SNL 1998c). *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 plant industry. It also has been widely used in many consequence analyses for preparing safety documentation (such as SARs, SAs, EAs, and EISs) for facilities throughout the DOE complex.

The *MACCS2* code uses three separate phases with input files (ATMOS, EARLY, and CHRONC) to perform transport and dose calculations for selected ranges or locations from a postulated release location. Other input files are also needed to support the model runs, including a meteorological data file, a site data file containing the population distribution around the postulated release location, and a dose conversion file.

The CHRONC input module was not used for the SNL/NM SWEIS because this module is designed to deal with long-term exposure pathways, such as ingestion. The ingestion pathway has no impact on the overall dose to the postulated onsite receptors because no foodstuffs are grown within KAFB. For receptors at or beyond the KAFB site boundary, the ingestion pathway has only a small impact on the overall dose (based on normal operational impacts).

For all cases, the postulated exposed individuals or populations were assumed to be exposed to the entire plume of released radioactive materials. That is, an individual would remain at one of these locations for the entire duration of the accident without taking any protective action.

Buoyant plume releases were modeled only for fire scenarios in which building confinement was assumed to be lost as part of the accident scenario (for example, an airplane crash). A heat release of 1 MW was assumed for these fires to create a buoyant release. The heat release of 1 MW represents a moderately small fire (DiNenno et. al. 1993). This size of fire at a facility is considered to be a good representation for most facility fires and represents conservative release conditions with respect to expected consequences to the MEI. Larger heat loads will lead to lower exposures to the MEI. All other releases were assumed to be nonbuoyant releases. Actual release heights were used for the various buildings as long as the postulated accident scenario did not affect the building integrity. Releases from the SPR were conservatively assumed to be at ground level rather than at the stack height because the stack height is relatively low.

All *MACCS2* runs used weather bin sampling from one year's worth of meteorological data (1996) (SNL/NM 1998j). Precipitation data were included in the meteorological input files, but were conservatively zeroed out for the analyses; however, dry deposition was assumed. This tended to overestimate the calculated short-term population doses.

In determining the consequence for the SWEIS, a stratified weather category bin sampling from one year's worth of meteorological data was used in running the *MACCS2* computer code. Over 100 samples of meteorological data were selected and used to model downwind dispersion and transport of the postulated release. Each of the meteorological samples included data on the wind speed, direction, and stability class.

MACCS2 sorts the meteorological data into 36 meteorological bins, representing combinations of stability categories, wind speeds, and rain intensity ranges. *MACCS2* samples randomly from each of these weather bins, thus ensuring a good representation of the entire weather data. The *MACCS2* User's Manual provides further detailed information on the sampling techniques available with the code (SNL 1998c). *MACCS2* provides results for each sample of meteorological data modeled and an annual probability of occurrence, thereby providing a rank-ordered distribution of consequences. The mean value of the consequence distribution calculated by *MACCS2* was used in this SWEIS.

The MAR inventories were input as part of ATMOS. The accident source term was determined by using the release fraction options for the various chemical groups in ATMOS. These release fractions were designed to match the calculated product of the DR, ARF, RF, and LPF from the source-term equation for each of the postulated release scenarios. The uncertainty associated with the consequence analysis is directly related to the uncertainties of both the source-term calculations (assumed to be at least one order of magnitude conservative) and the dispersion/transport modeling (assumed to be no less than the mean value). As such, the uncertainty of the consequences is at least no lower than the uncertainty of the source terms; that is, at least one order of magnitude more conservative.

To convert the *MACCS2* dose results into LCFs, the SWEIS used the International Commission on Radiological Protection (ICRP) factor of 5.0×10^{-4} additional latent cancers per person-rem for the members of the general public. For the noninvolved workers, the ICRP factor of 4.0×10^{-4} additional latent cancers was used, unless the reported dose was greater than 20 rem when the factor doubles.

F.2.3 Consequence Analysis Input

F.2.3.1 Source Term Data

Source term data (such as the quantity and form of the radioactive release) are discussed in general in the methodology section, above, and specifically for each accident scenario in the scenario descriptions later in this section.

To simplify the calculations where possible, some consequence calculations were performed for a unit release. In these cases, where source term isotopic distributions were the same but total quantities released were different, a *MACCS2* analysis was based on a unit activity release (such as 1 Ci of plutonium-239). The unit results were then scaled up to the total release to determine the consequences for the actual releases, as long as the product of ARFxRFxLPF did not change. It was possible to use one *MACCS2* run for multiple accident scenarios using this method. This scaling technique is not valid for releases that are much greater than 1 Ci. The technique was not used for such accident scenarios; scenario-specific calculations were performed for accident scenarios that involved releases greater than approximately 1 Ci.

It was assumed that all tritium released would be in the form of tritium oxide (tritiated water).

F.2.3.2 Meteorological Data

Actual site-specific meteorological data were obtained to support the consequence calculations. Meteorological data (such as wind speed, wind direction, and stability class), consisting of hourly sequential data and hourly precipitation rates, were obtained from SNL/NM (SNL/NM 1998j, 1999a). The data were for the years 1994 through 1996. The data were from two meteorological towers, A21 and A36. A21 is located in TA-II and A36 is located in TA-V. Based on discussions with SNL/NM personnel, these two towers were selected for accident modeling as being most representative of the atmospheric dispersion.

For *MACCS2* accident analyses, only the 1996 data were used. This year was considered to be the base year for the SWEIS. It is expected that the mean consequences would not vary much if data from other years were used.

F.2.3.3 Population Distributions

Four offsite population distributions, based on estimated 1995 population data, were provided by SNL/NM (Bleakly 1998a, 1998c). Two distributions were centered on TA-I and TA-V. The third distribution was centered on the Manzano Waste Storage Facilities. The fourth centered on the Aerial Cable Facility. The distributions were originally generated with the methodology used for the population distribution data for National Emissions Standards for Hazardous Air Pollutants (NESHAP) reports (Hylko 1998a, 1998b). These distributions were modified by SNL/NM to provide a finer grid for the radial spacing for input into *MACCS2*. The finer grid is necessary to evaluate the impacts to the population located within 5 mi of the release point. Tables F.2–1 and F.2–2 show the population distributions for TAs-I and -V, respectively, while Table F.2–3 shows the population distribution for the Manzano Waste Storage Facilities. Population distributions for the Aerial Cable Facility are shown in Section F.6 (Table F.6–24).

Population data were divided into 17 annular rings and 16 sectors corresponding to the 16 compass directions commonly used by *MACCS2*. *MACCS2* applies the dose at the mid-distance of the annular ring to all distances within that ring. Therefore, in order to provide information on dosage provided to a "noninvolved worker" close to the radionuclide source facility, the first annular ring, specified from zero to 0.8 km, was subdivided into two annular rings, ranging from zero to 0.2 km and from 0.2 to 0.8 km. This theoretical "noninvolved worker" was defined as a SNL/NM worker not involved with the facility where the accident occurs and located 100 m from the facility evaluated.

F.2.3.4 Location of Individual Receptors

For this SWEIS, two different types of individual receptors representing the general public were analyzed. The first, core receptors, represent locations where members of the public could be located within or close to the KAFB boundary. The second, boundary receptors, represent 16 locations on the KAFB boundary. Each type of receptor is discussed below.

Locations of Core Receptors

Members of the general public could be present during a potential accident at locations within or close to the KAFB boundary. These locations include the riding stables, child-care centers, base housing, and the National Atomic Museum, among others. It was conservatively assumed that an individual would remain outdoors at one of these locations for the entire duration of the accident without taking any protective action. The distance and direction to each receptor location were provided by SNL/NM (Bleakly 1998b, c). Fourteen different core receptor locations were selected to represent the many locations possible. Table F.2–4 provides each core receptor's distance, by direction, from each release point. The distance, by direction from the Aerial Cable Facility, by core receptor, is provided in Section F.6 (Table F.6–25). It should be noted that some receptor locations, due to their size or position, may occur within more than one sector and, therefore, may appear in the tables of consequence more than once.

The following 14 core receptor locations were identified:

- Base Housing
- Child Development Center-East
- Child Development Center-West
- Coronado Club
- Golf Course
- Kirtland Elementary School
- Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)

Table F.2–1. Population Distribution Surrounding Technical Area-I

DIRECTION	DISTANCE (miles)									
	0.12	0.5	1	1.5	2	2.5	3	3.5	4	4.5
N	0	0	0	657	1,071	1,382	1,690	1,997	2,304	2,611
NNE	0	5	50	667	1,073	1,389	1,699	2,009	2,319	2,629
NE	0	5	361	759	1,069	1,379	1,686	1,993	2,300	2,346
ENE	0	18	461	758	1,066	1,378	1,679	1,714	1,154	130
E	0	6	117	275	847	1,373	1,643	1,398	72	82
ESE	0	5	14	24	110	313	164	87	0	0
SE	0	0	15	24	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	247	793	1,273
SW	0	0	0	0	0	0	0	399	1,957	2,600
WSW	0	0	0	0	62	155	181	566	1,430	2,419
W	0	0	0	0	303	407	514	728	1,500	2,605
WNW	0	0	0	0	993	1,378	1,684	1,991	2,298	2,604
NW	0	0	0	329	1,063	1,376	1,683	1,990	2,297	2,604
NNW	0	0	0	574	1,066	1,377	1,684	1,991	2,298	2,605
TOTAL	**0**	**39**	**1,018**	**4,067**	**8,723**	**11,907**	**14,307**	**17,110**	**20,722**	**24,508**

DIRECTION	DISTANCE (miles)								
	5	7.5	10	15	20	30	40	50	0-50 Total
N	2,918	19,217	9,978	1,727	9,654	2,009	1,145	1,473	59,833
NNE	2,939	20,771	756	1,171	289	825	1,645	2,921	43,157
NE	1,689	2,117	845	2,292	1,143	1,768	3,261	9,302	34,315
ENE	92	603	1,011	2,509	2,453	2,329	3,261	3,962	24,578
E	92	603	875	2,416	1,532	3,108	2,021	1,877	18,337
ESE	92	603	1,689	2,414	2,630	2,597	388	498	11,628
SE	0	0	844	2,413	1,906	502	1,314	498	7,516
SSE	0	603	844	1,177	216	279	508	1,370	4,997
S	0	602	843	975	1,261	3,323	4,091	610	11,705
SSW	1,733	15,973	3,983	1,156	3,318	7,031	8,947	172	44,626
SW	2,906	18,736	15,972	2,248	7,487	6,525	4,989	2,952	66,771
WSW	2,908	5,104	1,226	2,413	3,379	8,312	4,933	1,455	34,543
W	2,911	10,800	3,219	20,627	3,375	9,644	3,625	8,004	68,262
WNW	2,911	19,542	22,063	37,794	11,424	7,445	4,773	1,018	117,918
NW	2,911	17,265	16,422	62,300	12,928	855	1,158	1,490	126,671
NNW	2,911	19,130	18,769	18,955	21,424	3,493	1,131	1,453	98,861
TOTAL	**27,013**	**151,669**	**99,339**	**162,587**	**84,419**	**60,045**	**47,190**	**39,055**	**773,718**

Source: Bleakly 1998a

Table F.2–2. Population Distribution Surrounding Technical Area-V

DIRECTION	DISTANCE (miles)									
	0.12	0.5	1	1.5	2	2.5	3	3.5	4	4.5
N	0	0	0	0	0	0	0	63	411	1,054
NNE	0	0	0	0	0	0	0	75	1,235	2,629
NE	0	0	0	0	0	0	0	0	230	1,198
ENE	0	0	0	0	0	0	0	0	0	82
E	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	82
SSE	0	0	0	0	0	0	0	0	72	82
S	0	0	0	0	0	0	0	62	72	82
SSW	0	0	0	0	0	0	0	0	570	140
SW	0	0	0	0	0	86	965	1,869	2,293	2,346
WSW	0	0	0	0	15	1,117	1,680	1,987	2,294	2,601
W	0	0	0	0	190	1,379	1,686	1,992	2,298	2,605
WNW	0	0	0	0	24	756	665	1,395	2,295	2,329
NW	0	0	0	0	0	0	0	64	306	613
NNW	0	0	0	0	0	0	0	0	42	336
TOTAL	***0***	***0***	***0***	***0***	***229***	***3,338***	***4,996***	***7,507***	***12,118***	***16;179***

DIRECTION	DISTANCE (miles)								
	5	7.5	10	15	20	30	40	50	0-50 Total
N	1,987	19,199	26,879	31,920	1,581	13,313	1,145	1,473	99,025
NNE	2,882	15,958	12,638	8,352	1,085	828	1,700	3,036	50,418
NE	1,096	716	854	2,552	3,121	2,276	3,261	4,193	19,497
ENE	92	603	884	2,519	2,297	2,329	3,261	3,910	15,977
E	0	0	845	2,415	1,274	2,535	1,244	1,324	9,637
ESE	0	603	1,689	2,414	2,888	1,582	1,314	498	10,988
SE	92	603	719	1,189	126	277	387	498	3,973
SSE	92	546	323	326	164	277	1,380	498	3,760
S	91	448	315	900	1,260	3,200	2,981	218	9,629
SSW	91	520	315	893	1,251	10,555	2,275	172	16,782
SW	1,708	2,133	621	5,423	8,411	3,843	4,201	1,404	35,303
WSW	2,908	16,421	2,088	2,413	2,953	5,725	4,951	1,599	48,752
W	2,809	7,363	844	2,680	3,375	9,570	3,329	8,004	48,124
WNW	2,492	10,909	3,288	30,006	4,981	9,558	7,419	864	76,981
NW	1,396	17,475	25,879	57,572	57,770	3,592	1,158	1,490	167,315
NNW	4,562	19,130	26,332	38,540	40,338	18,549	1,131	1,453	150,413
TOTAL	***22,298***	***112,627***	***104,513***	***190,114***	***132,875***	***88,009***	***41,137***	***30,634***	***766,574***

Source: Bleakly 1998a

Table F.2–3. Population Distribution Surrounding Manzano Waste Storage Facilities

DIRECTION	DISTANCE (miles)									
	0.12	0.5	1	1.5	2	2.5	3	3.5	4	4.5
N	0	0	0	0	0	0	679	1,797	2,324	2,605
NNE	0	0	0	0	0	0	304	1,213	744	387
NE	0	0	0	0	0	0	0	61	75	84
ENE	0	0	0	0	0	0	0	61	71	88
E	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	77
S	0	0	0	0	0	0	0	0	0	80
SSW	0	0	0	0	0	0	0	0	0	77
SW	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	129	1,725
W	0	0	0	0	0	0	0	0	765	2,120
WNW	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	61	1,067	1,469
TOTAL	***0***	***0***	***0***	***0***	***0***	***0***	***983***	***3,193***	***5,175***	***8,712***

DIRECTION	DISTANCE (miles)								
	5	7.5	10	15	20	30	40	50	0-50 TOTAL
N	2,911	19,155	26,817	14,213	387	5,873	1,147	1,474	79,382
NNE	765	1,784	856	2,431	841	1,090	4,029	10,468	24,912
NE	90	604	1,079	2,465	2,842	5,177	8,220	10,569	31,266
ENE	87	604	849	2,409	2,301	5,863	8,209	8,593	29,135
E	0	0	844	2,293	423	3,321	2,946	2,197	12,024
ESE	0	0	847	2,413	2,966	910	555	498	8,189
SE	0	602	837	1,501	187	540	823	498	4,988
SSE	99	583	388	141	97	276	1,380	498	3,539
S	99	520	315	824	1,011	2,580	2,821	253	8,503
SSW	89	584	341	893	1,250	6,146	2,803	174	12,357
SW	667	4,160	705	2,542	10,712	8470	4,620	1,698	33,574
WSW	3,153	18,750	13,989	2,396	3,078	6,135	5,231	2,635	57,221
W	2,779	16,938	5,713	6,921	3,372	9,644	5,642	7,108	61,002
WNW	152	12,712	18,012	41,775	7,875	13,277	8,335	1,236	103,374
NW	96	15,818	851	52,315	83,566	7,711	1,159	1,491	163,007
NNW	1,478	18,974	26,782	48,390	21,218	24,486	1,132	1,455	146,512
TOTAL	***12,465***	***111,788***	***99,225***	***183,922***	***142,126***	***101,499***	***59,052***	***50,845***	***778,985***

Source: Bleakly 1998c

Table F.2–4. Distance and Direction to Core Receptor Locations from Release Points

Core Receptor Location	Neutron Generator Facility (TA-I)		Explosive Components Facility (TA-II)		Z-Machine (TA-IV)		TA-V		Manzano Waste Storage Facilities	
	Direction	Distance (meters)	Direction	Distance (meters)	Direction	Distance (meters)	Direction	Distance (meters)	Direction	Distance (meters)
Closest Base Housing	W-WNW	1,800	WNW	2,300	NNW	2,300	NNW	5,900	NW	7,200
Child Development Center-East	NW	1,700	NW	2,500	NNW	2,900	NNW	6,900	NW	7,700
Child Development Center-West	WNW	5,500	WNW	6,100	WNW	5,900	NW	9,000	NW	10,800
Coronado Club	NW	1,500	NW	2,300	NNW	2,800	NNW	6,900	NW	7,600
Golf Course	SSE	2,700	SSE-S	2,000-2,100	ESE-SSE	1,500-1,600	N-NNE	1,900-2,000	WNW-NW	2,400-2,600
Kirtland Elementary School	W	5,900	WNW	6,500	WNW	6,200	NW	9,100	WNW	11,000
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	S	4,300	SSW	3,900	SSW	2,700	NW	1,700	W	4,200
Lovelace Hospital	WNW	3,800	WNW	4,400	NW	4,300	NNW	7,600	NW	9,200
National Atomic Museum	WNW	1,100	WNW	1,800	NNW	2,100	NNW	6,100	NW	6,900
Riding Stables	SSE	4,800	SSE	4,100	SE	3,500	NE	1,800	WNW	1,600
Sandia Base Elementary School	NNW	1,600	NW-NNW	2,300	NNW	3,000	N	7,200	NW-NNW	7,600

Table F.2–4. Distance and Direction to Core Receptor Locations from Release Points (concluded)

Core Receptor Location	Neutron Generator Facility (TA-I)		Explosive Components Facility (TA-II)		Z-Machine (TA-IV)		TA-V		Manzano Waste Storage Facilities	
	Direction	Distance (meters)	Direction	Distance (meters)	Direction	Distance (meters)	Direction	Distance (meters)	Direction	Distance (meters)
Shandiin Day Care Center	W-WNW	1,700	WNW	2,300	NW	2,400	NNW	6,200	NW	7,300
Veterans Affairs Medical Center	W-WNW	3,600	WNW	4,200	WNW-NW	3,400-3,900	NW-NNW	7,200-7,300	NW	8,800
Wherry Elementary School	WNW	2,100	WNW-NW	2,900	NW-NNW	3,100	NNW	7,000	NW	8,000

Source: Bleakly 1998b, c

Notes: 1) If more than one direction is indicated, the core receptor location occurs within multiple sectors. The range in distance is also provided.

2) Distances are rounded to the nearest 100 meters.

- Lovelace Hospital
- National Atomic Museum
- Riding Stables
- Shandiin Day Care Center
- Sandia Base Elementary School
- Veterans Affairs Medical Center
- Wherry Elementary School

Location of Boundary Receptors

In addition to the selected core receptor locations, for each release point, KAFB was divided into 16 directions (sectors). The boundary receptors represent the maximum dose that any member of the public outside KAFB could receive in that direction. The distances from the various release points was provided by SNL/NM for each of the 16 directions (Bleakly 1998b, c). The distance was based on the minimum distance from the release point to the KAFB boundary within that direction. Because TA-V is small compared to the distance to the KAFB boundary, the distances for all release points within TA-V were based from the center of the area. Table F.2–5 presents the distances to the KAFB boundary, by direction, for the release points. Similar information for the Aerial Cable Facility is presented in Section F.6 (Table F.6–26).

Location of the Maximally Exposed Individual

As described in section F.2.2.2, *MACCS2* makes multiple runs for each accident, using representative sampling of the meteorological data throughout the year's input data file. The means of the concentrations at each chosen location are provided by *MACCS2* and are used in this SWEIS for the core receptors and boundary locations. The highest mean exposure of those receptors and locations is selected as the single MEI for the accident. The MEI dose applies to a hypothetical individual who remains outdoors at that location for the duration of the accident and takes no protective action.

F.2.3.5 Other Consequence Analysis Input

Release plumes were modeled using the "straight-line" plume dispersion model for all *MACCS2* runs. In accidents involving fires that affect the releases, plume buoyancy was implemented by specification of a 1-MW sensible heat source added to the plume.

For cases where a pool was functional and in a position to control or reduce releases, the following pool DFs were used, as described in the *Annular Core Research Reactor (ACRR) Postulated Limiting Event Initial and Building Source Terms*, SAND91-0571 (SNL 1992b):

- DF = 1 for noble gases,
- DF = 100 for halogens, and
- DF = 1,400 for all other radionuclide release groups.

For cases where a pool was unavailable or unable to control or reduce releases, pool DFs were specified as 1.

For accidents described by melted fuel or ruptured or mechanically damaged cladding, ARFxRF fractions were specified for each *MACCS2* radionuclide release group from the *Airborne Release Fractions/Rates and Respirable*

Table F.2–5. Minimum Distance and Direction to the KAFB Boundary by Release Point

DIRECTION	DISTANCE (meters)				
	TECHNICAL AREA-V	NEUTRON GENERATOR FACILITY	EXPLOSIVE COMPONENT FACILITY	Z-MACHINE	MANZANO WASTE STORAGE FACILTIES
N	5,000	2,000	700	3,600	4,300
NNE	5,000	900	400	1,900	4,400
NE	5,900	800	300	1,300	4,400
ENE	7,100	600	200	1,800	3,700
E	14,500	600	200	7,300	3,700
ESE	10,400	700	6,800	7,500	3,700
SE	6,900	800	13,000	11,700	4,400
SSE	5,800	11,500	10,900	9,800	6,400
S	5,800	11,200	10,700	9,000	6,300
SSW	5,600	4,900	5,600	4,500	6,400
SW	3,700	5,100	4,700	3,500	7,300
WSW	3,100	4,800	5,000	4,100	6,200
W	3,100	2,600	3,300	4,100	6,000
WNW	3,100	2,700	3,200	2,800	8,100
NW	5,500	2,300	3,000	3,100	7,700
NNW	6,100	2,100	2,800	3,600	5,200

Source: Bleakly 1998b, c
Note: Distances are rounded to the nearest 100 meters.

Fractions for Nonreactor Nuclear Facilities, DOE-HDBK-3010-94, page 4-49 (DOE 1994b), as shown in Table F.2–6. (DOE-HDBK-3010-94 indicates that these data are "release fractions." In the sources that are referenced, these data are described as fractions released in the respirable range, which correlates to ARFxRF.)

Two sets of data are provided in DOE-HDBK-3010-94. In addition to the ARFxRF fractions for melting fuel (shown in Table F.2–6), gap activity ARFxRF fractions are given. The gap activity represents the fission products that have accumulated in the gap between the fuel matrix and the fuel element cladding. The gap fractions are much less than the melting fuel fractions, indicating that most of the fission products remain in the fuel matrix during operations. The fraction of the fission products released during an accident involving the reactor core would depend on the damage mechanism. The melting fuel data are appropriate for severe accidents that might involve fuel melt. The gap activity data are appropriate for accidents that might puncture the cladding without damaging the fuel matrix. Not all the accidents postulated in this appendix, however, are represented by one of these two categories. Some of the postulated accidents involve mechanical damage caused by very violent, energetic events. One example is the collapse of the bridge crane, which is postulated to fall on top of the reactor superstructure. This event could cause violent buckling of tubes and rods that extend down into the reactor core, which in turn could cause severe damage to adjacent fuel elements. The ARFxRF release from this scenario would be somewhere between the gap activity data and the melting fuel data. The analysis in this appendix used the data for melting fuel, which bounds the releases. It is acknowledged that this assumption results in calculated consequences that are higher than expected for the mechanical damage scenarios.

Table F.2–6. Airborne Release Fraction/Respirable Fraction by Radionuclide Group

RADIONUCLIDE RELEASE GROUP	ARFxRF FRACTION	GAP ACTIVITY FRACTION
Noble Gases	0.95	0.05
Iodine	0.22	0.05
Cesium	0.15	0.05
Tellurium	0.11	0.00
Strontium	0.03	0.00
Ruthenium	0.007	0.00
Lanthanum	0.002	0.00
Cerium	0.009	0.00
Barium	0.03	0.00

Source: DOE 1994b
ARFxRF: mathematical product of airborne release fraction and respirable fraction

Each of the postulated accident scenarios explicitly identies the material form for the MAR (such as powder or solid) and the energy stress that creates the postulated release condition (such as fire, explosion, spill). Using this information, bounding values of ARFxRF were obtained from DOE-HDBK-3010-94.

For accidents described as plutonium-239 (metal) fire scenarios, ARFxRF fractions were specified from DOE-HDBK-3010-94, page 4-2 (self-sustained oxidation–molten oxidized metal), as ARF=$5x10^{-4}$ and RF=0.5. For accidents described as uranium-235 (metal) fire scenarios, ARFxRF fractions were specified based on information in DOE-HDBK-3010-94, page 4-3 (complete oxidation of metal mass), as ARF=$1x10^{-3}$ and RF=1.0. It is recognized that complete oxidation of the metal mass would not be likely during the postulated accident scenarios involving a fire. The oxidation process during an accident is a complex event that depends (among other parameters) on the configuration of the metal and surrounding components; the spatial relationship of the metal to the fire; and the size, location, intensity, and duration of the fire. These parameters are very difficult to predict for an initiating event such as an airplane crash. Calculating an actual oxidation percentage is beyond the scope of this analysis. The assumption of complete or 100 percent oxidation bounds the calculated consequences for these scenarios; the reported consequences are higher than expected.

ARFxRF and pool DF values were implemented in *MACCS2* by adjusting the radionuclide release group fraction input values. Three general accident types were handled this way.

- For accidents where molten fuel or damaged cladding released fission products through a pool, thus preventing some of the fission products from being released to the atmosphere, the ARFxRF and pool DF factors were multiplied together to arrive at a release group fraction equivalent to be used in the *MACCS2* input file.
- For accidents where molten fuel or damaged cladding released fission products external to a pool, DOE-HDBK-3010-94 release fractions were used directly as the *MACCS2* group release fractions.

- For fire accident scenarios, the group release fractions were adjusted to reflect the ARFxRF values for either plutonium-239 or uranium-235, as applicable.

Specific modeling characteristics and parameters for each accident scenario are provided below in the individual TA sections.

F.2.4 Frequency of Occurrence Estimates

Existing safety documents for SNL/NM facilities do not include estimates of frequencies for all scenarios. In many instances, frequencies are discussed qualitatively; quantitative estimates are not developed. For some types of accidents, the bases for frequency estimates varied from facility to facility or used data that were not current. It was necessary, therefore, to evaluate existing estimates of accident scenario frequencies to ensure that the frequency estimates are consistent and reasonable.

Quantitative estimates were generally used in this SWEIS when provided in an existing safety document. Often a qualitative frequency category, or bin, was selected based on the description of the scenario in the safety document. Frequency categories recommended in the *Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-3009 (DOE 1994c) are shown in Table F.2–7.

When a new accident scenario was postulated for this SWEIS, engineering judgement was used to estimate the frequency category of the accident scenario. The frequency estimates were based on an assessment of the likelihood of the initiating event and the number and potential effectiveness (availability) of the preventive and existing mitigative controls that are required to fail in order for the scenario to occur. Quantitative evaluations (such as event or fault tree analysis) were not performed.

It was recognized that airplane crash scenarios were an important consideration because of the proximity of the SNL/NM site relative to KAFB and the Albuquerque International Sunport. An analysis of airplane crash frequencies for the SNL/NM facilities of interest was performed for the SWEIS and is provided in Section F.5. This analysis used recent data and the methodology of DOE-STD-3014 (DOE 1996f). For practical purposes, the Sandia Pulsed Reactor (SPR) Facility was used to represent all TA-V facilities for the calculation of airplane crash frequencies. Similarly, representative facilities were used for the other TAs. In one case, more than one facility was used to represent a TA (TA-I). In all cases, the frequency of occurrence of an airplane crash into an SNL/NM facility was determined to be in the frequency category of extremely unlikely (that is, between $1x10^{-4}$ and $1x10^{-6}$ per year). For all airplane crash scenarios, the damage ratio was assumed to be 1.0.

The airplane crash probability was calculated assuming a crash into one building. For multiple facilities to be damaged from an airplane crash, a very specific flight pattern and aircraft would have to be evaluated. This would result in a very small probability of occurrence.

The frequency categories shown in Table F.2–7 differ from the categories shown in Section F.6. The reason for the difference is that the input data used to produce the matrices in Section F.6 are taken from source documents prepared by SNL/NM, which used different category definitions.

Table F.2–7. Frequency Categories by Frequency

FREQUENCY CATEGORY SCENARIO	FREQUENCY DESCRIPTION	FREQUENCY (per year)
I	Likely	Greater than $1x10^{-2}$
II	Unlikely	$1x10^{-2}$ to $1x10^{-4}$
III	Extremely Unlikely	$1x10^{-4}$ to $1x10^{-6}$
IV	Beyond Extremely Unlikely (Incredible)	Less than $1x10^{-6}$

Source: DOE 1994c

F.2.5 Technical Areas-I and -II

F.2.5.1 Selection of Representative Accident Scenarios

Safety documentation and other information for TA-I and TA-II facilities were reviewed to identify facilities that contain radioactive material. The Neutron Generator Facility (NGF) in TA-I and the Explosive Components Facility (ECF) in TA-II are the only facilities with amounts of radioactive material that present a potential risk to the public, environment, or workers outside the facility.

For both facilities, tritium is the radioactive material that is present in quantities sufficient to warrant analysis. The radiological accident analysis for TAs-I and -II considers accident scenarios at the NGF and the ECF involving tritium.

The SNL/NM SWEIS source documents (SNL/NM 1998a) contain descriptions of the operations conducted at these facilities, potential accidents, and the amounts of tritium present for each alternative. The accident scenario that is postulated for analysis for each facility is a catastrophic, unspecified event that causes all the tritium present in the facility to be released in the form of tritiated water. This assumption bounds the consequences and simplifies the analysis.

One accident scenario (NG-1) was selected for the NGF, representing a total release of the tritium inventory present in the facility. The SNL/NM SWEIS source documents provide the MAR for the scenario in the form of facility tritium inventories of 836 Ci for each alternative (SNL/NM 1998a).

Likewise, only one accident scenario (ECF-1) is necessary for the ECF. The source documents indicate that the expected tritium inventory present at the ECF is 49 Ci. The tritium inventory is based on the amount involved in the shelf-life test, which is constant under each alternative.

The frequencies for all the accident scenarios established for TAs-I and -II facilities were estimated to be less than $1x10^{-3}$ per year. This estimate is based on the necessity of a catastrophic event, such as an airplane crash or earthquake, to cause release of the entire inventory of the facility. In both the NGF and the ECF, the tritium locations are dispersed throughout each facility and are contained in many devices, and they are not vulnerable to total release from operational events.

F.2.5.2 Consequence Analysis Modeling Characteristics and Parameters

Table F.2–8 provides the key modeling assumptions and input parameters for the *MACCS2* consequence analysis of TAs-I and -II accidents.

F.2.5.3 Results

The impacts of accidents are described in three tables for the MEI and noninvolved worker, the 50-mile population, and the set of core receptors.

Table F.2–9 provides the consequence estimates for the MEI and the maximally exposed noninvolved worker. A distance of 100 m from the release point was used to estimate the dose to noninvolved workers. Table F.2–10 provides consequence and risk estimates for the population present within the surrounding 50-mi radius.

Table F.2–11 provides consequence estimates for all core receptors. Because some core receptor locations cover a large area (for example, golf course), they could be located in more than one direction shown in the table. The results show that the consequences of radiological accidents in TAs-I and -II are very low.

Table F.2–8. Consequence Analysis Modeling Characteristics and Parameters Technical Areas-I and II

FACILITY	ACCIDENT ID[a]	ACCIDENT DESCRIPTION	ACCIDENT MODELING CHARACTERISTICS			
			PLUME RELEASE HEIGHT	PLUME BUOYANCY	POOL DF	ARFxRF
TECHNICAL AREA-I						
Neutron Generator Facility	NG-1	Catastrophic release of building's tritium	Ground	No	NA	1.0
TECHNICAL AREA-II						
Explosive Components Facility	ECF-1	Catastrophic release of building's tritium	Ground	No	NA	1.0

Source: Original
ARFxRF: mathematical product of airborne release fraction and respirable fraction
DF: decontamination factor; see Section F.2.2.1
NA: not applicable

[a] Facility Accident Descriptors:
Explosive Components Facility: ECF-1
Neutron Generator Facility: NG-1

Table F.2–9. Technical Areas-I and -II Radiological Accident Frequencies and Consequences to Maximally Exposed Individual and Noninvolved Worker

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	APPLICABLE ALTERNATIVE[b]	MAXIMALLY EXPOSED INDIVIDUAL		NONINVOLVED WORKER	
				DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
NG-1	Catastrophic release of building's tritium	1.0×10^{-3} to 1.0×10^{-6}	All	8.4×10^{-5}	4.2×10^{-8}	7.9×10^{-3}	3.2×10^{-6}
ECF-1	Catastrophic release of building's tritium	1.0×10^{-3} to 1.0×10^{-6}	All	7.8×10^{-5}	3.9×10^{-8}	4.6×10^{-4}	1.9×10^{-7}

Source: Original
[a] Facility Accident Descriptors:
Explosive Components Facility: ECF-1
Neutron Generator Facility: NG-1

[b] Applicable Alternative:
All–Accident scenario is applicable to all three alternatives

Table F.2–10. Technical Areas-I and -II Radiological Accident Frequencies and Consequences to the 50-Mile Population

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	APPLICABLE ALTERNATIVE[b]	DOSE (person-rem)	ADDITIONAL LATENT CANCER FATALITY
NG-1	Catastrophic release of building's tritium	1.0×10^{-3} to 1.0×10^{-6}	All	1.0×10^{-1}	5.1×10^{-5}
ECF-1	Catastrophic release of building's tritium	1.0×10^{-3} to 1.0×10^{-6}	All	5.9×10^{-3}	3.0×10^{-6}

Source: Original
[a] Facility Accident Descriptors:
Explosive Components Facility: ECF-1
Neutron Generator Facility: NG-1

[b] Applicable Alternative:
All–Accident scenario is applicable to all three alternatives

Table F.2–11. Technical Areas-I and -II Radiological Accident Frequencies and Consequences to Core Receptor Locations

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	APPLICABLE ALTERNATIVE[b]	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
ECF-1	Catastrophic release of building's tritium	1.0×10^{-3} to 1.0×10^{-6}	All	*Golf Course (1.6-2.4 km to SSE)*		*Golf Course (1.6-2.4 km to S)*	
				3.1×10^{-7}	1.5×10^{-10}	2.5×10^{-7}	1.3×10^{-10}
				National Atomic Museum, Base Housing, Shandiin Day Care Center (1.6-2.4 km to WNW)		*Sandia Base Elementary School, Coronado Club (1.6-2.4 km to NW)*	
				1.4×10^{-7}	7.0×10^{-11}	1.5×10^{-7}	7.6×10^{-11}
				Sandia Base Elementary School, Coronado Club (1.6-2.4 km to NNW)		*Wherry Elementary School (2.4-3.2 km to WNW)*	
				2.0×10^{-7}	9.8×10^{-11}	7.5×10^{-8}	3.7×10^{-11}
				Wherry Elementary School, Child Development Center-East (2.4-3.2 km to NW)		*Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC) (3.2-4.0 km to SSW)*	
				8.3×10^{-8}	4.2×10^{-11}	7.1×10^{-8}	3.5×10^{-11}
				Riding Stables (4.0-4.8 km to SSE)		*Veterans Affairs Medical Center, Lovelace Hospital (4.0-4.8 km to WNW)*	
				7.9×10^{-8}	4.0×10^{-11}	3.3×10^{-8}	1.7×10^{-11}
				Child Development Center-West (5.6-6.4 km to WNW)		*Kirtland Elementary School (6.4-7.2 km to WNW)*	
				1.9×10^{-8}	9.4×10^{-12}	1.5×10^{-8}	7.6×10^{-12}
NG-1	Catastrophic release of building's tritium	1.0×10^{-3} to 1.0×10^{-6}	All	*National Atomic Museum (0.8-1.6 km to WNW)*		*Coronado Club (0.8-1.6 km to NW)*	
				5.7×10^{-6}	2.8×10^{-9}	6.2×10^{-6}	3.1×10^{-9}

Table F.2–11. Technical Areas-I and -II Radiological Accident Frequencies and Consequences to Core Receptor Locations (concluded)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	APPLICABLE ALTERNATIVE[b]	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
				Sandia Base Elementary School (0.8-1.6 km to NNW)		*Base Housing, Shandiin Day Care Center (1.6-2.4 km to W)*	
				7.8×10^{-6}	3.9×10^{-9}	2.5×10^{-6}	1.2×10^{-9}
				Wherry Elementary School, Base Housing, Shandiin Day Care Center (1.6-2.4 km to WNW)		*Child Development Center-East (1.6-2.4 km to NW)*	
				2.4×10^{-6}	1.2×10^{-9}	2.6×10^{-6}	1.3×10^{-9}
				Golf Course (2.4-3.2 km to SSE)		*Veterans Affairs Medical Center (3.2-4.0 km to W)*	
				2.9×10^{-6}	1.4×10^{-9}	8.2×10^{-7}	4.1×10^{-10}
				Kirtland Elementary School (5.6-6.4 km to W)		*Veterans Affairs Medical Center, Lovelace Hospital (3.2-4.0 km to WNW)*	
				3.3×10^{-7}	1.7×10^{-10}	8.1×10^{-7}	4.0×10^{-10}
				Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC) (3.2-4.0 km to S)		*Riding Stables (4.0-4.8 km to SSE)*	
				1.1×10^{-6}	5.6×10^{-10}	1.4×10^{-6}	6.8×10^{-10}
				Child Development Center-West (4.8-5.6 km to WNW)			
				4.3×10^{-7}	2.1×10^{-10}		

Source: Original
KAFB: Kirtland Air Force Base
km: kilometer

[a] Facility Accident Descriptors:
Explosive Components Facility: ECF-1
Neutron Generator Facility: NG-1
[b] Applicable Alternative: All–Scenarios applicable to all three alternatives

F.2.6 Technical Area-IV

F.2.6.1 Selection of Representative Accident Scenarios

Safety documentation and other information for TA-IV facilities were reviewed to identify facilities that contain radioactive material. The SNL/NM SWEIS source documents contain descriptions of the operations conducted at these facilities and provide estimates of radioactive material inventory (SNL/NM 1998a). The Z-Machine is the only facility in TA-IV with amounts of radioactive material that present a potential consequence to the public, environment, or workers outside the facility. Tritium and plutonium are the radioactive materials that are present in quantities sufficient to be of concern.

Based on the amounts and form of radioactive material involved, the consequences from the greatest possible release would be small. The accident scenario that is postulated for analysis is a catastrophic, unspecified event that causes all the tritium (in the form of tritiated water) and/or all the plutonium present in the facility to be released. This assumption bounds the consequences and simplifies the analysis.

A tritium accident scenario and a plutonium accident scenario were postulated for two alternatives. Accident scenario ZPu-1, catastrophic release of plutonium inventory, would be the same under both the No Action and Expanded Operations Alternatives, resulting in a total of three accident scenarios (radioactive material would not be present in the Z-Machine under the Reduced Operations Alternative). The accident identifiers and MAR for each scenario are shown in Table F.2–12.

For both the No Action and the Expanded Operations Alternatives, because the accidental release is assumed to be a catastrophic release, both tritium consequences and plutonium consequences would occur at the same time and would be additive. The frequencies for all the accident scenarios established for the Z-Machine were estimated to be extremely unlikely ($1x10^{-4}$ to $1x10^{-6}$ per year). This estimate is based on the need for a catastrophic event, such as an airplane crash or earthquake, to cause release of the entire inventory of the facility.

F.2.6.2 Consequence Analysis Modeling Characteristics and Parameters

Table F.2–13 provides the key modeling assumptions and input parameters for the *MACCS2* consequence analysis of TA-IV accidents.

F.2.6.3 Results

Table F.2–14 provides the consequence estimates for the MEI and the noninvolved worker. A distance of 100 m from the release point was used to estimate the dose to noninvolved workers. Table F.2–15 provides consequence for the population within the surrounding 50-mi radius. Table F.2–16 provides consequence estimates for all core receptors. Because some core receptor locations are large (for example, golf course), the receptor could be located in more than one direction.

F.2.7 Technical Area-V

F.2.7.1 Selection of Representative Accident Scenarios

This section describes the selection of the representative radiological accident scenarios to characterize the accident impacts for TA-V in the SWEIS. This section also develops or references source-term data for the accidents selected for consequence analysis.

F.2.7.2 Scenario Selection Approach

A systematic approach was used to select a representative set of radiological accident scenarios at TA-V for analysis of consequences. Types of accidents selected included earthquakes, fires, criticalities, high-frequency accidents, and high-consequence accidents. The accidents selected cover the spectrum from low-consequences–high-frequency to high-consequences–low-frequency accidents. The complete set of accidents postulated in existing safety documents and Environmental Impact Statements (EISs) was the primary basis for selection. The SWEIS accident analysis team supplemented this set with several additional accident scenarios based on facility walk-throughs and review of the operations and associated hazards. Generally, existing accident scenarios were used as-is.

The first step in identifying the set of representative accident scenarios for further analysis in the SWEIS was to review existing safety documents and EISs and identify the accident scenarios postulated in these documents. Scenario frequencies, if available, were also noted. Accident frequencies are not estimated for many

Table F.2–12. Accident Scenarios for Z-Machine

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	RELEASE
NO ACTION ALTERNATIVE		
ZH3-1	Catastrophic release of tritium inventory	1,000 curies tritium
ZPu-1	Catastrophic release of plutonium inventory	200 milligrams plutonium
EXPANDED OPERATIONS ALTERNATIVE		
ZH3-2	Catastrophic release of tritium inventory	50,000 curies tritium
ZPu-1	Catastrophic release of plutonium inventory	200 milligrams plutonium

Source: Original
[a] Facility Accident Descriptors:
Z-Machine-tritium: ZH3-1, ZH3-2
Z-Machine-plutonium: ZPu-1
Note: For Reduced Operations Alternative, the Z-Machine will not operate.

Table F.2–13. Technical Areas-IV Consequence Analysis Modeling Characteristics and Parameters

FACILITY	ACCIDENT ID[a]	ACCIDENT SCENARIO	ACCIDENT MODELING CHARACTERISTICS			
			PLUME RELEASE HEIGHT	PLUME BUOYANCY	POOL DF	ARFxRF
TECHNICAL AREA-IV						
Z-Machine	ZH3-1 ZH3-2	Catastrophic release of building's tritium	Ground-level	No	NA	1.0
	ZPu-1	Catastrophic release of building's plutonium	Ground-level	No	NA	1.0

Source: Original
ARFxRF: mathematical product of airborne release fraction and respirable fraction
DF: decontamination factor; see Section F.2.2.1
NA: Not applicable

[a] Facility Accident Descriptors:
Z-Machine-tritium: ZH3-1, ZH3-2
Z-Machine-plutonium: ZPu-1

Table F.2–14. Technical Area-IV Radiological Accident Frequencies and Consequences to the Maximally Exposed Individual and Noninvolved Worker

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Maximally Exposed Individual		Noninvolved Worker	
				Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$1.92x10^{-5}$	$9.6x10^{-9}$	$9.7x10^{-3}$	$3.9x10^{-6}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$9.6x10^{-4}$	$4.8x10^{-7}$	$4.9x10^{-1}$	$1.9x10^{-4}$
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N,E	$8.85x10^{-4}$	$4.4x10^{-7}$	$5.4x10^{-1}$	$2.2x10^{-4}$

Source: Original
[a] Facility Accident Descriptors:
Z-Machine-tritium: ZH3-1, ZH3-2
Z-Machine-plutonium: ZPu-1

[b] Applicable Alternative:
N–Scenario is applicable to No Action Alternative
E–Scenario is applicable to Expanded Operations Alternative

Table F.2–15. Technical Area-IV Radiological Accident Frequencies and Consequences to 50-Mile Population

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	50-Mile Population	
				Dose (person-rem)	Additional Latent Cancer Fatality
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$5.4x10^{-2}$	$2.7x10^{-5}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	2.7	$1.4x10^{-3}$
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N,E	1.8	$9.2x10^{-4}$

Source: Original
[a] Facility Accident Descriptors:
Z-Machine-tritium: ZH3-1, ZH3-2
Z-Machine-plutonium: ZPu-1

[b] Applicable Alternative:
N–Scenario is applicable to No Action Alternative
E–Scenario is applicable to Expanded Operations Alternative

Table F.2–16. Technical Area-IV Radiological Accident Frequencies and Consequences to Core Receptor Locations

Accident ID	Accident Scenario Description	Accident Frequency (per Year)	Applicable Alternative	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
				Golf Course (0.8-1.6 km to ESE)		**Golf Course (0.8-1.6 km to SE)**	
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$1.7x10^{-5}$	$8.7x10^{-9}$	$1.9x10^{-5}$	$9.6x10^{-9}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$8.7x10^{-4}$	$4.4x10^{-7}$	$9.6x10^{-4}$	$4.8x10^{-7}$
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$8.2x10^{-4}$	$4.1x10^{-7}$	$8.8x10^{-4}$	$4.4x10^{-7}$
				Golf Course (0.8-1.6 km to SSE)		**Shandiin Day Care (1.6-2.4 km to NW)**	
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$1.4x10^{-5}$	$6.9x10^{-9}$	$4.1x10^{-6}$	$2.1x10^{-9}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$6.9x10^{-4}$	$3.4x10^{-7}$	$2.1x10^{-4}$	$1.0x10^{-7}$
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$6.3x10^{-4}$	$3.1x10^{-7}$	$1.6x10^{-4}$	$7.8x10^{-8}$
				National Atomic Museum, Base Housing (1.6-2.4 km to NNW)		**KAFB Underground Munitions and Maintenance Storage Complex (KUMMSC) (2.4-3.2 km to SSW)**	
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$4.2x10^{-6}$	$2.1x10^{-9}$	$2.5x10^{-6}$	$1.3x10^{-9}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$2.1x10^{-4}$	$1.1x10^{-7}$	$1.3x10^{-4}$	$6.3x10^{-8}$
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$1.7x10^{-4}$	$8.5x10^{-8}$	$1.0x10^{-4}$	$5.0x10^{-8}$
				Wherry Elementary (2.4-3.2 km to NW)		**Sandia Base Elementary, Wherry Elementary, Coronado Club, Child Development Center-East (2.4-3.2 km to NNW)**	
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$2.2x10^{-6}$	$1.1x10^{-9}$	$2.3x10^{-6}$	$1.1x10^{-9}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$1.1x10^{-4}$	$5.6x10^{-8}$	$1.1x10^{-4}$	$5.7x10^{-8}$

Table F.2–16. Technical Area-IV Radiological Accident Frequencies and Consequences to Core Receptor Locations (concluded)

Accident ID	Accident Scenario Description	Accident Frequency (per Year)	Applicable Alternative	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$8.2x10^{-5}$	$4.1x10^{-8}$	$8.9x10^{-5}$	$4.4x10^{-8}$
				Riding Stables (3.2-4.0 km to SE)		**Veterans Affairs Medical Center (3.2-4.0 km to WNW)**	
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$3.0x10^{-6}$	$1.5x10^{-9}$	$1.0x10^{-6}$	$5.1x10^{-10}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$1.5x10^{-4}$	$7.5x10^{-8}$	$5.1x10^{-5}$	$2.5x10^{-8}$
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$1.2x10^{-4}$	$6.2x10^{-8}$	$4.1x10^{-5}$	$2.0x10^{-8}$
				Veterans Affairs Medical Center (3.2-4.0 km to NW)		**Lovelace Hospital (4.0-4.8 km to NW)**	
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$1.5x10^{-6}$	$7.3x10^{-10}$	$1.0x10^{-6}$	$5.2x10^{-10}$
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$7.3x10^{-5}$	$3.6x10^{-8}$	$5.2x10^{-5}$	$2.6x10^{-8}$
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$5.1x10^{-5}$	$2.5x10^{-8}$	$3.5x10^{-5}$	$1.7x10^{-8}$
				KAFB Elementary School, Child Development Center-West (5.6-6.4 km to WNW)			
ZH3-1	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N	$4.2x10^{-7}$	$2.1x10^{-10}$		
ZH3-2	Catastrophic release of building's tritium	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$2.1x10^{-4}$	$1.0x10^{-7}$		
ZPu-1	Catastrophic release of building's plutonium	$1.0x10^{-4}$ to $1.0x10^{-6}$	N,E	$1.6x10^{-5}$	$8.0x10^{-9}$		

Source: Original
km: kilometer
[a] Facility Accident Descriptors:
Z-Machine-tritium: ZH3-1, ZH3-2
Z-Machine-plutonium: ZPu-1
[b] Applicable Alternative:
N–Scenario is applicable to No Action Alternative
E–Scenario is applicable to Expanded Operations Alternative

Notes: 1) Under the Reduced Operations Alternative, the Z-Machine does not use tritium or plutonium.
2) Depending on the exact accident scenario, the consequences for the Expanded Operations Alternative may or may not be additive.

scenarios postulated in SARs. The SWEIS accident analysis team estimated frequency bins for these scenarios ,based on descriptions in the SARs. (Due to uncertainties and the randomness of events that cause accidents, scenario frequencies are typically categorized into frequency bins, as described above in Section F.2.4.)

The following TA-V nuclear facilities were considered in the first step of this selection process:

- ACRR (Defense Programs [DP] configuration)
- ACRR (medical isotopes production configuration)
- Hot Cell Facility (HCF) (medical isotopes production configuration)
- SPR Facility
- Gamma Irradiation Facility (GIF)
- New Gamma Irradiation Facility (NGIF)

Additional accident scenarios were identified by the SWEIS accident analysis team.

A two-step screening process was then used to select the set of accident scenarios for SWEIS consequence analysis. The first step was to review the complete set of accidents for potentially high-consequence and high-risk accidents as well as accident types of interest. The following types of accidents were selected for further consideration:

- High-consequence accidents
- High-frequency accidents
- Airplane crash accidents
- Earthquakes
- Criticality events
- Fires

The accident scenarios selected during this first screening step are summarized in Table F.2–17. Identification codes have been assigned to each scenario, as indicated in Table F.2–17, and in the scenario descriptions in following sections.

The second screening step eliminated several scenarios from those listed in Table F.2–17. The objective of this second screening step was to identify a reasonable number of accidents that would characterize the consequences from radiological accidents at TA-V facilities. Scenarios eliminated from consideration by this second screening step are those that are clearly bounded by other scenarios or those that lead to essentially the same consequences and risk. Both the frequency (as it affects the risk) and the severity of the consequences of scenarios were considered in the screen. Table F.2–17 identifies those scenarios that were and were not selected for analysis by the final screening process.

Accident frequencies shown in Table F.2–17 are based on source documents such as SARs. Some of these documents present frequency in a semi-quantitative form or as a range (for example $<1x10^{-6}$ or IV). The range reflects the degree of uncertainty in the event's occurrence.

Note that no scenarios for the GIF are included in Table F.2–17. The first screening step eliminated the scenarios for this facility because they were determined to be bounded by the accidents that might occur at the other TA-V facilities.

F.2.7.3 Description of Accident Scenarios

The following sections discuss in detail each of the accident scenarios listed on Table F.2–17. A discussion of the second screening step is included for each scenario, providing an explanation for scenarios eliminated from further analysis. For scenarios that were selected for analysis, information is provided describing the scenario frequency, the radioactive MAR, and the basis for the radioactive source term for the consequence analysis.

ACRR/Medical Isotopes Production (AM Scenarios)

AM-1 Airplane Crash—Collapse of Bridge Crane

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.3 of the *Medical Isotopes Production Project Environmental Impact Statement* (MIPP EIS) (DOE 1996b). To bound the risks of an airplane crash, it was assumed that the airplane crash would cause the bridge crane to fall into the reactor pool, impact the reactor superstructure, and result in the rupture of four fuel elements in the reactor core.

The frequency of $5x10^{-5}$ per year used in the MIPP EIS is that of the crash, and does not factor in the likelihood of the crane being over the reactor pool at the time of the crash. The frequency of this scenario would be one or two orders of magnitude less than the frequency of the crash itself. Massey, et al. (SNL 1995e), concluded that other than the fatalities that result from the crash, the consequences to the ACRR would not exceed those from a seismic event causing a similar accident (collapse of bridge crane).

Table F.2–17. Technical Area-V Radiological Accident Scenarios for the No Action, Reduced Operations, and Expanded Operations Alternatives

FACILITY/ MODE	ACCIDENT ID	ACCIDENT SCENARIO	FREQUENCY (per year or bin)	MATERIALS AT RISK	ANALYZE IN SWEIS (Y/N)	JUSTIFICATION
Annular Core Research Reactor/Medical Isotopes Production Configuration	AM-1	Airplane crash - collapse of bridge crane	$6.3x10^{-6}$	FPs in 4 fuel elements	Y	Airplane crash
	AM-2	Earthquake - collapse of bridge crane	$<1x10^{-6}$	FPs in 4 fuel elements	Y	Earthquake
	AM-3	Fuel element rupture	III	FPs in 1 fuel element	Y	High frequency could result in highest risk
	AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$	One irradiated target	Y	Unique from core-related accidents
	AM-5	Fuel handling accident (irradiated element)	III	One irradiated fuel element	Y	Occurs outside of pool; no mitigation by pool water
	AM-6	Airplane crash and/or fire in reactor room with unirradiated fuel and targets present	III	57 new fuel elements + 38 targets	Y	Occurs outside of pool; no mitigation by pool water
	AM-7	Target rupture during transfer from Annular Core Research Reactor to Hot Cell Facility	$<1x10^{-6}$	One irradiated target	Y	Occurs outside of pool and might be outside of building; no mitigation
Hot Cell Facility/ Medical Isotopes Production Configuration	HM-1	Operator error during molybdenum-99 target processing	1.0	Cold trap gases	Y	Highest risk from MIPP EIS
	HM-2	Operator error during iodine-125 target processing	0.1	Cold trap gases	Y	Highest consequences from MIPP EIS
	HM-3	Airplane crash, penetrates building into hot cell in basement	$<1x10^{-7}$	Cold trap gases + irradiated targets	N	Airplane crash

Table F.2–17. Technical Area-V Radiological Accident Scenarios for the No Action, Reduced Operations, and Expanded Operations Alternatives (continued)

FACILITY/ MODE	ACCIDENT ID	ACCIDENT SCENARIO	FREQUENCY (per year or bin)	MATERIALS AT RISK	ANALYZE IN SWEIS (Y/N)	JUSTIFICATION
	HM-4	Fire in steel containment box	II	One irradiated target + cold trap gases	Y	Higher consequences than scenarios analyzed in MIPP EIS
	HC-1	Earthquake – building collapse	7.0×10^{-4}	HM-4 + HS-2	Y	Consequences as summation of HM-4 + HS-2 as ground level release
Hot Cell Facility/ Room 108 Storage	HS-1	Fire in Room 108, #3	3.3×10^{-5}	SAR Table 3.4-11 (average) + MIPP waste	Y	Fire
	HS-2	Fire in Room 108, #4	2.0×10^{-7}	SAR Table 3.4-11 (maximum) + MIPP waste	Y	Fire – Highest consequence scenario for hot cell storage rooms
	HS-3	Criticality in Room 108, 50 kg of plutonium-239	$<1\times10^{-7}$	SAR Table 3.4-83	N	Criticality
Sandia Pulsed Reactor Facility	S3M-1	Fire in the reactor building	III	2.469×10^{5}g uranium-235 + FPs	N	Fire
	S3M-2	Control element misadjustment before pulse-element insertion	III	2.469×10^{5}g uranium-235 + FPs	Y	High-risk SAR scenario
	S3M-3	Failure of a fissionable experiment	III	Experiment plutonium-239 7.0×10^{3}gram	Y	Highest consequence scenario in SAR
	SCA-1	Critical assembly – anticipated transient without scram accident	III	Assembly FPs	N	Low likelihood; potential releases similar to limiting S3M accidents
	SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	Plutonium experiment	Y	No mitigation; occurs outside building

Table F.2–17. Technical Area-V Radiological Accident Scenarios for the No Action, Reduced Operations, and Expanded Operations Alternatives (concluded)

FACILITY/ MODE	ACCIDENT ID	ACCIDENT SCENARIO	FREQUENCY (per year or bin)	MATERIALS AT RISK	ANALYZE IN SWEIS (Y/N)	JUSTIFICATION
	SP-1	Earthquake-building collapse	$7x10^{4}$	SS-1	Y	Earthquake
	S4-1	Control element misadjustment before pulse-element insertion	III	$4.6035x10^{5}$g uranium-235 + FPs	Y	Highest risk scenario in No Action Alternative that will be more severe in Expanded Operations Alternative
Annular Core Research Reactor/ Defense Programs Configuration	AR-1	Uncontrolled addition of reactivity	IV	SAR Tables 14A-2 & 14A-3	Y	Highest consequence event in SAR
	AR-2	Fuel element rupture	I	FPs in 4 fuel elements	Y	High frequency could result in highest risk
	AR-3	Failure of experiment containing Annular Core Research Reactor fuel pins	III	Uranium dioxide experiment (20% enriched)	N	Consequences and risk bounded by other events
	AR-4	Fire in reactor room with experiment present	III	Plutonium Experiment	Y	Fire
	AR-5	Earthquake - collapse of bridge crane	$7x10^{-4}$	10% core FP inventory	Y	Earthquakes
	AR-6	Airplane crash - collapse of bridge crane	$6.3x10^{-6}$	10% core FP inventory	Y	Airplane crash

Sources: DOE 1996f; SNL/NM 1995c, 1995e, 1995v; Appendix F.4; SNL 1996d; Schmidt 1998
EIS: environmental impact statement
FP: fission products
g: gram
MIPP: Medical Isotopes Production Project
SAR: safety analysis report
SWEIS: Site-Wide Environmental Impact Statement
Y/N: yes/no
Note: Shaded scenarios were added by SWEIS Accident Analysis Team.

SWEIS Screen—This scenario was selected for SWEIS analysis because it is a potentially high-risk scenario.

SWEIS Scenario Description—The SWEIS analysis postulated the same scenario as the MIPP EIS. The consequences are based on the rupture of four fuel elements in the reactor core.

SWEIS Frequency—The airplane crash frequency for TA-V was updated for the SWEIS. It was calculated to be $6.3x10^{-6}$ per year. The SWEIS used this frequency for the scenario frequency, although it is recognized that the frequency will be lower because the bridge crane is seldom over the reactor. However, this scenario is assumed to bound the effect an airplane crash into the ACRR building might have on the reactor core.

SWEIS Source Term:

MAR—The release was based on a rupture of four fuel elements. The fission product inventory in one element is given in the "Total Inventory" column of Table 1 of Attachment 2 to the April 13, 1998 memo from T. R. Schmidt to L. S. Bayliss (Schmidt 1998). This fuel element inventory times four (for four elements) is used rather than the building releases from the MIPP EIS to allow the SWEIS analysis to use consistent assumptions for existing or known mitigative features. (SNL/NM personnel noted that the Attachment 2 data were the basis for the MIPP EIS analysis.)

Release Assumptions—Fission products from the four ruptured elements were assumed to be released into the reactor pool (with consideration for the appropriate release fraction). The airplane crash was assumed to breach the reactor building, resulting in a ground-level release of the fission products, which pass through the reactor pool. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AM-2 Earthquake—Collapse of Bridge Crane

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.3 of the MIPP EIS (DOE 1996b). The MIPP EIS assumed that the earthquake would cause the crane to fall onto the reactor superstructure with resultant rupture of four fuel elements. The releases for this scenario were assumed to be the same as those for the airplane crash scenario (scenario AM-1).

SWEIS Screen—As discussed below under the SWEIS Frequency paragraph, recent site-specific data indicate the frequency of an earthquake large enough to cause collapse of the bridge crane is approximately $7x10^{-4}$ per year (See section F.7.2). This is higher than the frequency of less than $1x10^{-6}$ per year that was previously estimated in Massey, et al. (SNL 1995e). This scenario was analyzed for the SWEIS using the recent frequency data. At this frequency, this is a high-risk scenario.

SWEIS Scenario Description—A large earthquake occurs at TA-V (0.22 *g*), causing ACRR building damage that results in collapse of the bridge crane. The bridge crane falls into the reactor pool, impacts the reactor superstructure, and results in the rupture of four fuel elements in the reactor core. Other than the initiating event, this scenario is the same as the airplane crash, Scenario AM-1. No additional releases are postulated because the reactor is located at the bottom of the pool and protected from other debris that may result from failure of the building structure.

SWEIS Frequency—Section F.7 discusses earthquake frequencies and facility responses for TA-V. A Uniform Building Code (UBC)-level earthquake (0.22 *g*) with a frequency of $7x10^{-4}$ per year could result in collapse of the ACRR building.

SWEIS Source Term:

MAR—The MAR is the same as that discussed above for Scenario AM-1.

Release Assumptions—The release assumptions were the same as for Scenario AM-1, above. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AM-3 Fuel Element Rupture

Source Scenario Description—The ACRR SAR (SNL/NM 1996d), in paragraph 14.4.8, postulates a waterlogged fuel element rupture accident. This scenario would be initiated by a pinhole leak in the cladding of a fuel element through which water is drawn by heat-up/cool-down cycles. Steam generation during a pulse might build up internal pressure and rupture the cladding. The rupture of the waterlogged element could damage adjacent fuel elements. The SAR analysis assumes failure of a total of four fuel elements, with ejection of the fuel from all four elements into the pool water. Based on the SAR discussion, the frequency of this accident was estimated to be 0.1 per year.

Table F.2–18. Consequence Analysis Modeling Characteristics and Parameters for Technical Area-V

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO	PLUME RELEASE HEIGHT (meters)	PLUME BUOYANCY	POOL DF	ARFxRF
Annular Core Research Reactor/ Medical Isotopes Production Configuration	AM-1	Airplane crash - collapse of bridge crane	Ground	No	See Note	See Table F.2–6
	AM-2	Earthquake - collapse of bridge crane	Ground	No	See Note	See Table F.2–6
	AM-3	Fuel element rupture	14.3	No	See Note	See Table F.2–6
	AM-4	Rupture of one molybdenum -99 target	14.3	No	See Note	See Table F.2–6
	AM-5	Fuel handling accident - irradiated element	14.3	No	NA	See Table F.2–6
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	Ground	Yes	NA	For uranium-235, $1.0 \times 10^{-3} \times 1.0$
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	Ground	No	NA	See Table F.2–6
Hot Cell Facility/ Medical Isotopes Production Configuration	HM-1	Operator error – molybdenum-99 target processing	38.1	No	NA	1.0
	HM-2	Operator error – iodine-125 target processing	38.1	No	NA	1.0
	HM-4	Fire in steel containment box	38.1	No	NA	See Table F.2–6 for target releases ARFxRF=1.0 for cold trap releases
	HM-4G	Fire in steel containment box	Ground	No	NA	See Table F.2–6 for target releases ARFxRF=1.0 for cold trap releases
Hot Cell Facility–Room 108 Storage	HS-1	Fire in room 108, average inventories	38.1	No	NA	For uranium-235, $1.0 \times 10^{-3} \times 1.0$ For plutonium-239, $5.0 \times 10^{-4} \times 0.5$

Table F.2–18. Consequence Analysis Modeling Characteristics and Parameters for Technical Area-V (continued)

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO	PLUME RELEASE HEIGHT (meters)	PLUME BUOYANCY	POOL DF	ARFxRF
Hot Cell Facility–Room 108 Storage (continued)	HS-2	Fire in room 108, maximum inventories	38.1	No	NA	For uranium-235, $1.0 \times 10^{-3} \times 1.0$ For plutonium-239, $5.0 \times 10^{-4} \times 0.5$
	HS-2G	Fire in room 108, maximum inventories	Ground	No	NA	For uranium-235, $1.0 \times 10^{-3} \times 1.0$ For plutonium-239, $5.0 \times 10^{-4} \times 0.5$
	HC-1	Earthquake - building collapse	Ground	No	NA	For uranium-235, $1.0 \times 10^{-3} \times 1.0$ For plutonium-239, $5.0 \times 10^{-4} \times 0.5$ See Table F.2–6 for target releases ARFxRF=1.0 for cold trap releases
Sandia Pulsed Reactor	S3M-2	Control element misadjustment before insert	Ground	No	NA	For core fission products, see Table F.2–6 For uranium-235, $1.0 \times 10^{-3} \times 1.0$
	S3M-3	Failure of a fissionable experiment	Ground	No	NA	For core fission products, see Table F.2–6 For plutonium-239, $5.0 \times 10^{-4} \times 0.5$
	SS-1	Airplane crash into North Vault storage vault	Ground	Yes	NA	For core fission products, see Table F.2–6 For plutonium-239, $5.0 \times 10^{-4} \times 0.5$
	SP-1	Earthquake – building collapse	Ground	Yes for SS-1	NA	For core fission products, see Table F.2–6 For plutonium-239, $5.0 \times 10^{-4} \times 0.5$
	S4-1	Control element misadjustment before insert	Ground	No	NA	For core fission products, see Table F.2–6 For uranium-235, $1.0 \times 10^{-3} \times 1.0$
Annular Core Research Reactor/ Defense Programs Configuration	AR-1	Uncontrolled addition of reactivity	14.3	No	NA	See Table F.2–6

Table F.2–18. Consequence Analysis Modeling Characteristics and Parameters for Technical Area-V (concluded)

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO	PLUME RELEASE HEIGHT (meters)	PLUME BUOYANCY	POOL DF	ARFxRF
Annular Core Research Reactor/ Defense Programs Configuration (continued)	AR-2	Rupture of waterlogged fuel element	14.3	No	See Note	See Table F.2–6
	AR-4	Fire in reactor room with experiment present	14.3	No	NA	For plutonium-239, $5.0x10^{-4}$x 0.5
	AR-5	Earthquake – collapse of bridge crane	Ground	No	See Note	See Table F.2–6
	AR-6	Airplane crash - collapse of bridge crane	Ground	No	See Note	See Table F.2–6

Sources: DOE 1994b; SNL/NM 1995e, 1995v; SNL 1992b, 1996d
ARFxRF: mathematical product of airborne release fraction and respirable fraction
DF: decontamination factor; see Section F.2.2.1
NA: not applicable
Note : Pool DF values used are 1.0 for noble gases, 100 for halogens, and 1,400 for all other radionuclides.

SWEIS Screen—The mechanism for the fuel element rupture that is described in the SAR is dependent on the reactor operating in a pulse mode. Massey, et al. (SNL 1995e), screened out this accident by estimating that the frequency of this type of fuel element failure is likely to be less than $1x10^{-6}$ per year in the medical isotopes production configuration (that is steady-state operation). The SWEIS Accident Analysis Team agrees that the failure mechanism described in the SAR might not be physically possible in steady-state operation. However, other failure mechanisms exist for reactor fuel elements operating in a steady-state mode. Accident analyses for power reactors operating in the steady-state mode typically include a fuel element rupture scenario (NRC 1996). The SWEIS therefore includes a fuel element rupture scenario that releases the fission product inventory of one fuel element. While the consequences of this scenario are bounded by other accidents, its frequency is estimated to be greater than some of the higher consequence accidents. Including this scenario contributes to a larger spectrum of accidents considered in the SWEIS accident analysis.

SWEIS Scenario Description—The SWEIS analysis postulated a rupture of one fuel element in the reactor core during steady-state operation. The exact mechanism is not specified, but a number are possible. Potential mechanisms include overheating of a fuel element or mechanical damage to an element during handling that causes a failure during operation. An insertion of excess reactivity is also possible, even in the steady-state mode, due to a number of unplanned operational transients. This is another potential cause of a fuel element rupture.

SWEIS Frequency—The rupture of a fuel element when the reactor is operating in the steady-state is estimated to be unlikely (10^{-2} to 10^{-4} per year). Fuel element ruptures are not a common occurrence, but a number of power reactor fuel element failures have occurred to some degree.

SWEIS Source Term:

MAR—The release was based on the fission product inventory of one fuel element, which is given in the "Total Inventory" column of Table 1 of Attachment 2 to the April 13, 1998, memo from T. R. Schmidt to L. S. Bayliss (Schmidt 1998). These data are discussed above under scenario AM-1.

Release Assumptions—Fission products from the ruptured element were assumed to be released into the reactor pool (with consideration for the appropriate release fraction). An elevated release through the stack was assumed for the fission products that pass through the reactor pool. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AM-4 Rupture of One Molybdenum-99 Target

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.3 of the MIPP EIS (DOE 1996b). The MIPP EIS assumed that one target would rupture in the core. This accident was postulated to bound accidents involving targets that might take place during irradiation.

SWEIS Screen—This scenario was analyzed for the SWEIS because it represents a scenario different from the fuel-related accidents and is a potentially high-risk scenario.

SWEIS Scenario Description—The SWEIS analysis postulated the same scenario as the MIPP EIS. The consequences were based on the rupture of one irradiated target in the target grid assembly in the reactor core.

SWEIS Frequency—A feasibility study of MIPP estimates the frequency of this event at $1x10^{-4}$ to $1x10^{-6}$ per year (SNL 1995e).

SWEIS Source Term:

MAR—The release was based on the "Total Inventory" column of Table 2 of Attachment 2 to the April 13, 1998, memo from T. R. Schmidt to L. S. Bayliss (Schmidt 1998). These target inventories were used rather than the MIPP EIS releases to allow the SWEIS analysis to use consistent assumptions for existing or known mitigative features.

Release Assumptions—Fission products from the ruptured target were assumed to be released into the reactor pool (with consideration for the appropriate release fraction). An elevated release through the stack was assumed. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AM-5 Fuel Handling Accident—One Irradiated Fuel Element Ruptures

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.3 of the MIPP EIS (DOE 1996b). The MIPP EIS states that fuel-handling accidents were evaluated and not considered to have as great a risk as those chosen for analysis in the EIS. This appears to be based on the assumption that fuel handling will be performed under water until the fission products have decayed to where they are no longer a significant hazard.

SWEIS Screen—This scenario was analyzed for the SWEIS because it is a potentially high-consequence scenario. The accident was assumed to occur outside of the reactor pool, so there would be no pool influence.

SWEIS Scenario Description—The scenario under the SWEIS is that, while being transferred from the ACRR pool to the GIF pool, an irradiated fuel element is dropped, impacts a hard surface, and ruptures. Although plans are to transfer the fuel to the GIF pool under water, the analysis assumes that for some reason the transfer has to be made by lifting the element out of the ACRR pool and up through the air into the GIF pool. The facility operators indicated that fuel elements have been transferred this way in the past.

SWEIS Frequency—Based on the plans to normally transfer fuel under water, the high radiation level posed by such irradiated fuel if removed from the pool, and the large number of administrative controls that will have to be overridden, the frequency of this event was estimated to be extremely unlikely, $1x10^{-4}$ to $1x10^{-6}$ per year.

SWEIS Source Term:

MAR—The release was based on the fission product inventory of one irradiated fuel element. Table 3 of Attachment 2 to the April 13, 1998, memo from T. R. Schmidt to L. S. Bayliss (Schmidt 1998) provides the inventory of one fuel element for worst-case power history immediately after shutdown. Fuel elements will be allowed to decay prior to transfer, resulting in lower fission product inventories. The inventories in Table 3 were used for the SWEIS source term because data are not available for decayed elements and it is uncertain how long the elements will be allowed to decay. This assumption results in higher consequences than if a decay period was accounted for in the source term.

Release Assumptions—Fission products from the ruptured element were assumed to be released directly into the reactor building (with consideration for the appropriate release fraction). An elevated release through the stack was assumed. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AM-6 Airplane Crash and Fire in Reactor Room with Unirradiated Fuel and Targets Present

Source Scenario Description—An airplane crash was considered in the MIPP EIS (DOE 1996b), but only its impact on the core was evaluated. There was no consideration of the potential impact of an airplane crash on material that might be on the operating floor.

SWEIS Screen—This scenario was analyzed for the SWEIS because it represents a different type of accident than those that have been postulated. In addition, there would be no pool influence because the release would occur outside the reactor pool.

SWEIS Scenario Description—The scenario postulates an airplane crash into the reactor building while the reactor is shut down in preparation for refueling. New fuel elements would be present in the reactor room awaiting insertion into the core. In addition, fresh targets would also be present awaiting insertion after refueling. The airplane would penetrate the building and cause a large fire in the reactor room.

SWEIS Frequency—The airplane crash frequency for TA-V was updated for the SWEIS. It was calculated to be $6.3x10^{-6}$ per year. This frequency was used for this scenario, recognizing that this is an overestimate because it does not account for the limited amount of time that new fuel and fresh targets would be present on the operating floor.

SWEIS Source Term:

MAR—The MIPP EIS projects 57 spent fuel elements would require replacement per year. Assuming one refueling per year, 57 fresh fuel elements could be present on the operating floor just prior to refueling. In addition, it was assumed that two fresh target loads would also be present on the operating floor. This is based on two loads of 19 targets each, which would be the initial target configuration. This is a conservative, bounding assumption, because it is unlikely that two loads would be present on the operating floor. Two loads of the initial design load of 19 targets also bounds one load at the higher load size of 38 targets. The MAR equals 22.37 kg of uranium-235 (57 fuel elements x 380 *g* of uranium-235 per fuel element + 38 targets x 18.6 *g* of uranium-235 per target) (Schmidt 1998). The dose contribution from the uranium-238 in the fuel elements is less than 1 percent, based on a comparison of relative amounts, their specific activity, and dose conversion factors.

Release Assumptions—The release was assumed to be a ground-level release because the airplane crash was assumed to breach the reactor building. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AM-7 Target Rupture During Transfer from ACRR to HCF

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.4 of the MIPP EIS (DOE 1996b). A target rupture would occur in transit between the ACRR and the HCF as a result of an unspecified incident involving the transport equipment or operation.

SWEIS Screen—This scenario was analyzed in the SWEIS because it is the worst-case scenario involving an irradiated target and is a potentially high-consequence scenario.

SWEIS Scenario Description—The same scenario was postulated for the SWEIS.

SWEIS Frequency—The MIPP EIS estimates this frequency to be beyond extremely unlikely, less than 1×10^{-6} per year. The targets are transported in a cask designed to protect the target in the event of most potential transport accidents. The SWEIS assumes a frequency at the high end of the estimate, 1×10^{-6} per year.

SWEIS Source Term:

MAR—The source term is the fission product inventory listed in Table 5–24 of the MIPP EIS. The MIPP EIS data were used directly for this scenario because neither the MIPP EIS nor the SWEIS assumes any mitigation.

Release Assumptions—The Table 5–24 inventory was assumed to be released directly into the atmosphere, because this scenario can occur between the reactor building and the HCF. The release was assumed to be a ground-level release. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

HCF—Medical Isotopes Production Configuration (HM Scenarios)

HM-1 Operator Error During Molybdenum-99 Target Processing

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.5 of the MIPP EIS (DOE 1996b). An operator could inadvertently open the wrong valve or open the correct valve at the wrong time. Mechanical failures of valves or transfer lines could occur, releasing the waste gases from the decay tank (cold trap). The loss of fission products would be inside the hot cells and most of the fission products would be contained on the charcoal or high-efficiency particulate air (HEPA) filters. Noble gases, however, would be vented to the HCF stack. It was assumed that the targets were irradiated for 7 days at 20 kw of power and had cooled for 16 hours before the release. A total of 1,550 Ci of noble gases would be released; their proportions were assigned based on the above power rating of the targets. The estimated release is shown in Table 5–26 of the MIPP EIS.

SWEIS Screen—This scenario was analyzed in the SWEIS because it is the highest risk scenario in the MIPP EIS.

SWEIS Scenario Description—The same scenario was postulated for the SWEIS.

SWEIS Frequency—The MIPP EIS estimated a frequency of 1.0×10^{-2} to 1.0×10^{-1} per year. The SWEIS used this estimate, recognizing that the frequency would likely be lowered as design development continues, especially if this event is identified as having a high risk. Design features or operational controls could be added to reduce the frequency of this scenario.

SWEIS Source Term:

MAR—The content of the decay cold trap would be available for release. The gas that would be released is given in Table 5–26 of the MIPP EIS.

Release Assumptions—The gas inventories in Table 5–26 were assumed to be released as an elevated stack release. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

HM-2 Operator Error During Iodine-125 Target Processing

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.5 of the MIPP EIS (DOE 1996b). This scenario is similar to HM-1, but would occur while iodine-125 targets, rather than molybdenum-99 targets, are being processed. This scenario was assumed to occur 72 hours after irradiation. Cold trap valves would be left open when the gas is being transferred between decay storage tanks. The estimated release would consist of 31 Ci of xenon-125. The MIPP EIS assumes that other radionuclides (such as iodine-125) would be present, but filters would capture all the halogens. The dose would be dominated by the xenon-125.

SWEIS Screen—This scenario was analyzed in the SWEIS because it was the highest consequence scenario in the MIPP EIS.

SWEIS Scenario Description—The same scenario was postulated for the SWEIS.

SWEIS Frequency—The MIPP EIS estimated a frequency of 1.0 x 10^{-2} to 1.0 x 10^{-1} per year, which was used for the SWEIS. This is essentially the same event as HM-1, but the frequency is an order of magnitude less because iodine-125 targets would be processed much less frequently than molybdenum-99 targets.

SWEIS Source Term:

MAR—The MAR is the content of the decay tank (cold trap). The MIPP EIS determined that the 31 Ci of xenon-125 in the tank would dominate the dose calculations. The SWEIS analysis used this inventory.

Release Assumptions—The gas inventory of 31 Ci of xenon-125 was assumed to be released as an elevated stack release. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

HM-3 Airplane Crash, Penetrates Building into HCF Basement

Source Scenario Description—This scenario is discussed in paragraph 5.15.1.5 of the MIPP EIS (DOE 1996b). The MIPP EIS qualitatively concludes that the probability of an airplane crash into the HCF, as well as the potential dose, would be much smaller than the probability and consequences from an operator error scenario (HM-1 or HM-2).

SWEIS Screen—This scenario was not analyzed for the SWEIS. Its consequences and risks would be less than other HCF scenarios.

HM-4 Fire in Steel Containment Box Used for Processing Targets

Source Scenario Description—The MIPP EIS (DOE 1996b) states that a fire was considered but not analyzed because the potential dose was much smaller than the consequences from the HM-1 and HM-2 scenarios.

SWEIS Screen—This scenario was analyzed for the SWEIS because it would result in higher consequences than the other scenarios for target processing that were taken from the MIPP EIS.

SWEIS Scenario Description—Lacking design and operational details, a bounding scenario was postulated for the SWEIS. It was assumed that a large fire in the steel containment box would result in the release of the gases in the decay tank (cold trap), as in scenario HM-1, plus the fission products from one irradiated target being processed.

SWEIS Frequency—Based on the frequency of occurrence of similar fire accident scenarios postulated in the existing HCF SAR, this scenario was estimated to be unlikely (frequency of 1x10^{-2} to 1x10^{-4} per year).

SWEIS Source Term:

MAR—The release from one target is based on the "Total Inventory" column of Table 2 of Attachment 2 to the April 13, 1998, memo from T. R. Schmidt to L. S. Bayliss (Schmidt 1998). The inventory of gases in the cold trap is given in the MIPP EIS, Table 5–26.

Release Assumptions—The release would be the sum of the cold trap gases and the fission products released from the target and was assumed to be an elevated stack release. The cold trap gas inventories were taken directly from Table 5–26. The target release was assumed to be the fission product inventories from Table 2, accounting for the appropriate release fraction. The fission products from the target were assumed to be released without mitigation. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

HCF (HC Scenario)

HC-1 Earthquake - Building Collapse

Source Scenario Description—The HCF SAR (SNL/NM 1995e) discusses seismic analyses that show that earthquakes up to the UBC-level in magnitude (0.22 *g*) are not expected to cause any major damage to the facility. The SAR indicates the event would pose no radiological or toxicological consequences to workers or the public. However, a recent study (Paragon 1997 and 1998) found that the HCF would fail the 0.22 *g* earthquake.

SWEIS Screen—Section F.7 discusses earthquake frequencies and facility responses for TA-V. A UBC-level earthquake (0.22 *g*) with a frequency of 7x10^{-4}

per year could result in collapse of the HCF building. This scenario was analyzed for the SWEIS because it is a high-risk scenario.

SWEIS Scenario Description—A large earthquake (0.22 *g*) occurs at TA-V, causing significant damage to the HCF building. The collapse causes multiple effects on radioactive material in the facility. The gases in the cold trap from processing medical isotopes production targets are postulated to be released. A fire is postulated in the steel containment box where a target is being processed, resulting in the release of the fission products from that target. A fire is also postulated in Room 108, assuming the maximum inventory of fissionable material is being stored there in addition to waste material from medical isotopes production. These effects and the resultant releases are the same as the combination of Scenarios HM-4 and HS-2, above.

SWEIS Frequency—Section F.7 discusses earthquake frequencies and facility responses for TA-V. A UBC-level earthquake (0.22 *g*) with a frequency of $7x10^{-4}$ per year could result in collapse of the ACRR building.

SWEIS Source Term:

MAR—The MAR is the sum of the MAR in Scenarios HM-4 and HS-2, above.

Release Assumptions—The release assumptions were the same as for Scenarios HM-4 and HS-2, above, for the respective MAR. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

HCF—Room 108 Storage (HS Scenarios)

HS-1 Fire in Room 108 (SAR Scenario #3)

Source Scenario Description—This scenario is discussed in Section 3.4.2.1 of the HCF SAR (SNL/NM 1995e). A general combustible fire would be ignited by an event such as an electrical short, forklift incident, or other unspecified circumstance. Various radioactive materials ranging from fissile material to fission products in various forms are stored in Room 108. The inventory of such materials changes from time to time. Although the combustible loading in Room 108 is low on average, the nature of the radioactive material stored there limits the type of mitigating systems and actions. The limit on the maximum quantity of fissile material in Room 108 is 500 kg, with 350 kg allocated for the SPR. Table 3.4–11 of the HCF SAR shows the types and amounts of radioactive material typically stored in Room 108, both average and maximum estimates. The SAR analysis considered both average and maximum quantities, but the frequency of having the maximum material amount in the room was very low. The likelihood of a medium-size fire with maximum quantities present (Scenario #4) was, therefore, determined to be very low, less than $1x10^{-6}$. Scenario #3 is a medium-size fire with the average material quantities available. The total of the average quantities would be 13.5 kg (from Table 3.4–11). Scenario #3 is more likely than Scenario #4, but its consequences are lower. The consequence analysis in the SAR simplified the calculations by choosing plutonium-239 as the surrogate material representing all radionuclides present. This simplification eliminated the need to consider different materials with their different properties. With this assumption, the SAR analysis postulated 13.5 kg of plutonium-239 as the MAR for a fire.

SWEIS Screen—HCF SAR scenarios #3 and #4 were both analyzed for the SWEIS because they are potentially high-risk and high-consequence scenarios, respectively. The two scenarios are similar events: SAR Scenario #3 (SWEIS Scenario HS-1) is a medium-size fire with average material inventories, and SAR Scenario #4 (SWEIS Scenario HS-2) is a medium-size fire with maximum material inventories.

SWEIS Scenario Description— Although the mission of the HCF is changing with the conversion to medical isotopes production, SNL/NM indicated that Room 108 will continue to be used to store nuclear material related to the facility's previous mission, at least for a while. Additional radioactive materials related to the new mission may also be present in Room 108. While radioactive waste from the medical isotopes production process will be stored in barrels in Room 109 (adjacent to Room 108), Room 108 will be used to stage barrels prior to shipping. The same fire scenario analyzed in the SAR is postulated in the SWEIS, with the additional radioactive material from the isotopes production waste barrels that may be staged in Room 108.

Medical isotopes production waste (which includes fission products, uranium oxide, and contaminated equipment) will be managed in a solidified cement form in the barrels. Up to 180 barrels of waste in solidified cement may be stored in Room 109. In this form, however, the radioactive material is not susceptible to dispersal by fire. An accident scenario in Room 109, such as a large fire, is not, therefore, postulated for the SWEIS. The consequences of such an event are bounded by the postulated fire in Room 108, which contains nuclear material in a dispersible form.

SWEIS Frequency—The SAR frequency of $3.3x10^{-5}$ for Scenario #3 was used for the SWEIS.

SWEIS Source Term:

MAR— This scenario represents average material inventories, HS-2 represents maximum inventories. The historic material quantities for this scenario are given in the "average" column of Table 3.4–11 of the HCF SAR. TA-V management has indicated that existing nuclear material will continue to be stored in Room 108, at least for a while, in addition to using the room to stage waste from medical isotopes production (Schmidt 1998). The accident scenario from the HCF SAR would still apply during medical isotopes production, but the medical isotopes production waste must be considered in addition to the historical inventories in the SAR.

Up to eight barrels of medical isotopes production waste are estimated to be staged in Room 108. Each barrel could contain up to 1,200 Ci of mixed fission products in the form of solidified cement within vented stainless steel containers and up to 400 g of fully enriched uranium dioxide. While all the material will be in solidified cement and not susceptible to dispersal, some material (uranium oxide) is assumed to be available for dispersal to bound the accident consequences. For this average inventory scenario, half the barrels are postulated to be present with half the maximum content of radioactive material. This assumption results in a MAR of 800 g of enriched uranium dioxide for the medical isotopes production waste.

Release Assumptions—The release was based on applying the release fractions for plutonium and uranium exposed to a large fire to the inventories present. Table 3.4–11 of the HCF SAR describes the forms of plutonium and uranium present. Separate releases for plutonium and uranium were calculated and modeled. An elevated stack release was assumed. As discussed above, the uranium in the isotopes production waste was assumed to be in a dispersible form (that is, exposed metal) even though it is planned to be placed in solidified cement inside barrels. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

HS-2 Fire in Room 108 (SAR Scenario #4)

Source Scenario Description—This scenario, discussed above under the HS-1 scenario, is a larger consequence, lower frequency fire scenario than SAR Scenario #3 (SNL/NM 1995e).

SWEIS Screen—This scenario was analyzed for the SWEIS. See the discussion above for scenario HS-1.

SWEIS Scenario Description—The same scenario was postulated for the SWEIS. The material inventories in the SAR were supplemented by the staging nuclear material related to medical isotopes production (waste) in Room 108 (see the discussion below under MAR).

SWEIS Frequency—The frequency in the HCF SAR of $2.0x10^{-7}$ for Scenario #4 was used for the SWEIS.

SWEIS Source Term:

MAR—This scenario represents maximum material inventories. The maximum historic quantities are given in the "maximum" column of Table 3.4–11 of the HCF SAR. The maximum medical isotopes production waste quantity was added to this. As noted above under the discussion for Scenario HS-1, medical isotopes production waste is planned to be in solidified cement and not susceptible to dispersal. The addition of some of this waste to the MAR in a dispersible form is postulated to bound the consequences of the accident scenario. The maximum MAR from isotopes production waste for HS-2 was postulated to be the total uranium oxide inventory of eight barrels with each barrel containing the maximum inventory of 400 Ci per barrel. This results in a total of 3.2 kg of uranium oxide.

Release Assumptions—The release was based on applying the release fractions for plutonium and uranium exposed to a large fire to the inventories present. Table 3.4–11 of the HCF SAR describes the forms of plutonium and uranium present. Separate releases for plutonium and uranium were calculated and modeled. An elevated stack release was assumed. As discussed above, the uranium in the isotopes production waste was assumed to be in a dispersible form (that is exposed metal) even though it is planned to be placed in solidified cement inside barrels.

HS-3 Criticality in Room 108, 50 kg of Plutonium-239

Scenario Description—This scenario is discussed in Section 3.4.2.4 of the HCF SAR (SNL/NM 1995e). A violation of an administrative control related to fissile material quantity or storage configuration would cause an inadvertent criticality.

SWEIS Screen—This scenario was not analyzed for the SWEIS. Consequences to onsite workers and the public would be small (although the consequences to a worker in the immediate vicinity could be lethal). The frequency was estimated in the SAR to be very small (at least extremely unlikely, if not incredible). Other HCF accident scenarios bound the risk and consequences of this scenario outside the facility.

SPR Facility—SPR IIIM Reactor (S3M Scenarios)

S3M-1 Fire in the Reactor Building

Source Scenario Description—This scenario is discussed in Section 15.3.1 of the SPR Facility SAR (SNL/NM 1995v). The amount of combustible materials in the reactor building has been purposely minimized, but three general sources of fires could be identified: 1) combustion of the reactor fuel itself; 2) a hazardous experiment, perhaps involving flammable materials; and 3) typical fire sources not specifically related to the reactor, such as electrical shorts, spontaneous combustion, and others. Based on bounding assumptions, the worst-case effects of a fire would be a breach of the filter system, a release to the environment of 15 g of (respirable) uranium, and a release to the environment of all fission products from an approximate $0.25 superprompt critical pulse that would melt approximately 10 percent of the core fuel (the melt would contain approximately 1.8×10^{17} fissions).

SWEIS Screen—This scenario was not analyzed for the SWEIS because its consequences and risk are both bounded by the following scenario, S3M-2.

S3M-2 Control Element Misadjustment Before Pulse-Element Insertion

Source Scenario Description—This scenario is discussed in Section 15.4.2 of the SPR Facility SAR (SNL/NM 1995v). Control element positions are set for each operation to produce the desired pulse size. The adjustment process requires the operators to calculate the desired control element positions and then place the elements in these positions from the control room. Control element misadjustment before pulse element insertion could result in a larger than anticipated superprompt critical pulse. The estimated upper limit total worth insertion of approximately

> **Unit of Reactivity – The Dollar ($)**
>
> When a reactor is operational, it can be critical in either of two states: critical with delayed neutrons or critical with prompt neutrons. The amount of reactivity in the core when the core becomes critical with prompt neutrons is defined as a dollar's worth of reactivity. When a reactor is "prompt critical," very small changes in the amount of reactivity in the core can create very large, sudden, and rapid changes in reactor "power."

$1.40 would result in the nearly complete destruction of the core and subsequent release of an abnormal amount of fission products to the reactor room and to the environment. The result of a $1.40 insertion event, discussed in Section 15.3.2 of the SPR Facility SAR, would be an unplanned superprompt critical pulse with a fission yield of approximately 4.1×10^{18}. The analysis assumes that all the fission products from the 4.1×10^{18} fissions would be released to the reactor building from the reactor fuel. The 100 percent release from the fuel and then out the building is very conservative. While the analysis did not include the contribution from the uranium-235 in the core, conservative assumptions for the fission products released from the melt region are sufficient to encompass any added downwind dose from the uranium.

SWEIS Screen—This scenario was analyzed for the SWEIS because it was a high-risk scenario.

SWEIS Scenario Description—The scenario in the SPR Facility SAR is for the SPR III reactor. The same scenario was postulated for the SWEIS for the SPR IIIM reactor.

SWEIS Frequency—Based on the discussion in the SAR, the frequency of this scenario was estimated to be extremely unlikely (1×10^{-4} to 1×10^{-6} per year).

SWEIS Source Term:

MAR—This scenario assumes that the worst case would be vaporization of the entire core. The MAR would be the uranium in the core plus any fission products present at the time of the accident. The SAR analysis only included the release of fission products, noting that the contribution of the uranium in the core to the consequence calculations would be small. The SWEIS analysis included the contribution from the uranium in the core, although this resulted in a small contribution to the consequences.

The SAR indicates that with worst-case assumptions, this accident scenario could result in a 4.1×10^{18} fission pulse (for the SPR III reactor). Fission product data for this size pulse were not available. Table 11–1 of the SPR SAR, however, presents fission product data for a 3×10^{17} fission pulse after an operating history that is equivalent to infinite operation at the highest expected operating power level. Inspection of the data indicates that the pulse would add little to the fission products that would build up over the assumed long-term operation. The inventories of several short-lived isotopes would be substantially greater, but these would decay quickly and the incremental inventories would not contribute much to the resultant dose. Therefore, the difference between imposing a 4.1×10^{18} pulse rather than a 3×10^{17} pulse on the core with this assumed operating history would be negligible.

The data from SPR SAR Table 11–1 were used to develop the fission product MAR for this scenario. To account for the larger SPR IIIM core, it was assumed the number of fissions and resultant fission product inventories would be greater by a direct ratio of core masses. This is a reasonable estimate because the SPR IIIM core would have the same composition as the SPR III core. The total mass of the SPR IIIM core is 295 kg (Kaczor 1998); the total mass of the SPR III core is 258 kg (SAR). The SPR SAR Table 11–1 data were scaled up for SPR IIIM by a factor of 295/258=1.1434.

To determine the contribution of the uranium in the SPR IIIM core, the mass of uranium-235 must be determined. With a core composition of 90 percent uranium with an enrichment of 93 percent, the core would have 246.9 kg of uranium-235.

Release Assumptions—The releases would be based on appropriate release fractions for a melt scenario. The release calculation considers all the fission products and the uranium-235 present in the SPR IIIM core. Although the release would flow through the SPR Facility stack, a ground-level release was assumed because of the low stack height. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

S3M-3 Failure of a Fissionable Experiment

Scenario Description—This scenario is discussed in Section 15.4.3 of the SPR Facility SAR (SNL/NM 1995v). The so-called shock rod experiments are typical of the historic experiments involving fissionable material. These experiments involve the rapid heating of uranium or plutonium rods to excite the fundamental oscillation modes of the material. The tests are routinely carried to experiment failure, generally due to high-stress cracking at elevated temperature. The purpose of these experiments is to study basic properties of the material and its dynamic response. Plutonium experiments are required to incorporate two levels of containment; however, to encompass the worst case, the scenario assumes failure of all containment and the complete melt of 7,000 g of plutonium.

SWEIS Screen—This scenario was analyzed for the SWEIS because it is a high-consequence scenario.

SWEIS Scenario Description—This scenario was postulated for the SWEIS. The difference in reactors (SPR IIIM versus SPR III) would have no impact on this scenario because the experiment is independent of the reactor used.

SWEIS Frequency—Based on the discussion in the SAR, the frequency of this scenario was estimated to be extremely unlikely (1×10^{-4} to 1×10^{-6} per year).

SWEIS Source Term:

MAR—This scenario assumes that the worst case would be a complete melt of all the plutonium. The MAR would be the plutonium mass plus the fission products that are present in the plutonium from the pulse. The SAR indicates the pulse for this scenario would involve 5×10^{16} plutonium fissions, but the fission product data for this number of plutonium fissions are not available. Fission product data available for 1×10^{18} plutonium fissions (*Rocky Flats Risk Assessment Guide, 1985,* Table 4.3–1) were used for the SWEIS analysis (Rockwell International 1985). This resulted in conservatively high consequences.

Release Assumptions—The releases would be based on appropriate release fractions for a melt scenario. The release calculation would consider all the fission products and the plutonium-239. Although the release would flow through the SPR Facility stack, a ground-level release was assumed because of the low stack height. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

SPR Facility—Critical Assembly (SCA Scenario)

SCA-1 Anticipated Transient Without Scram Accident

Scenario Description—This scenario is discussed in Section 13.8 of the *Critical Assembly SAR* (SNL/NM 1995c). "Anticipated Transients Without Scram" accidents are initiated by reactivity anomalies sufficient to challenge the automatic protection system and are exacerbated by total failure of this system. The worst-case consequences are caused by an unmitigated fast ramp reactivity insertion accident. The frequency of accident scenarios leading to the fast ramp rate regime is exceedingly small because of the number of independent hardware failures and operator errors required. The consequence analysis was based on an upper bound estimate of 8.6×10^{18} fissions.

SWEIS Screen—The Particle Bed Critical Assembly (PBCA) is currently not present at SNL/NM, and there are no plans to return it. TA-V management did indicate that it is possible for the assembly to be returned in the future and operated at the SPR Facility. This accident scenario, which is the highest consequence scenario for the PBCA, yields an upper bound estimate of 8.6×10^{18} fissions, slightly greater than the yield from the SPR IIIM reactor in scenario S3M-2. These two scenarios are estimated to be in the same frequency bin (1×10^{-4} to 1×10^{-6} per year), but the PBCA scenario is less likely than scenario S3M-2. The conservative assumptions in developing the SCA scenario are discussed in the *Critical Assembly SAR*. Considering that the PBCA will be operated much less frequently than SPR IIIM, if at all, the risk of scenario S3M-2 was considered greater than the risk of scenario SCA-1. Scenario S3M-3 represents the highest consequence scenario for SPR Facility operations. Scenario SCA-1, therefore, is considered bounded by scenarios S3M-2 and S3M-3 and was not analyzed for the SWEIS.

SPR Facility—Storage (SS Scenario)

SS-1 Airplane Crash into North Vault (NOVA) Storage Vault

Source Scenario Description—This scenario was not postulated in the SPR Facility SAR (SNL/NM 1995v). SNL/NM TA-V personnel indicated that this vault is now used infrequently (Schmidt 1998).

SWEIS Screen—This scenario was analyzed in the SWEIS because it is a potentially high-consequence scenario.

SWEIS Scenario Description—The SWEIS analysis postulated an airplane crash into the vault, causing a large fire that releases stored radioactive material. An experiment containing plutonium-239, similar to the experiment used in scenario S3M-3 and representative of other plutonium components tested at TA-V, was assumed to be stored in the NOVA.

The SPR Facility has other vaults within the primary facility structure that are used more frequently for storing radioactive material. The structure's thick concrete walls offer protection from an airplane crash. The NOVA vault also offers some protection, but its walls are not as robust structurally as the main building. An airplane crash into the NOVA vault would have a greater impact on the vault's contents than a crash into the building structure in the vicinity of one of the other vaults.

SWEIS Frequency—The frequency of an airplane crash at the SPR Facility was calculated for the SWEIS to be 6.3×10^{-6} per year (Appendix F.4). This will be used for the scenario frequency, even though the scenario frequency will be somewhat lower because a plutonium experiment is not always stored in the vault. Discussions with TA-V personnel, however, indicated that some experiments have in the past been kept in storage onsite for long periods of time (TtNUS 1998k). The scenario frequency will also be lower because 6.3×10^{-6} per year represents a crash anywhere into the SPR Facility. The frequency of a crash directly into the North Vault will be less because the vault is a fraction of the overall facility profile (that is, it is a smaller target than the entire facility).

SWEIS Source Term:

MAR—The MAR for this scenario is 7 kg of plutonium-239. While more material could be present at times, the likelihood of an airplane crash during these short periods of time would be extremely low. The one plutonium experiment is a reasonable assumption for the MAR.

Release Assumptions—The releases would be based on appropriate release fractions for a large fire scenario. A ground-level release is assumed because the crash would open the vault to atmosphere. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

SPR Facility (SP Scenario)

SP-1 Earthquake - Building Collapse

Source Scenario Description—The SPR SAR (SNL/NM 1995v) dismisses seismic events due to the assumption that earthquakes up to the UBC-level in magnitude (0.22 *g*) are not expected to cause any major damage to the facility. The SAR indicates the event would pose no radiological consequences to workers or the public.

SWEIS Screen—Section F.7 discusses earthquake frequencies and facility responses for TA-V. A UBC-level earthquake (0.22 *g*) with a frequency of $7x10^{-4}$ per year could result in collapse of the SPR NOVA. The reactor building would remain intact. This scenario was analyzed for the SWEIS because it is a high-risk scenario.

SWEIS Scenario Description—A large earthquake (0.22 *g*) occurs at TA-V, causing collapse of the SPR NOVA. It is assumed that the building collapse causes a seismically induced fire within the NOVA. Scenario SS-1, which is a postulated airplane crash into the NOVA, could be used as a representative bounding release scenario for the vault fire.

SWEIS Frequency—Section F.7 discusses earthquake frequencies and facility responses for TA-V. A UBC-level earthquake (0.22 *g*) with a frequency of $7x10^{-4}$ per year could result in collapse of the SPR facility including the reactor building. However, the vault is not expected to be damaged or collapse due to this postulated seismic event.

SWEIS Source Term:

MAR—The MAR for this new postulated accident scenario is bounded by the source terms from Scenario SS-1. Since the SPR NOVA must be considered as a radiological contaminated building, dust and suspension of building particles would contribute only a minor source term.

Release Assumptions—The release assumptions were the same as for Scenario SS-1 (airplane crash into the NOVA). Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

SPR Facility—SPR IV Reactor (S4 Scenario)

S4-1 Control Element Misadjustment Before Pulse-Element Insertion

Scenario Description—This is the same scenario as S3M-2, except that the accident would occur during operation of the SPR IV reactor rather than the SPR IIIM reactor.

SWEIS Screen—This scenario was analyzed for the SWEIS because it is a high-risk scenario in the SAR.

SWEIS Scenario Description—The scenario analyzed in the SPR Facility SAR (SNL/NM 1995v) is for the SPR III reactor. The same scenario is postulated in the SWEIS for the SPR IV reactor.

SWEIS Frequency—Based on the discussion in the SPR Facility SAR, the frequency of this scenario was estimated to be extremely unlikely ($1x10^{-4}$ to $1x10^{-6}$ per year).

SWEIS Source Term:

MAR—The MAR was based on the same assumptions as Scenario S3M-2, except that material quantities and fission products would be scaled up for the larger SPR IV reactor core. The total core mass for SPR IV would be 550 kg (Schmidt 1998). With a core composition of 90 percent uranium with an enrichment of 93 percent, the core would have 460.35 kg of uranium-235. SAR fission product data would be scaled up by a factor of 550/258=2.1318.

Release Assumptions—The releases were based on applicable fractions for a melt scenario. Although the release would flow through the SPR Facility stack, a ground-level release was assumed because of the low stack height. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

ACRR-DP Configuration (AR Scenarios)

AR-1 Uncontrolled Addition of Reactivity (Insertion of $10.25)

Source Scenario Description—This scenario is discussed in Section 14.3.1 of the ACRR SAR (SNL/NM 1996d). A total reactivity worth of $10.25 is inserted into the core over a time frame of 80 milliseconds. This accident is assumed to occur without regard to some initiating event or failure of a reactivity control system or violation of prescribed procedures. The absolute magnitude of the reactivity change could be caused by the addition of reactivity from either the removal of negative reactivity (control rods, transient rods, or a negative worth experiment) or positive reactivity (positive worth experiment). In terms of operational capabilities, the reactivity would represent the total available in the transient bank coupled to an unplanned removal of a large negative worth experiment in the same time frame.

SWEIS Screen—This scenario was analyzed in the SWEIS because it is the highest consequence event in the ACRR SAR.

SWEIS Scenario Description—The same scenario was postulated for the SWEIS.

SWEIS Frequency—This scenario would require the occurrence of several events, some of which would negate inherent safety features. Based on the discussion in the ACRR SAR, the frequency of this scenario would be beyond extremely unlikely, or less than $1x10^{-6}$. A frequency of $1x10^{-6}$ was estimated for the SWEIS.

SWEIS Source Term:

MAR—Core fission product and actinide inventories at the time of the event, including consideration of the insertion, are provided in Tables 11A–1 and 11A–3 in the ACRR SAR (and are repeated in Tables 14A–2 and 14A–3). The SAR estimates that 2 percent of the core material would be available for release as "liquid" fuel.

Release Assumptions—The fission product inventory from 2 percent of the fuel would be released after considering appropriate release fractions. This scenario was assumed to be such an energetic event that the fission products would be driven up through the pool without the full decontamination that is assumed for other pool accidents. No pool decontamination was assumed. The release was assumed to be an elevated stack release. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AR-2 Waterlogged Fuel Element Ruptures

Source Scenario Description—This scenario is discussed in Section 14.4.8 of the ACRR SAR (SNL/NM 1996d). This event would be initiated by failure of a single waterlogged fuel element during a pulse from low initial power and subsequent damage to adjacent elements. The pulse would be assumed to occur when the maximum fission product inventories have built up in the core. Adjacent elements would be assumed to be damaged by the rupture of the waterlogged element. The analysis assumes failure of a total of four fuel elements, with ejection of the fuel from all four elements into the pool water.

SWEIS Screen—This scenario was analyzed for the SWEIS because it represents a potentially high-risk scenario. Although the release for this scenario would be less than the releases for other scenarios, its risk could be greater because of its higher frequency.

SWEIS Scenario Description—The same scenario was postulated for the SWEIS.

SWEIS Frequency—Based on the discussion in the ACRR SAR and the ACRR's operating history, the frequency of this scenario was estimated to be $1x10^{-1}$ to $1x10^{-2}$ per year (that is, once every 10 to 100 years). The SAR characterizes the potential for waterlogged fuel elements as "likely," but states that the presence of leaking fuel elements would be identified by an increase in the radioactivity in the reactor coolant. The cause of the increased radioactivity would be investigated and corrected, most likely prior to the heat-up and cool-down cycles that are needed to fill the fuel element void space and cause the cladding to burst during a pulse. In addition, the SAR discusses operating history data for small research reactors like the ACRR. A few leaking fuel elements have been observed, but they are rare, and there have been no incidents of explosive failures. The ACRR has operated for over 30 years with no leaking fuel elements.

SWEIS Source Term:

MAR—The fission product inventories would be based on the conservative, long-term operating history described in Chapter 11 of the ACRR SAR. The applicable fission product inventories would be the prepulse numbers in Tables 11A–1 and 11A–3 (repeated in Tables 14A–2 and 14A–3 of the ACRR SAR). This accident could occur during steady-state or pulse operations. If it were to occur during a normal pulse imposed on the inventories from the assumed operating history, inventories slightly higher than the prepulse inventories would be present. The data for an incremental increase due to a normal pulse are not available, but it is evident from the referenced tables that a pulse would not increase the fission product inventories of interest by very much. The conservatism in the assumed operating history more than compensates for a slight increase that a pulse would cause, and the prepulse inventories would be adequate for this analysis. The SAR estimates the upper bound of fission product inventory released by this event to be 2.3 percent of total core inventory. This estimate was used for the SWEIS analysis.

Release Assumptions—The fission products from 2.3 percent of the fuel were assumed to be released into the pool with consideration for the appropriate release fraction. The release from the reactor building was assumed to be an elevated stack release. Table F.2–18 summarizes the source-term release characteristics (that is release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AR-3 Failure of Experiment Containing ACRR Fuel Pins

Scenario Description—This scenario is discussed in Section 14.4.10.4 of the ACRR SAR (SNL/NM 1996d). The experiment would comprise fresh ACRR fuel pins (uranium dioxide at 20 percent enrichment) with fission products from the ACRR pulse experiment only. The test fuel pins would rupture during a pulse that deposits a total energy of 3 MW-seconds.

SWEIS Screen—This scenario was not analyzed for the SWEIS because its consequences and risk are bounded by other scenarios. In addition, future experiments involving reactor fuel would not be likely, given the new mission for the ACRR and the limited scope of any pulse-mode operations.

AR-4 Fire in Reactor Room with Experiment Present

Source Scenario Description—This scenario is discussed in Section 14.4.11.1 of the ACRR SAR (SNL/NM 1996d). This scenario is postulated in the SAR, but it is not analyzed quantitatively. The SAR stated that fissionable material in an experiment could be affected by a fire, and small quantities of uranium oxide and other contaminants could be released into the local atmosphere. The SAR states that the consequences would not exceed those calculated for the limiting event.

SWEIS Screen—This scenario was analyzed for the SWEIS because it is a potentially high-consequence and high-risk scenario.

SWEIS Scenario Description—To bound the potential consequences of this type of scenario, the SWEIS conservatively assumed a large fire in the reactor room without specific analysis of combustible loading and ignition sources. Also, to bound the potential consequences, an experiment containing plutonium was assumed to be present in the reactor room.

SWEIS Frequency—The frequency is based on a Category II frequency bin (unlikely) for a large fire in the reactor room. The scenario frequency was assumed to be one lower category to account for the limited amount of time a plutonium experiment would be present in the reactor room when the fire occurs. This results in a Category III frequency bin estimate (extremely unlikely) for this scenario ($1x10^{-4}$ to $1x10^{-6}$ per year).

SWEIS Source Term:

MAR—The ACRR SAR does not quantify the MAR or the release from this scenario. Scenario S3M-3 indicates 7 kg of plutonium-239 could be present in an experiment in the SPR Facility. Assuming that a similar experiment could be present in the ACRR, the MAR for this scenario would be 7 kg of plutonium-239.

Release Assumptions—The release was based on the release fraction for a plutonium component in a large fire. The release from the reactor building was assumed to be an elevated stack release. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AR-5 Earthquake - Collapse of Bridge Crane

Source Scenario Description—The ACRR SAR (SNL/NM 1996d) evaluates the collapse of the bridge crane; however, such an event was not expected to cause any major damage to the facility. The SAR indicated that such an event would pose no radiological consequences to workers or the public.

SWEIS Screen—As discussed under the SWEIS frequency paragraph below, recent site-specific data indicate the frequency of an earthquake large enough to cause collapse of the bridge crane is approximately $7x10^{-4}$ per year. This is higher than the frequency of less than $1x10^{-6}$ per year that was previously estimated in Massey, et al. (SNL 1995e). This scenario was analyzed for the SWEIS using the recent frequency data. At this frequency, this scenario is a high-risk scenario.

SWEIS Scenario Description—A large earthquake occurs at TA-V (0.22 *g*), causing ACRR building damage that results in collapse of the bridge crane. The bridge crane falls into the reactor pool, impacts the reactor superstructure, and results in the rupture of 10 percent of the core or 24 fuel elements in the reactor core. Other than the initiating event, this scenario is the same as the airplane crash, Scenario AM-1. No additional releases are postulated because the reactor is located at the bottom of the pool and protected from other debris that may result from failure of the building structure.

SWEIS Frequency—Section F.7 discusses earthquake frequencies and facility responses for TA-V. A UBC-level earthquake (0.22 *g*) with a frequency of $7x10^{-4}$ per year, could result in collapse of the ACRR facility. This scenario will be analyzed for the SWEIS because it is a high-risk scenario.

SWEIS Source Term:

MAR— The fission product inventories would be based on the conservative, long-term operating history described in Chapter 11 of the ACRR SAR. The applicable fission product inventories would be the prepulse numbers in Tables 11A–1 and 11A–3 (repeated in Tables 14A–2 and 14A–3). The SAR estimates the upper bound of fission product inventory released by this event to be 10 percent of total core inventory. This estimate was used for the SWEIS analysis.

Release Assumptions—The release assumptions were the same as for Scenario AR-6. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

AR-6 Airplane Crash—Collapse of Bridge Crane

Scenario Description—This scenario is discussed in Section 14.4.11.4 of the ACRR SAR (SNL/NM 1996d). The SAR discusses the probability of an aircraft crash into the reactor building, but does not evaluate the potential consequences.

SWEIS Screen—This scenario was analyzed in the SWEIS because it is a potentially high-risk scenario.

SWEIS Scenario Description—In order to bound the consequences of an airplane crash, the MIPP EIS (DOE 1996b) assumed the crash would knock the bridge crane off its rails onto the reactor superstructure. This would be the same scenario as AR-5, except for a different initiating event. The SWEIS analysis postulated an airplane crash would cause collapse of the bridge crane, which would be assumed to fall directly on to the reactor superstructure and damage 24 fuel elements (approximately 10 percent of the core).

SWEIS Frequency—The airplane crash frequency for TA-V was updated for the SWEIS. It was calculated to be $6.3x10^{-6}$ per year (Section F.4). The SWEIS used this frequency for the scenario frequency, although it is recognized that the frequency would be lower because the bridge crane would seldom be over the reactor. However, this scenario is assumed to bound the effect an airplane crash into the ACRR building could have on the reactor core.

SWEIS Source Term:

MAR—The fission product inventories would be based on the conservative, long-term operating history described in Chapter 11 of the ACRR SAR. The applicable fission product inventories would be the prepulse numbers in Tables 11A–1 and 11A–3 (repeated in Tables 14A–2 and 14A–3 of the ACRR SAR). The SAR estimates the upper bound of fission product inventory released by this event to be 10 percent of total core inventory. This estimate was used for the SWEIS analysis.

Release Assumptions—The fission products from 10 percent of the fuel were assumed to be released into the pool with consideration for the appropriate release fraction. The airplane crash was assumed to breach the reactor building, resulting in a ground-level release. Table F.2–18 summarizes the source-term release characteristics (such as release height and buoyancy considerations) and the values for the source-term factors used in the determination of the source terms from this postulated accident scenario.

F.2.7.4 Consequence Analysis Modeling Characteristics and Parameters

Table F.2–18 provides a summary of the scenario-specific modeling characteristics and parameters for the scenarios described in the previous sections. These characteristics and parameters were used in the consequence analyses by incorporation into the *MACCS2* input files.

F.2.7.5 Technical Area-V Results

Results from the *MACCS2* runs have been used to provide consequence estimates for TA-V for each of the accident scenarios. Three sets of results tables are presented for each alternative containing accident consequences for each accident scenario. Table F.2–19 provides the consequence estimates for the MEI and the maximally exposed noninvolved worker for each scenario. A distance of 100 m from the release point was used to estimate the dose to noninvolved workers. Table F.2–20 provides consequence estimates for the 50-mi population. Table F.2–21 provides consequence estimates for the core receptor locations.

Of all the credible (having a frequency >10^{-6} per year) accidents for TA-V, accident AR-4 yields the largest dose to the MEI and the largest dose to the population within 50 mi. This accident involves the ACRR and applies in the No Action and Expanded Operations Alternatives only. Those doses (0.002 rem and 18 person-rem) are about the same as those from accident S3M-3 (0.0017 rem and 16 person-rem). The latter applies to all three alternatives.

Those accidents have a probability of 10^{-4} to 10^{-6} per year, and could produce about 0.009 excess latent cancer fatalities in the surrounding populations, were they to occur. The MEI for those accidents is located at the Golf Course and has only a $1x10^{-6}$ chance of a latent fatal cancer resulting from the accident.

F.2.8 Manzano Waste Storage Facilities

The Manzano Waste Storage Facilities are located in the Manzano Area southeast of TA-I. Four structures, each a one-story bunker made of concrete and covered with dirt, are designated as nuclear facilities. These bunkers are authorized to store nuclear waste in the form of low-level mixed waste (LLMW), low-level waste (LLW), and transuranic (TRU) waste. Storage of surplus special nuclear material is also authorized. Quantities are controlled to limit the amount of nuclear material in each bunker to Hazard Category 3 limits (that is, less than Hazard Category 2 thresholds), as defined by DOE-STD-1027-92 (DOE 1992c).

A SAR documents the safety basis for these facilities (SNL/NM 1997q). An HA identifies the hazards and develops potential accident scenarios. A major finding of the HA is that the accident scenarios that pose the greatest risk are fire-related, especially vehicle and forklift-initiated fire events. Based on this finding, the SAR concludes that the limiting accident scenario is a vehicle fire occurring while packages are being transported into, out of, or around the Manzano Area. The frequency of this accident scenario was estimated to be in the range of $1x10^{-4}$ to $1x10^{-2}$ per year.

The fire event discussed in the SAR is assumed to be initiated by a vehicle malfunction or fuel leak. The waste package is assumed to be fully involved in the fire. The SAR analysis assumes, for bounding purposes, that the maximum activity authorized to be stored in one bunker, represented by plutonium-239, is in the waste package and is involved in the fire. Typical package shipments contain much lower quantities and materials other than plutonium.

The radioactive source term from the accident was determined using the standard source-term equation, which is given in Eq. F.2–1 of this Appendix. The following parameter values were used in the SWEIS analysis:

- MAR = 900 grams (55.2 Ci) of plutonium-239
- DR = 1.0
- ARF = $5x10^{-4}$
- RF = 1.0
- LPF = 1.0

Tables F.2–22 through F.2–24 present the results of modeling this accident using the *MACCS2* computer code. The population distribution surrounding the release point is shown in Table F.2–3, while the distance and direction to core receptors and the KAFB boundary are given in Tables F.2–4 and F.2–5.

Although the doses to the MEI (at the Riding Stables) and the 50-mi population are lower, because of the higher frequency of MZ-1, it poses a greater risk to the public than AR-4 and S3M-3 (Section F.2.7.5).

The consequences of this accident will not differ noticeably for the three alternatives because the accident release is based on the authorized quantity and not estimated quantity. SNL/NM has indicated that the quantity of material stored for the Reduced Operations Alternative would decrease by 50 percent from the No Action Alternative, and increase by 30 percent for the Expanded Operations Alternative (SNL/NM 1998a). The maximum authorized quantities would not change due to these variations. However, the frequency of the accident scenario might change due to more shipments or fewer shipments, but such variation would not change the range of the estimated frequency. The consequences of this accident are, therefore, assumed to be the same for all three alternatives.

Table F.2–19. Technical Area-V Radiological Accident Frequencies and Consequences to Maximally Exposed Individual and Noninvolved Worker

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Maximally Exposed Individual		Noninvolved Worker	
				Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
AM-1	Airplane crash - collapse of bridge crane	6.3×10^{-6}	All	4.8×10^{-4}	2.4×10^{-7}	1.9×10^{-1}	7.4×10^{-5}
AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	All	1.1×10^{-4}	5.4×10^{-8}	9.6×10^{-3}	3.8×10^{-6}
AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	All	8.5×10^{-5}	4.3×10^{-8}	7.5×10^{-3}	3.0×10^{-6}
AM-5	Fuel handling accident - irradiated element	1.0×10^{-4} to 1.0×10^{-6}	All	1.2×10^{-3}	6.1×10^{-7}	1.9×10^{-1}	7.6×10^{-5}
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	All	2.1×10^{-7}	1.0×10^{-10}	1.2×10^{-4}	4.9×10^{-8}
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0 \times 10^{-6}$	All	9.7×10^{-5}	4.9×10^{-8}	3.4×10^{-2}	1.4×10^{-5}
HM-1	Operator error - molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	6.5×10^{-6}	3.3×10^{-9}	4.0×10^{-4}	1.6×10^{-7}
HM-2	Operator error - iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	2.1×10^{-7}	1.0×10^{-10}	1.0×10^{-5}	4.2×10^{-9}
HM-4	Fire in steel containment box	1.0×10^{-2} to 1.0×10^{-4}	All	4.8×10^{-4}	2.4×10^{-7}	5.7×10^{-3}	2.3×10^{-6}
HS-1	Fire in room 108, average inventories	3.3×10^{-5}	All	3.6×10^{-4}	1.8×10^{-7}	5.0×10^{-4}	2.0×10^{-7}

Table F.2–19. Technical Area-V Radiological Accident Frequencies and Consequences to MEI and Noninvolved Worker (concluded)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Maximally Exposed Individual		Noninvolved Worker	
				Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
HS-2	Fire in room 108, maximum inventories	2.0×10^{-7}	All	1.3×10^{-2}	6.6×10^{-6}	1.8×10^{-2}	7.4×10^{-6}
S3M-2	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	All	2.9×10^{-4}	1.5×10^{-7}	6.3×10^{-1}	2.5×10^{-4}
S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	All	1.7×10^{-3}	8.4×10^{-7}	4.8	3.8×10^{-3}
SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	All	1.2×10^{-3}	5.8×10^{-7}	6.9×10^{-1}	5.5×10^{-4}
S4-1	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	E	5.5×10^{-4}	2.7×10^{-7}	1.2	4.7×10^{-4}
AR-1	Uncontrolled addition of reactivity	$<1.0 \times 10^{-6}$	N, E	1.9×10^{-3}	9.3×10^{-7}	2.9×10^{-1}	1.2×10^{-4}
AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	N, E	3.5×10^{-4}	1.7×10^{-7}	3.0×10^{-2}	1.2×10^{-5}
AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	N, E	2.0×10^{-3}	1.0×10^{-6}	3.4×10^{-1}	1.4×10^{-4}
AR-6	Airplane crash - collapse of bridge crane	6.3×10^{-6}	N, E	1.7×10^{-3}	8.4×10^{-7}	5.6×10^{-1}	2.2×10^{-4}

Source: Original
TA: technical area
[a] Technical Area-V Facility Accident Descriptors:
Annular Core Research Reactor: DP Configuration: AR-1, AR-2, AR-4, AR-6
Annular Core Research Reactor: Medical Isotopes Production Configuration: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell: Medical Isotopes Production Configuration: HM-1, HM-2, HM-4
Hot Cell: Room 108 Storage: HS-1, HS-2
Sandia Pulsed Reactor: S3M-2, S3M-3, SS-1, S4-1

[b] Applicable Alternative:
All–Scenarios applicable to all three alternatives
N–Scenario applicable to No Action Alternative
E–Scenario is applicable to Expanded Operations Alternative

Table F.2–20. Technical Area-V Radiological Accident Frequencies and Consequences to 50-Mile Population

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (person-rem)	Additional Latent Cancer Fatality
AM-1	Airplane crash - collapse of bridge crane	$6.3\text{x}10^{-6}$	All	3.9	$2.0\text{x}10^{-3}$
AM-3	Rupture of waterlogged fuel element	$1.0\text{x}10^{-2}$ to $1.0\text{x}10^{-4}$	All	$9.8\text{x}10^{-1}$	$4.9\text{x}10^{-4}$
AM-4	Rupture of one molybdenum-99 target	$1.0\text{x}10^{-4}$, to $1.0\text{x}10^{-6}$	All	$7.8\text{x}10^{-1}$	$3.9\text{x}10^{-4}$
AM-5	Fuel handling accident - irradiated element	$1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$	All	9.9	$4.9\text{x}10^{-3}$
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3\text{x}10^{-6}$	All	$3.3\text{x}10^{-3}$	$1.6\text{x}10^{-6}$
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0\text{x}10^{-6}$	All	$7.9\text{x}10^{-1}$	$3.9\text{x}10^{-4}$
HM-1	Operator error - molybdenum-99 target processing	$1.0\text{x}10^{-1}$ to $1.0\text{x}10^{-2}$	All	$7.6\text{x}10^{-2}$	$3.8\text{x}10^{-5}$
HM-2	Operator error - iodine-125 target processing	$1.0\text{x}10^{-1}$ to $1.0\text{x}10^{-2}$	All	$3.1\text{x}10^{-3}$	$1.6\text{x}10^{-6}$
HM-4	Fire in steel containment box	$1.0\text{x}10^{-2}$ to $1.0\text{x}10^{-4}$	All	5.2	$2.6\text{x}10^{-3}$
HS-1	Fire in room 108, average inventories	$3.3\text{x}10^{-5}$	All	4.3	$2.1\text{x}10^{-3}$
HS-2	Fire in room 108, maximum inventories	$2.0\text{x}10^{-7}$	All	$1.6\text{x}10^{2}$	$7.9\text{x}10^{-2}$
S3M-2	Control element misadjustment before insert	$1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$	All	2.4	$1.2\text{x}10^{-3}$
S3M-3	Failure of a fissionable experiment	$1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$	All	$1.6\text{x}10^{1}$	$7.9\text{x}10^{-3}$
SS-1	Airplane crash into North Vault storage vault	$6.3\text{x}10^{-6}$	All	$1.8\text{x}10^{1}$	$9.2\text{x}10^{-3}$
S4-1	Control element misadjustment before insert	$1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$	E	4.5	$2.2\text{x}10^{-3}$

Table F.2–20. Technical Area-V Radiological Accident Frequencies and Consequences to 50-Mile Population (concluded)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (person-rem)	Additional Latent Cancer Fatality
AR-1	Uncontrolled addition of reactivity	$<1.0\times10^{-6}$	N,E	1.5×10^{1}	7.3×10^{-3}
AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	N,E	2.7	1.3×10^{-3}
AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	N,E	1.8×10^{1}	9.0×10^{-3}
AR-6	Airplane crash - collapse of bridge crane	6.3×10^{-6}	N,E	1.2×10^{1}	5.9×10^{-3}

Source: Original

[a] Technical Area-V Facility Accident Descriptors:
Annular Core Research Reactor-DP Configuration: AR-1, AR-2, AR-4, AR-6
Annular Core Research Reactor-Medical Isotopes Production Configuration: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell Facility: Medical Isotopes Production Configuration: HM-1, HM-2, HM-4
Hot Cell Facility: Room 108 Storage: HS-1, HS-2
Sandia Pulsed Reactor: S3M-2, S3M-3, SS-1, S4-1

[b] Applicable Alternative:
All–Scenarios applicable to all three alternatives
N–Scenario applicable to No Action Alternative
E–Scenario applicable to Expanded Operations Alternative

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
				Golf Course (1.6-2.4 km to N)		*Golf Course (1.6-2.4 km to NNE)*	
AM-1	Airplane crash - collapse of bridge crane	$6.3x10^{-6}$	All	$4.5x10^{-4}$	$2.2x10^{-7}$	$4.8x10^{-4}$	$2.4x10^{-7}$
AM-3	Rupture of waterlogged fuel element	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	$9.8x10^{-5}$	$4.9x10^{-8}$	$1.1x10^{-4}$	$5.4x10^{-8}$
AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$7.8x10^{-5}$	$3.9x10^{-8}$	$8.5x10^{-5}$	$4.3x10^{-8}$
AM-5	Fuel handling accident - irradiated element	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.2x10^{-3}$	$5.9x10^{-7}$	$1.2x10^{-3}$	$6.1x10^{-7}$
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3x10^{-6}$	All	$2.1x10^{-7}$	$1.0x10^{-10}$	$2.0x10^{-7}$	$9.8x10^{-11}$
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0x10^{-6}$	All	$9.0x10^{-5}$	$4.5x10^{-8}$	$9.7x10^{-5}$	$4.9x10^{-8}$
HM-1	Operator error - molybdenum-99 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	All	$6.2x10^{-7}$	$3.1x10^{-10}$	$6.5x10^{-6}$	$3.3x10^{-9}$
HM-2	Operator error - iodine-125 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	All	$1.9x10^{-7}$	$9.7x10^{-11}$	$2.1x10^{-7}$	$1.0x10^{-10}$
HM-4	Fire in steel containment box	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	$4.6x10^{-4}$	$2.3x10^{-7}$	$4.8x10^{-4}$	$2.4x10^{-7}$
HS-1	Fire in room 108, average inventories	$3.3x10^{-5}$	All	$3.4x10^{-4}$	$1.7x10^{-7}$	$3.6x10^{-4}$	$1.8x10^{-7}$
HS-2	Fire in room 108, maximum inventories	$2.0x10^{-7}$	All	$1.3x10^{-2}$	$6.3x10^{-6}$	$1.3x10^{-2}$	$6.6x10^{-6}$
S3M-2	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$2.8x10^{-4}$	$1.4x10^{-7}$	$2.9x10^{-4}$	$1.5x10^{-7}$

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations (continued)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	All	1.6×10^{-3}	8.1×10^{-7}	1.7×10^{-3}	8.4×10^{-7}
SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	All	1.2×10^{-3}	5.8×10^{-7}	1.1×10^{-3}	5.5×10^{-7}
S4-1	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	E	5.3×10^{-4}	2.6×10^{-7}	5.5×10^{-4}	2.7×10^{-7}
AR-1	Uncontrolled addition of reactivity	$<1.0\times10^{-6}$	N, E	1.8×10^{-3}	8.9×10^{-7}	1.9×10^{-3}	9.3×10^{-7}
AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	N, E	3.2×10^{-4}	1.6×10^{-7}	3.5×10^{-4}	1.7×10^{-7}
AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	N, E	2.0×10^{-3}	9.8×10^{-7}	2.0×10^{-3}	1.0×10^{-6}
AR-6	Airplane crash – collapse of bridge crane	6.3×10^{-6}	N, E	1.6×10^{-3}	7.8×10^{-7}	1.7×10^{-3}	8.4×10^{-7}
				Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC) (1.6-2.4 km to NW)		***National Atomic Museum, Base Housing, Shandiin Day Care Center (5.6-6.4 to NNW)***	
AM-1	Airplane crash – collapse of bridge crane	6.3×10^{-6}	All	3.7×10^{-4}	1.9×10^{-7}	7.7×10^{-5}	3.9×10^{-8}
AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	All	8.2×10^{-5}	4.1×10^{-8}	1.9×10^{-5}	9.3×10^{-9}
AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	All	6.5×10^{-5}	3.3×10^{-8}	1.5×10^{-5}	7.5×10^{-9}
AM-5	Fuel handling accident – irradiated element	1.0×10^{-4} to 1.0×10^{-6}	All	9.7×10^{-4}	4.8×10^{-7}	1.4×10^{-4}	7.0×10^{-8}

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations (continued)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	All	1.7×10^{-7}	8.6×10^{-11}	3.7×10^{-8}	1.9×10^{-11}
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0 \times 10^{-6}$	All	7.5×10^{-5}	3.7×10^{-8}	1.6×10^{-5}	7.8×10^{-9}
HM-1	Operator error – molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	5.3×10^{-6}	2.7×10^{-9}	1.4×10^{-6}	7.2×10^{-10}
HM-2	Operator error - iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	1.7×10^{-7}	8.4×10^{-11}	5.1×10^{-8}	2.6×10^{-11}
HM-4	Fire in glove box	1.0×10^{-2} to 1.0×10^{-4}	All	3.8×10^{-4}	1.9×10^{-7}	7.3×10^{-5}	3.6×10^{-8}
HS-1	Fire in room 108, average inventories	3.3×10^{-5}	All	2.8×10^{-4}	1.4×10^{-7}	5.1×10^{-5}	2.6×10^{-8}
HS-2	Fire in room 108, maximum inventories	2.0×10^{-7}	All	1.0×10^{-2}	5.2×10^{-6}	1.9×10^{-3}	9.4×10^{-7}
S3M-2	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	All	2.3×10^{-4}	1.2×10^{-7}	3.6×10^{-5}	1.8×10^{-8}
S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	All	1.3×10^{-3}	6.7×10^{-7}	1.9×10^{-4}	9.4×10^{-8}
SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	All	9.7×10^{-4}	4.8×10^{-7}	2.1×10^{-4}	1.1×10^{-7}
S4-1	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	E	4.3×10^{-4}	2.2×10^{-7}	6.7×10^{-5}	3.4×10^{-8}
AR-1	Uncontrolled addition of reactivity	$<1.0 \times 10^{-6}$	N,E	1.5×10^{-3}	7.4×10^{-7}	2.1×10^{-4}	1.1×10^{-7}
AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	N,E	2.7×10^{-4}	1.3×10^{-7}	5.3×10^{-5}	2.7×10^{-8}

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations (continued)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	N, E	1.6×10^{-3}	8.0×10^{-7}	2.2×10^{-4}	1.1×10^{-7}
AR-6	Airplane crash – collapse of bridge crane	6.3×10^{-6}	N, E	1.3×10^{-3}	6.5×10^{-7}	2.4×10^{-4}	1.2×10^{-7}
				Veterans Affairs Medical Center, Wherry Elementary School, Coronado Club, Child Development Center-East (6.4-7.2 km to NNW)		***Veterans Affairs Medical Center (7.2-8.1 km to NW)***	
AM-1	Airplane crash – collapse of bridge crane	6.3×10^{-6}	All	6.4×10^{-5}	3.2×10^{-8}	4.9×10^{-5}	2.5×10^{-8}
AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	All	1.6×10^{-5}	7.8×10^{-9}	1.2×10^{-5}	6.0×10^{-9}
AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	All	1.2×10^{-5}	6.2×10^{-9}	9.5×10^{-6}	4.7×10^{-9}
AM-5	Fuel handling accident - irradiated element	1.0×10^{-4} to 1.0×10^{-6}	All	1.1×10^{-4}	5.7×10^{-8}	8.2×10^{-5}	4.1×10^{-8}
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	All	3.2×10^{-8}	1.6×10^{-11}	2.4×10^{-8}	1.2×10^{-11}
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0\times10^{-6}$	All	1.3×10^{-5}	6.5×10^{-9}	9.8×10^{-6}	4.9×10^{-9}
HM-1	Operator error – molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	1.2×10^{-6}	6.1×10^{-10}	9.2×10^{-7}	4.6×10^{-10}
HM-2	Operator error – iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	4.4×10^{-8}	2.2×10^{-11}	3.5×10^{-8}	1.7×10^{-11}

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations (continued)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
HM-4	Fire in steel containment box	1.0×10^{-2} to 1.0×10^{-4}	All	6.0×10^{-5}	3.0×10^{-8}	4.5×10^{-5}	2.2×10^{-8}
HS-1	Fire in room 108, average inventories	3.3×10^{-5}	All	4.2×10^{-5}	2.1×10^{-8}	3.2×10^{-5}	1.6×10^{-8}
HS-2	Fire in room 108, maximum inventories	2.0×10^{-7}	All	1.5×10^{-3}	7.7×10^{-7}	1.2×10^{-3}	5.9×10^{-7}
S3M-2	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	All	2.9×10^{-5}	1.5×10^{-8}	2.1×10^{-5}	1.0×10^{-8}
S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	All	1.5×10^{-4}	7.6×10^{-8}	1.1×10^{-4}	5.4×10^{-8}
SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	All	1.8×10^{-4}	8.9×10^{-8}	1.4×10^{-4}	6.8×10^{-8}
S4-1	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	E	5.5×10^{-5}	2.7×10^{-8}	3.9×10^{-5}	2.0×10^{-8}
AR-1	Uncontrolled addition of reactivity	$<1.0\times10^{-6}$	N, E	1.7×10^{-4}	8.6×10^{-8}	1.2×10^{-4}	6.2×10^{-8}
AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	N, E	4.4×10^{-5}	2.2×10^{-8}	3.2×10^{-5}	1.6×10^{-8}
AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	N, E	1.8×10^{-4}	8.9×10^{-8}	1.3×10^{-4}	6.5×10^{-8}
AR-6	Airplane crash – collapse of bridge crane	6.3×10^{-6}	N, E	1.9×10^{-4}	9.7×10^{-8}	1.4×10^{-4}	7.1×10^{-8}
				Kirtland Elementary School, Child Development Center-West (8.1-12.1 km to NW)		***Riding Stables (1.6-2.4 km to NE)***	
AM-1	Airplane crash – collapse of bridge crane	6.3×10^{-6}	All	3.0×10^{-5}	1.5×10^{-8}	4.7×10^{-4}	2.4×10^{-7}
AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	All	7.3×10^{-6}	3.7×10^{-9}	1.0×10^{-4}	5.2×10^{-8}

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations (continued)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$5.8x10^{-6}$	$2.9x10^{-9}$	$8.2x10^{-5}$	$4.1x10^{-8}$
AM-5	Fuel handling accident - irradiated element	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$4.7x10^{9}$	$2.4x10^{6}$	$1.2x10^{-3}$	$5.8x10^{-7}$
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3x10^{-6}$	All	$1.4x10^{-8}$	$7.1x10^{-12}$	$1.9x10^{-7}$	$9.4x10^{-11}$
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0x10^{-6}$	All	$6.0x10^{-6}$	$3.0x10^{-9}$	$9.4x10^{-5}$	$4.7x10^{-8}$
HM-1	Operator error – molybdenum-99 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	All	$6.1x10^{-7}$	$3.0x10^{-10}$	$6.1x10^{-6}$	$3.1x10^{-9}$
HM-2	Operator error - iodine-125 target processing	1.0x10-1 to $1.0x10^{-2}$	All	$2.4x10^{-8}$	$1.2x10^{-11}$	$2.0x10^{-7}$	$9.9x10^{-11}$
HM-4	Fire in glove box	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	$2.6x10^{-5}$	$1.3x10^{-8}$	$4.6x10^{-4}$	$2.3x10^{-7}$
HS-1	Fire in room 108, average inventories	$3.3x10^{-5}$	All	$1.9x10^{-5}$	$9.4x10^{-9}$	$3.4x10^{-4}$	$1.7x10^{-7}$
HS-2	Fire in room 108, maximum inventories	$2.0x10^{-7}$	All	$6.9x10^{-4}$	$3.4x10^{-7}$	$1.3x10^{-2}$	$6.3x10^{-6}$
S3M-2	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.2x10^{-5}$	$6.2x10^{-9}$	$2.7x10^{-5}$	$1.4x10^{-8}$
S3M-3	Failure of a fissionable experiment	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$6.3x10^{-5}$	$3.2x10^{-8}$	$1.5x10^{-3}$	$7.7x10^{-7}$
SS-1	Airplane crash into North Vault storage vault	$6.3x10^{-6}$	All	$8.0x10^{-5}$	$4.0x10^{-8}$	$1.1x10^{-3}$	$5.3x10^{-7}$
S4-1	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$2.3x10^{-5}$	$1.1x10^{-8}$	$5.1x10^{-4}$	$2.5x10^{-7}$

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations (continued)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
AR-1	Uncontrolled addition of reactivity	$<1.0\times10^{-6}$	N, E	7.0×10^{-5}	3.5×10^{-8}	1.8×10^{-3}	8.8×10^{-7}
AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	N, E	1.9×10^{-5}	9.3×10^{-9}	3.3×10^{-4}	1.7×10^{-7}
AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	N, E	7.5×10^{-5}	3.8×10^{-8}	1.9×10^{-3}	9.7×10^{-7}
AR-6	Airplane crash – collapse of bridge crane	6.3×10^{-6}	N, E	8.2×10^{-5}	4.1×10^{-8}	1.6×10^{-3}	8.1×10^{-7}
				Sandia Base Elementary School (6.4-7.2 km to N)		***Lovelace Hospital (7.2-8.1 km to NNW)***	
AM-1	Airplane crash – collapse of bridge crane	6.3×10^{-6}	All	7.5×10^{-5}	3.8×10^{-8}	5.4×10^{-5}	2.7×10^{-8}
AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	All	1.8×10^{-5}	9.1×10^{-9}	1.3×10^{-5}	6.6×10^{-9}
AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	All	1.5×10^{-5}	7.3×10^{-9}	1.0×10^{-5}	5.2×10^{-9}
AM-5	Fuel handling accident - irradiated element	1.0×10^{-4} to 1.0×10^{-6}	All	1.3×10^{-4}	6.4×10^{-8}	9.2×10^{-5}	4.6×10^{-8}
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	All	3.7×10^{-8}	1.8×10^{-11}	2.6×10^{-8}	1.3×10^{-11}
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0\times10^{-6}$	All	1.5×10^{-5}	7.6×10^{-9}	1.1×10^{-5}	5.4×10^{-9}
HM-1	Operator error – molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	1.4×10^{-6}	6.9×10^{-10}	1.0×10^{-6}	5.2×10^{-10}

Table F.2–21. Technical Area-V Radiological Accident Frequencies and Consequences to Core Receptor Locations (concluded)

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
HM-2	Operator error - iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	All	5.1×10^{-8}	2.5×10^{-11}	3.9×10^{-8}	1.9×10^{-11}
HM-4	Fire in steel containment box	1.0×10^{-2} to 1.0×10^{-4}	All	6.8×10^{-5}	3.4×10^{-8}	4.9×10^{-5}	2.5×10^{-8}
HS-1	Fire in room 108, average inventories	3.3×10^{-5}	All	4.9×10^{-5}	2.4×10^{-8}	3.4×10^{-5}	1.7×10^{-8}
HS-2	Fire in room 108, maximum inventories	2.0×10^{-7}	All	1.8×10^{-3}	8.9×10^{-7}	1.3×10^{-3}	6.3×10^{-7}
S3M-2	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	All	3.3×10^{-5}	1.6×10^{-8}	2.4×10^{-5}	1.2×10^{-8}
S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	All	1.7×10^{-4}	8.4×10^{-8}	1.2×10^{-4}	6.2×10^{-8}
SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	All	2.1×10^{-4}	1.0×10^{-7}	1.5×10^{-4}	7.4×10^{-8}
S4-1	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	E	6.1×10^{-5}	3.0×10^{-8}	4.5×10^{-5}	2.2×10^{-8}
AR-1	Uncontrolled addition of reactivity	$<1.0\times10^{-6}$	N, E	1.9×10^{-4}	9.6×10^{-8}	1.4×10^{-4}	7.0×10^{-8}
AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	N, E	5.0×10^{-5}	2.5×10^{-8}	3.6×10^{-5}	1.8×10^{-8}
AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	N, E	2.0×10^{-4}	1.0×10^{-7}	1.4×10^{-4}	7.1×10^{-8}
AR-6	Airplane crash - collapse of bridge crane	6.3×10^{-6}	N, E	2.2×10^{-4}	1.1×10^{-7}	1.6×10^{-4}	7.9×10^{-8}

Source: Original

[a] Technical Area-V Facility Accident Descriptors:
Annular Core Research Reactor-Defense Program Configuration: AR-1, AR-2, AR-4, AR-6
Annular Core Research Reactor-Medical Isotopes Production Configuration: AM-1, AM-2, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell Facility: Medical Isotopes Production: HM-1, HM-2, HM-4
Hot Cell Facility: Room 108 Storage: HS-1, HS-2
Sandia Pulsed Reactor: S3M-2, S3M-3, S4-1, SS-1

[b] Applicable Alternative:
All–Scenario applicable to all three alternatives
N–Scenario applicable to No Action Alternative
E–Scenario applicable to Expanded Operations Alternative

Table F.2–22. Manzano Waste Storage Facilities Radiological Accident Frequencies and Consequences to the Maximally Exposed Individual and Noninvolved Worker

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Maximally Exposed Individual		Noninvolved Worker	
				Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
MZ-1	Waste package fire	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	$4.9x10^{-4}$	$2.5x10^{-7}$	$3.2x10^{-1}$	$1.3x10^{-4}$

Source: Original
[a] Manzano Waste Storage Facilities Accident Descriptor: MZ-1
[b] Applicable Alternative:
All–Scenario is applicable to all three alternatives

Table F.2–23. Manzano Waste Storage Facilities Accident Frequencies and Consequences to 50-Mile Population

Accident ID[a]	Accident Scenario Descriptions	Accident Frequency (per year)	Applicable Alternative[b]	Dose (person-rem)	Additional Latent Cancer Fatality
MZ-1	Waste Package Fire	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	3.7	$1.8x10^{-3}$

Source: Original
[a] Manzano Waste Storage Facilities Accident Descriptor: MZ-1
[b] Applicable Alternative:
All–Scenario is applicable to all three alternatives

Table F.2–24. Manzano Waste Storage Facilities Radiological Accident Frequencies and Consequences to Core Receptors

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
MZ-1	Waste Package Fire	$1.0x10^{-3}$	All	*Riding Stables (0.8-1.6 km to WNW)*		*Golf Course (1.6-2.4 km to NW)*	
				$4.9x10^{-4}$	$2.5x10^{-7}$	$3.1x10^{-4}$	$1.6x10^{-7}$
				Golf Course (2.4-3.2 km to WNW)		*Kirtland Underground Munitions and Maintenance Storage Complex (4.0-4.8 km to W)*	
				$1.4x10^{-4}$	$7.1x10^{-8}$	$9.1x10^{-5}$	$4.5x10^{-8}$
				National Atomic Museum, Base Housing (6.4-7.2 km to NW)		*Sandia Base Elementary School, Wherry Elementary School, Coronado Club, Child Development Center-East, Shandiin Day Care Center (7.2-8.1 km to NW)*	
				$4.4x10^{-5}$	$2.2x10^{-8}$	$3.6x10^{-5}$	$1.8x10^{-8}$
				Sandia Base Elementary School (7.2-8.1 km to NNW)		*Kirtland Elementary School (8.1-12.1km to WNW)*	
				$3.9x10^{-5}$	$2.0x10^{-8}$	$1.7x10^{-5}$	$8.5x10^{-9}$
				Veterans Affairs Medical Center, Lovelace Hospital, Child Development Center-West (8.1-12.1 km to NW)			
				$2.1x10^{-5}$	$1.1x10^{-8}$		

Source: Original
[a] Manzano Waste Storage Facilities Accident Descriptor: MZ-1

[b] Applicable Alternative:
All–Scenario is applicable to all three alternatives

F.3 CHEMICAL ACCIDENTS

F.3.1 Introduction

The purpose of this section is to document the evaluation of the potential hazards from the accidental release of chemicals present at SNL/NM. The section discusses the potential impacts from catastrophic releases of chemicals to the environment and the potential impacts from small spills that could affect only a few involved workers within the area of the spill. There are more than 1,300 individual chemicals presently being used at SNL/NM in quantities ranging from a few milligrams to tanks containing upwards of 10,000 gal. For this evaluation, it is important to identify not only the "worst" hazardous or toxic chemical, but also that chemical's volatility and affected inventory.

F.3.2 Screening For Hazardous Chemicals

To assess the impacts of the "worst" hazardous or toxic chemicals, an existing screening tool was modified to account for the volume of the chemicals involved. The screening tool is based on the Vapor Hazard Ratio (VHR) (Restrepo 1993). The VHR is the equilibrium vapor pressure (in ppm) divided by the acceptable concentration (ppm). Because the VHR can range over several orders of magnitude, the Vapor Hazard Index (VHI) was developed, which is the logarithm of VHR and is used to identify and rank chemicals by their inherent properties. The VHI is calculated by using the following formula:

$$VHI = \log(VHR) = \log[(VP*1.0\times10^6)/(\text{acceptable concentration}*760\ \text{mmHg})]$$

(Eq. F.3-1)

Where: VP = vapor pressure in millimeters of mercury at standard temperature and pressure, acceptable concentration is in parts per million (ppm), and mmHg = millimeters of mercury.

The SWEIS uses the ERPG Level-2 (ERPG-2) as the acceptable concentration limit (AIHA 1997). The DOE and the U.S. Environmental Protection Agency (EPA) have accepted in the Risk Management Program Rule (40 Code of Federal Regulations (CFR) §68.112) that ERPG-2 limits would be the acceptable limits in emergency planning.

In order to include the effect of volume in the determination of the "worst" chemical, the screening methodology developed an additional index called the Risk Hazard Index (RHI), which is the log of VHR times the affected inventory. This reduces to the following equation:

Planning Guideline

- The ERPG-1 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
- The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
- The ERPG-3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life threatening health effects.

American Industrial Hygiene Association (AIHA 1997)

$$RHI = \log(VHR * \text{inventory}) = \log(VHR) + \log(\text{inventory}) = VHI + \log(\text{inventory})$$

(Eq. F.3-2)

Where: Inventory is expressed in pounds.

The chemical with the highest RHI within a facility is the chemical that will have the worst potential impacts from an accident during which the entire building inventory is released. Chemicals with lower RHIs would have lesser impacts. The RHI is the tool used in this SWEIS to determine the chemical within a facility with the potential for the highest accident impacts from that facility. This approach assumes a total release of a building's chemical inventory. If smaller disproportionate releases are assumed, the ranking could change. Because the number of release scenarios is very large, the total release scenario was chosen to represent the maximum potential chemical impact.

Table F.3–1 illustrates this concept. Chlorine, with a higher VHI but only a 1-lb release, has an RHI of 5.5 with an *ALOHA* (NSC 1995) modeled distance of 324 ft to meet the chlorine ERPG-2 level. Methyl iodide, with a smaller VHI of 4.0 but with a 50-lb release, has an RHI of 5.7 and an *ALOHA* modeled distance of 390 ft to meet the methyl iodide ERPG-2 level. For a 1-lb release of methyl iodide, the RHI takes on a value less than the chlorine RHI of 5.5.

The VHI was calculated for a list of almost 190 hazardous/toxic chemicals that could be present at SNL/NM. The list was composed of chemicals from four sources: 1) chemicals that had an approved ERPG-2 level (DOE 1999b), 2) chemicals that the EPA determined should be considered in an accident assessment (40 CFR Part 68.130, Table 2), 3) chemicals that SNL/NM considered as their most hazardous or toxic materials (SNL/NM 1998n, 1999a), and 4) chemicals present at SNL/NM that had a Temporary Emergency Exposure Limit (TEEL)-2 value recommended by the DOE (DOE 1999c).

The vapor pressures were obtained from standard handbooks of chemicals such as the *Handbook of Chemistry and Physics* (Weast 1967) and the National Institute of Occupational Safety and Health (NIOSH) *Pocket Guide to Chemical Hazards* (CDC 1997), from material safety data sheets (UV 1998), and from the DOE (DOE 1999c). For those chemicals that are considered to be gases at room temperature, a value of 760 mm was entered. The ERPG-2 values were determined according to a strict hierarchy. The preferred source was the approved ERPG-2 from the DOE Subcommittee on Consequence Assessment and Protective Actions (DOE-SCAPA) (DOE 1998g). The second-ranked source was a Westinghouse Safety Management Solutions, Inc., document that compiled TEEL-2 levels (DOE 1999c). The third-ranked source was the level of concern from the EPA *Technical Guide of Hazards Analysis, Emergency Planning for Extremely Hazardous Substances* (EPA 1987). The fourth-ranked source used was one-tenth of the "Immediately Dangerous to Life and Health" (IDLH) guideline, as presented in the NIOSH document (CDC 1997). The fifth-ranked source used was the time-weighted average (TWA) times 5 (CDC 1997). If the referenced document contained a value, but the units were mg/m^3, the following equation was used to convert to ppm:

$$\text{ERPG-2 in ppm} = (24.5/\text{M.W.})^* \ C \quad \text{(Eq. F.3–3)}$$

Where: M.W. = molecular weight in grams, and
C = concentration in mg/m^3.

Table F.3–2 identifies the list of chemicals considered, sources for including the chemical, vapor pressure, ERPG-2, and VHI. For some chemicals, the VHI is listed as <10 mmHg vapor pressure, which is the lower limit for application of the VHI/RHI screening. Any chemical having a vapor pressure less than 10 mmHg will not be volatile enough to release any significant fraction of its inventory into the atmosphere. A "not calculated" indicates that vapor pressure for that chemical or ERPG-2 could not be found. Therefore, any chemical with either notation was not included in the screening.

There are four possible separate and distinct sources of chemical inventories identified by building and location at SNL/NM. The first, CheMaster (SNL/NM 1996n), is an

Table F.3–1. Example Comparisons of RHI Values from Chlorine and Methyl Iodide Releases

CHEMICAL	VAPOR PRESSURE (mmHg)	ERPG-2 (ppm)	VHI	WEIGHT (pounds)	RHI	DISTANCE TO MEET ERPG-2 LEVEL (ft)
Chlorine	760	3	5.52	1	5.5	324
				10	6.5	1,074
Methyl Iodide	400	50	4.02	1	4.0	48
				50	5.7	390

Source: Original
ERPG-2: Emergency Response Planning Guideline Level 2
ft: feet
mmHg: millimeters of mercury
ppm: parts per million
RHI: Risk Hazard Index
VHI: Vapor Hazard Index

Table F.3–2. List of Screening Chemicals and their Properties

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
DOE-SCAPA	Acetaldehyde	740	200	3.69
SNL NM	Acetic Acid	11.40	35	2.63
SNL NM	Acetone	180	8,500	1.45
DOE-SCAPA, 40 CFR 68.130, SNL NM	Acrolein	220.4	0.5	5.76
DOE-SCAPA	Acrylic Acid	3	50	<10 mmHg Vapor Pressure
DOE-SCAPA, 40 CFR 68.130, SNL NM	Acrylonitrile	83.6	35	3.50
40 CFR 68.130, SNL NM	Acrylyl Chloride	300	0.24	6.21
SNL NM	Aluminum Oxide Anhydrous	0	15	<10 mmHg Vapor Pressure
40 CFR 68.130	Allyl Alcohol	19	15	3.22
40 CFR 68.130, SNL NM	Allylamine	500	1.37	5.68
DOE-SCAPA	Allyl Chloride	298.68	40	3.99
DOE-SCAPA, 40 CFR 68.130 SNL NM	Ammonia	760	200	3.70
SNL NM	Ammonium Fluoride	0	12.5	<10 mmHg Vapor Pressure
SNL NM	Ammonium Hydrogen Difluoride	N.F.	12.5	Not Calculated
DOE-SCAPA, 40 CFR 68.130, SNL NM	Ammonium Hydroxide (<25%)	6.87	200	<10 mmHg Vapor Pressure
DOE-SCAPA, 40 CFR 68.130, SNL NM	Ammonium Hydroxide (>25%)	23.84	200	2.20
SNL NM	Antimony Pentafluoride	10.108	0.31	4.64
40 CFR 68.130	Arsenous Trichloride	8.892	0.5	<10 mmHg Vapor Pressure
40 CFR 68.130, SNL NM	Arsine	760	0.5	6.3
DOE-SCAPA	Benzene	76	150	2.82
DOE-SCAPA	Benzyl Chloride	0.912	10	<10 mmHg Vapor Pressure
DOE-SCAPA	Beryllium	0	0.68	<10 mmHg Vapor Pressure
40 CFR 68.130, SNL NM	Boron Trichloride	760	2.09	5.68
40 CFR 68.130, SNL NM	Boron Trifluoride	760	2.5	5.60

Table F.3–2. List of Screening Chemicals and their Properties (continued)

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
DOE-SCAPA, 40 CFR 68.130 SNL NM	Bromine	172	1	5.35
DOE-SCAPA	1,3 Butadiene	760	200	3.70
SNL NM	N-Butyl Acetate	3.20	50	<10 mmHg Vapor Pressure
DOE-SCAPA	N-Butyl Acrylate	3.268	25	<10 mmHg Vapor Pressure
DOE-SCAPA	N-Butyl Isocyanate	N.F.	0.05	Not Calculated
DOE-SCAPA, 40 CFR 68.130, SNL NM	Carbon Disulfide	364.8	50	3.98
DOE-SCAPA	Carbon Monoxide	760	350	3.46
DOE-SCAPA	Carbon Tetrachloride	92.72	100	3.09
SNL NM	Carbon Tetrafluoride	760	N.F.	Not Calculated
DOE-SCAPA, SNL NM	Chlorine	760	3	5.52
40 CFR 68.130	Chlorine Dioxide	760	0.5	6.30
DOE-SCAPA	Chlorine Trifluoride	760	1	6.00
DOE-SCAPA	1-Chloro-1, 1-Difluoroethane	760	15,000	1.82
DOE-SCAPA	Chloroacetyl Chloride	19	1	4.40
40 CFR 68.130	Chloroform	161.12	50	3.63
40 CFR 68.130, SNL NM	Chloromethyl Ether	30	0.05	5.87
40 CFR 68.130, SNL NM	Chloromethyl Methyl Ether	192.28	0.55	5.66
DOE-SCAPA	Chloropicrin	18	0.2	5.07
DOE-SCAPA	Chlorosulfonic Acid	1	2.1	<10mm Hg Vapor Pressure
DOE-SCAPA	Chlorotrifluroethylene	760	100	4.00
DOE-SCAPA, 40 CFR 68.130	Crotonaldehyde	19	10	3.40
40 CFR 68.130	Crotonaldehyde, (E)-[2]Butenal	36	13.98	3.53
DOE-SCAPA	Cyanogen Chloride	760	0.4	6.40
SNL NM	Cyanuric Fluoride	135	0.03	6.76
SNL NM	Cyclohexane	100	1,300	2.01
40 CFR 68.130	Cyclohexylamine	9.12	50	<10 mmHg Vapor Pressure

Table F.3–2. List of Screening Chemicals and their Properties (continued)

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
DOE-SCAPA, 40 CFR 68.130, SNL NM	Diborane	760	1	6
SNL NM	Dibromotetrafluoroethane	N.F.	N.F.	Not Calculated
SNL NM	Dibutyl Phthalate	0.01	25	<10 mmHg Vapor Pressure
SNL NM	Dichlorodifluoromethane	760	1,500	2.82
DOE-SCAPA	Diketene	10	5	3.42
DOE-SCAPA	Dimethylamine	760	100	4.00
DOE-SCAPA, 40 CFR 68.130	Dimethyldichlorosilane	139	5	4.56
SNL NM	Dimethyl Sulfate	4.94	0.7	<10 mmHg Vapor Pressure
DOE-SCAPA	Dimethyl Disulfide	28.6	50	2.88
DOE-SCAPA	N,N-Dimethylformamide Anhydrous	3	100	<10 mmHg Vapor Pressure
40 CFR 68.130	1,1-Dimethylhydrazine	157	5	4.62
DOE-SCAPA	Dimethyl Sulfide	520	500	3.14
SNL NM	Dioxathion	0.01	0.18	<10 mmHg Vapor Pressure
SNL NM	Disilane	760	25	4.60
DOE-SCAPA, 40 CFR 68.130	Epichlorohydrin	12.16	20	2.90
SNL NM	2-Ethoxyethyl Acetate	1.20	15	<10 mmHg Vapor Pressure
SNL NM	Ethyl Alcohol	43.00	3,300	1.23
SNL NM	Ethyl Silicate	1.00	50	<10 mmHg Vapor Pressure
SNL NM	Ethylene Dichloride	64.00	50	3.23
SNL NM	Ethylene Glycol	0.05	40	<10 mmHg Vapor Pressure
40 CFR 68.130	Ethylenediamine	11	10	3.16
40 CFR 68.130	Ethyleneimine	160	2.3	4.96
SNL NM	Ethylene Fluorohydrin	50	0.03	6.39
DOE-SCAPA, 40 CFR 68.130, SNL NM	Ethylene Oxide	760	50	4.30
DOE-SCAPA, 40 CFR 68.130	Fluorine	760	5	5.30
DOE-SCAPA, 40 CFR 68.130	Formaldehyde	760	10	5

Table F.3–2. List of Screening Chemicals and their Properties (continued)

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
40 CFR 68.130, SNL NM	Furan	700	0.43	6.33
DOE-SCAPA	Furfural	1.0944	10	<10 mmHg Vapor Pressure
SNL NM	Gallium Trichloride	0.2	4.45	<10 mmHg Vapor Pressure
SNL NM	Glycerin	0	50	<10 mmHg Vapor Pressure
DOE-SCAPA	Hexachlorobutadiene	0.2	10	<10 mmHg Vapor Pressure
DOE-SCAPA	Hexafluoroacetone And Hydrates	760	1	6
DOE-SCAPA	Hexafluoropropylene	760	50	4.30
SNL NM	N-Hexane	100	250	2.72
40 CFR 68.130	Hydrazine	10.64	0.80	4.24
DOE-SCAPA, 40 CFR 68.130, SNL NM	Hydrochloric Acid (< 28%)	4.9	20	<10 mmHg Vapor Pressure
DOE-SCAPA, 40 CFR 68.130, SNL NM	Hydrochloric Acid (> 28%)	131	20	3.94
DOE-SCAPA, 40 CFR 68.130, SNL NM	Hydrofluoric Acid	0	20	<10 mmHg Vapor Pressure
DOE-SCAPA, 40 CFR 68.130, SNL NM	Hydrogen Chloride	760	20	4.70
DOE-SCAPA, 40 CFR 68.130, SNL NM	Hydrogen Cyanide	760	10	5
DOE-SCAPA, 40 CFR 68.130, SNL NM	Hydrogen Fluoride	760	20	4.70
DOE-SCAPA	Hydrogen Peroxide	5	50	<10 mmHg Vapor Pressure
40 CFR 68.130, SNL NM	Hydrogen Selenide	760	0.20	6.70
DOE-SCAPA, 40 CFR 68.130, SNL NM	Hydrogen Sulfide	760	30	4.52
DOE-SCAPA	Iodine	0.304	0.5	<10 mmHg Vapor Pressure
40 CFR 68.130, SNL NM	Iron, Pentacarbonyl	35.72	0.1	5.67
DOE-SCAPA, 40 CFR 68.130	Isobutyronitrile	100	50	3.42
DOE-SCAPA	2-Isocyanatoethyl Methacrylate	80	0.1	6.02

Table F.3–2. List of Screening Chemicals and their Properties (continued)

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
SNL NM	Isophorone Diisocyanate	0.0003	0.14	<10 mmHg Vapor Pressure
SNL NM	Isopropyl Alcohol	33	400	2.04
40 CFR 68.130	Isopropyl Chloroformate	50	19.98	3.52
DOE-SCAPA	Lithium Hydride	0	0.31	<10 mmHg Vapor Pressure
40 CFR 68.130	Methacrylonitrile	90	1.1	5.03
DOE-SCAPA	Methanol	93.48	1,000	2.09
DOE-SCAPA, SNL NM	Methyl Bromide	760	50	4.30
DOE-SCAPA, 40 CFR 68.130	Methyl Chloride	760	400	3.40
40 CFR 68.130	Methyl Chloroformate	210	0.47	5.77
40 CFR 68.130	Methyl Hydrazine	49.6	2	4.51
DOE-SCAPA	Methyl Iodide	400	50	4.02
DOE-SCAPA, 40 CFR 68.130, SNL NM	Methyl Isocyanate	352.64	0.5	5.97
SNL NM	Methyl Isothiocyanate	15	0.3	4.82
DOE-SCAPA, 40 CFR 68.130	Methyl Mercaptan	760	25	4.60
DOE-SCAPA, SNL NM	Methylene Chloride	360.24	750	2.80
DOE-SCAPA, 40 CFR 68.130, SNL NM	Methyltrichlorosilane	136.04	3	4.78
40 CFR 68.130	Methyltricyanate	20	28.53	2.96
DOE-SCAPA	Methylene Diphenyl Diisocyanate	0.001	0.2	<10 mmHg Vapor Pressure
DOE-SCAPA, SNL NM	Monomethylamine	760	100	4.00
SNL NM	Naphtha	1	1,000	<10 mmHg Vapor Pressure
40 CFR 68.130, SNL NM	Nickel Carbonyl	400	0.05	7.02
40 CFR 68.130, SNL NM	Nitric Acid (</= 80%)	8	15	<10 mmHg Vapor Pressure
40 CFR 68.130, SNL NM	Nitric Acid (> 80%)	20	15	3.24
40 CFR 68.130, SNL NM	Nitric Oxide	760	25	4.60
40 CFR 68.130, SNL NM	Nitrous Oxide	760	125	3.90
40 CFR 68.130, SNL NM	Nitrogen Dioxide	760	5.01	5.30
SNL NM	Osmium Tetroxide	11	0.01	6.18

Table F.3–2. List of Screening Chemicals and their Properties (continued)

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
SNL NM	Ozone	760	0.5	6.30
40 CFR 68.130	Peracetic Acid	60	1.45	4.74
DOE-SCAPA	Perchloroethylene	14.44	200	1.98
40 CFR 68.130	Perchloromethylmercaptan	3.04	1	<10 mmHg Vapor Pressure
DOE-SCAPA, SNL NM	Perfluoroisobutylene	760	0.10	7.00
DOE-SCAPA, SNL NM	Phenol	0.3572	50	<10 mmHg Vapor Pressure
DOE-SCAPA, 40 CFR 68.130, SNL NM	Phosgene	760	0.2	6.70
DOE-SCAPA, 40 CFR 68.130, SNL NM	Phosphine	760	0.5	6.30
SNL NM	Phosphoric Acid	0.03	500	<10 mmHg Vapor Pressure
40 CFR 68.130, SNL NM	Phosphorus Oxychloride	40	0.48	5.04
40 CFR 68.130, SNL NM	Phosphorus Trichloride	135	2.5	4.85
DOE-SCAPA	Phosphorus Pentoxide	0.00001	4.32	<10 mmHg Vapor Pressure
40 CFR 68.130	Piperidine	40.28	6.34	3.92
40 CFR 68.130	Propionitrile	39.52	1.65	4.50
SNL NM	1,2-Propanediol	0.08	75	<10 mmHg Vapor Pressure
SNL NM	N-Propyl Alcohol	10	250	1.72
40 CFR 68.130	Propyl Chloroformate	24	1.99	4.20
40 CFR 68.130	Propyleneimine	112	51.5	3.46
DOE-SCAPA, 40 CFR 68.130	Propylene Oxide	445	250	3.37
SNL NM	Pyrene	0.00001	0.21	<10 mmHg Vapor Pressure
SNL NM	Sarin	2.9	0.01	<10 mmHg Vapor Pressure
SNL NM	Silane	760	25	4.60
SNL NM	A-187 Silane	N.F.	25	Not Calculated
SNL NM	A-1100 Silane	N.F.	25	Not Calculated
SNL NM	A-1120 Silane	N.F.	25	Not Calculated
SNL NM	Y-9492 Silane	N.F.	25	Not Calculated

Table F.3–2. List of Screening Chemicals and their Properties (continued)

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
SNL NM	Dow Corning Z-6070 Silane	N.F.	25	Not Calculated
SNL NM	Dow Corning Z-6020 Silane	N.F.	25	Not Calculated
SNL NM	Dow Corning Z-6032 Silane	N.F.	25	Not Calculated
SNL NM	Dow Corning Z-6040 Silane	N.F.	25	Not Calculated
SNL NM	Silicon Tetrafluoride	760	0	<10 mmHg Vapor Pressure
SNL NM	Sodium Hydroxide	0.988	0.61	<10 mmHg Vapor Pressure
DOE-SCAPA	Styrene	5.46	250	<10 mmHg Vapor Pressure
DOE-SCAPA, 40 CFR 68.130, SNL NM	Sulfur Dioxide	760	3	5.52
DOE-SCAPA, SNL NM	Sulfuric Acid	1	10	<10 mmHg Vapor Pressure
SNL NM	Sulfur Hexafluoride	760	N.F.	Not Calculated
40 CFR 68.130	Sulfur Tetrafluoride	760	2.09	5.68
DOE-SCAPA, 40 CFR 68.130	Sulfur Trioxide	433	3.06	5.27
SNL NM	Tellurium Hexafluoride	760	1	6
SNL NM	Tetraethyl Telluride	N.F.	0.00	Not Calculated
DOE-SCAPA	Tetrafluoroethylene	760	1,000	3.00
DOE-SCAPA	Tetramethoxysilane	12	10	3.20
40 CFR 68.130, SNL NM	Tetramethyl Lead	23.4	0.37	4.92
40 CFR 68.130, SNL NM	Tetranitromethane	8	1	<10 mmHg Vapor Pressure
SNL NM	Thionyl Chloride	100	5	4.42
DOE-SCAPA, 40 CFR 68.130	Titanium Tetrachloride	9.88	2.58	<10 mmHg Vapor Pressure
DOE-SCAPA	Toluene	22.91	300	2.00
40 CFR 68.130, SNL NM	Tolyene 2,4-Diisocyanate	0.05	1	<10 mmHg Vapor Pressure
40 CFR 68.130	Tolyene 2,6-Diisocyanate	0.05	0.13	<10 mmHg Vapor Pressure
40 CFR 68.130	Tolyene Diisocyanate	1	1	<10 mmHg Vapor Pressure
SNL NM	Trans-1,4-Dichlorobutene	6	0.03	<10 mmHg Vapor Pressure

Table F.3–2. List of Screening Chemicals and their Properties (concluded)

SOURCE(S) OF CHEMICAL LISTING	CHEMICAL	VAPOR PRESSURE (mmH)	ERPG-2 OR TEEL-2 (ppm)	VAPOR HAZARD INDEX
SNL NM	Chloromethyltrichlorosilane	30	0.04	5.99
DOE-SCAPA	1, 1, 1-trichloroethane	100	700	2.27
DOE-SCAPA	Trichloroethylene	59.28	500	2.19
DOE-SCAPA	Trichlorosilane	522.6	3	5.36
SNL NM	Triethoxysilane	23	0.75	4.61
DOE-SCAPA	Trimethoxysilane	N.F.	2	Not Calculated
DOE-SCAPA	Trimethylamine	760	100	4.00
40 CFR 68.130	Trimethylchlorosilane	71	11.27	3.92
DOE-SCAPA	Uranium Hexafluoride	107.92	1.04	5.13
SNL NM	Vanadium Pentoxide	0.0000001	4.71	<10 mmHg Vapor Pressure
DOE-SCAPA, 40 CFR 68.130	Vinyl Acetate	88.92	75	3.19
SNL NM	Vinyl Chloride	760	75	4.12
SNL NM	Xylene	7.90	200	<10 mmHg Vapor Pressure

Sources: 40 CFR §68.130; CDC 1997; DOE 1998g, 1999b, 1999c; EPA 1987; SNL/NM 1998a, 1999b; Weast 1967; UV 1998
DOE-SCAPA: DOE Subcommittee on Consequence Assessment and Protective Actions
ERPG-2: Emergency Response Planning Guideline Level 2
mmHg: millimeters of mercury
N.F.: not found
ppm: parts per million
TEEL-2: Temporary Emergency Exposure Limit

electronic database supporting SNL/NM source documents that contains chemical inventories by location for three separate buildings (Buildings 828, 858, 897) (SNL/NM 1996n). The second, HAs, which document the impact of release of hazardous materials for emergency planning purposes, were available for eight referenced facilities and identified the "worst" several chemicals for each facility (SNL/NM 1995i [Building 823], SNL 1994c [Building 878], SNL 1995d [Building 880], SNL 1995f [Building 883], SNL/NM 1994f [Building 884], SNL 1994d [Building 888]). The third source of data is the building profiles. Of the over 30 profiles reviewed, only one, Building 905 (SNL/NM 1996x), provided any information that was in addition to the CheMaster database and HA documents. The fourth source of data is the SNL/NM responses to questions about the Microsystems and Engineering Sciences Applications (MESA) Complex (SNL/NM 1999b). Quantities of chemicals from all four sources were then converted to pounds to be used in the RHI calculation.

The screening chemicals in Table F.3–2 were compared with the list of chemicals presented in the four sources of data. If a screening chemical was identified in the data sources, the amount of the chemical stored was combined with the VHI to calculate a RHI for that location. The volume of each chemical was accumulated to calculate an RHI for the entire building. The chemicals with the highest RHI values are identified in Table F.3–3. The inventories of the highlighted chemicals in Table F.3–3 were used for the dispersion models for each building.

In only one case, arsine in Building 893, data gained from a facility walk-through and meeting (TtNUS 1998k) were used to lower the building inventory from that shown on the CheMaster system. This was done after consulting with facility representatives to verify that inventories were rarely expected to exceed 65 lb and then verifying actual onsite storage. For those rare instances when the amount of arsine in the building exceeded 65 pounds, the combination of the probability of the instance and the probability of the accident would result in a total accident probability much less than 10^{-6} per year.

Table F.3–3. List of Chemicals and Risk Hazard Indexes by Facility

BUILDING NAME	BUILDING NUMBER	CHEMICAL NAME	BUILDING INVENTORY	BUILDING INVENTORY	VHI INDEX	RHI INDEX
Systems Research and Development	823	*Ammonia*	6,236.4 L	10.4	3.7	4.72
		Carbon Disulfide	7.6 L	0.056	3.98	2.73
		Carbon Monoxide	19,487.9 L	53.6	3.46	5.19
		Hexane	45.1 L	65.2	3.17	4.98
		Hydrogen Sulfide	841 L	2.81	4.52	4.97
		Nitric Acid	13.375 L	43.75	3.62	5.26
		Nitric Oxide	85 L	0.25	4.6	4.00
		Nitrogen Dioxide	22 L	0.93	5.3	5.27
		Nitrous Oxide	7,461 L	32.17	3.9	5.41
		Sulfur Dioxide	85 L	0.53	5.52	5.24
Microelectronics Development Laboratory	858	*Chlorine*	540 ft^3	106.41	5.52	7.55
		Hydrogen Fluoride	0.6 ft^3	0.033	4.7	3.22
		Arsine 15%	62.8 ft^3	2	6	6.30
		Phosphine (Converted to 100%)	51.7 ft^3	4.84	6.3	7.00[a]
		Fluorine 5%	38 ft^3	0.16	5.3	4.50
		Diborane	100 ft^3	7.7	6	6.89
		Silane (Silicon Tetrahydride)	546.4 ft^3	47.1	4.6	6.27

Table F.3–3. List of Chemicals and Risk Hazard Indexes by Facility (continued)

BUILDING NAME	BUILDING NUMBER	CHEMICAL NAME	BUILDING INVENTORY	BUILDING INVENTORY	VHI INDEX	RHI INDEX
Microsystems and Engineering Sciences Applications Complex		*Ammonia*	100 lb	100	3.7	5.70
		Ammonia Auhydrous	140 lb	140	3.7	5.85
		Arsine	80 lb	80	6.3	8.20
		Boron Trichloride	32 lb	32	5.68	7.19
		Bromine	200 mL	1.37	5.35	5.49
		Hydrochloric Acid	114 L	300	3.94	6.41
		Nitric Acd	75.7 L	251	3.24	5.64
		Nitrous Oxide	100 lb	100	3.9	5.90
		Phosphine	60 lb[a]	60[a]	6.3	8.08
		Saline	8.3 lb	8.3	4.6	5.52
Industrial Hygiene Instrumentation Laboratory	869	*Carbon Disulfide*	3.8 L	0.03	3.98	2.46
		Nitric Acid	5.7 L	18.6	3.62	4.89
Advanced Manufacturing Process Laboratory	878	*Nitrous Oxide*	50 lb	50	3.9	5.60
Computing Building	880	*Hydrofluoric Acid 49%*	4 lb	2	4.7	5.00
Photovoltaic Device Fabrication Laboratory	883	*Ammonia*	6 lb	6	3.7	4.48
		Hydrofluoric Acid	12 L	0.02	4.7	3.00
		Nitric Acid	20 L	29.5	3.62	5.09

Table F.3–3. List of Chemicals and Risk Hazard Indexes by Facility (continued)

BUILDING NAME	BUILDING NUMBER	CHEMICAL NAME	BUILDING INVENTORY	BUILDING INVENTORY	VHI INDEX	RHI INDEX
Photovoltaic Device Fabrication Laboratory (cont.)	883	*Phosphine*	72 ft^3	6.8	6.3	7.13
6-MeV Tandem Van Der Graaf Generator	884	*Ammonia*	34.2 lb	34.2	3.7	5.23
		Carbon Monoxide	10 ft^3	0.78	3.46	3.35
		Hydrofluoric Acid	10 lb	10	4.7	5.70
		Nitric Acid	3 L	9.8	3.62	4.61
Lightning Simulation Facility	888	*Fluorine 5%*	500 L	0.07	5.3	4.15
Compound Semiconductor Laboratory (CSRL)	893	*Ammonia Anhydrous*	400 lb	400	3.7	6.3
		Bromine	200 ml	1.37	5.35	5.49
		Hydrochloric Acid 37%	114 L	300.5	3.94	6.41
Compound Semiconductor Laboratory (CSRL)–Gas Storage Location	893 Gas Storage Location	*Arsine 100%*	99.5 lb	65	6.3	8.11
		Boron Trichloride	32 lb	32	5.68	7.19
		Boron Trifluoride	70 g	0.15	5.6	4.79
		Nitric Acid	75.7 L	250.9	3.24	5.64
		Nitrous Oxide	100 lb	100	3.9	5.9
		Phosphine 100%	99 lb	50	6.3	8.00
		Silane (Silicon Tetrahydride)	31.4 lb	8.3	4.6	5.52

Table F.3–3. List of Chemicals and Risk Hazard Indexes by Facility (concluded)

BUILDING NAME	BUILDING NUMBER	CHEMICAL NAME	BUILDING INVENTORY	BUILDING INVENTORY	VHI INDEX	RHI INDEX
Integrated Materials Research Laboratory	897	*Ammonia*	1.82 kg	4	3.7	4.30
		Bromine	900 g	2	5.35	5.65
		Chlorine	2 kg	4.4	5.52	6.16
		Fluorine	424.7 L	1.25	5.3	5.40
		Furan	500 ml	0.003	6.33	3.81
		Hydrofluoric Acid	2.54 kg	5.6	4.7	5.45
		Methylamine	800 ml	0.002	5	2.30
		Nitric Acid	13.4 L	43.8	3.62	5.26
		Nitric Oxide	158.2 g	0.35	4.6	4.14
		Thionyl Chloride	1 L	3.6	4.42	4.98
Explosive Components Facility	905	*Alcohols*	30 L	52.8	2.09	3.81
		Hydrogen Chloride 5%	15 L	0.054	4.7	3.43
		Thionyl Chloride	28 L	101.1	4.42	6.42

Source: Original
ft³: cubic feet
g: gram
kg: kilogram
L: liter
lb: pound
ml: milliliter
RHI: Risk Hazard Index
VHI: Vapor Hazard Index
[a]Amounts of arsine and phosphine shown are the amounts if stored in one location. Two storage locations would result in each location containing half the amount.
Note: The highlighted chemicals were used for the dispersion model for each building.

F.3.3 Atmospheric Dispersion of Chemicals

The atmospheric concentration analysis uses the *ALOHA* computer program (NSC 1995). This program is capable of modeling release rates from various sources and the resultant hazardous gas cloud concentrations. The program does not account for wind shifts, terrain steering effect, fires, chemical reactions, or radioactive materials.

Each chemical release is assumed to be a ground-level dispersion, modeled as a point source, with a total release time of 10 minutes for the inventory. A neutral atmospheric stability (stability level "D") and a wind speed of 1.5 m/sec are used for all *ALOHA* simulations in this document.

The most frequent stability class at SNL/NM is D, occurring 44 percent of the time. Wind speeds of 3m/sec and greater usually accompany D stability. The use of D stability with 1.5 m/sec yields more conservative results (higher concentrations at distances further from the release point) than the corresponding meteorological conditions used in estimation of radiological impacts, which were evaluated using the equivalent of 50-percentile dispersion. The 50-percentile dispersion parameters are D stability and 4.3 m/sec.

The release time of 10 minutes was chosen to maximize the accident concentrations. The 10-minute release duration is recommended in the EPA risk management program (EPA 1999). It was assumed that the entire chemical would be released from its container. Because the release was not modeled by *ALOHA*, the temperature of the ambient conditions was not important.

Because the wind direction during an accident cannot be predicted, the SWEIS chemical analysis assumed dispersion of the chemicals in the predominant wind direction (from south-southwest to north-northeast), during daytime (7 am to 7 pm) (see Table F.3–3a). Daytime was chosen to maximize the number of people affected onsite because more people are working onsite during daytime than during nighttime periods. In addition, the predominant wind direction during the nighttime would disperse the chemicals toward the center of KAFB and minimize the offsite impacts.

Table F.3-3a shows the likelihood of a chemical plume migrating in a particular direction, should an accident occur.

Each chemical release assumes loss of the building's inventory due to some catastrophic event such as an earthquake or airplane crash. No attempt is made to model actual process release rates, which would probably be of greater duration or lesser quantity, resulting in a lower concentration. Atmospheric inversion is not considered. No credit is taken for existing process control features, storage practices, or containerization safety features that may slow or limit the releases. Even in a catastrophic event, release of the building's inventory is somewhat improbable due to the robust types of storage containers and the segregation of processes within the buildings.

> **Atmospheric Stability Categories**
>
> Meteorologists have divided the atmospheric stability into seven categories, ranging from A (extremely unstable) to D (neutral) to G (extremely stable). The stability categories can be determined either by the wind speed and change of temperature with height or by the standard deviation of the horizontal wind direction.

The effects of potential chemical interactions between different chemicals were not modeled because the results are not predictable to a degree of certainty appropriate for the SWEIS. Some chemicals, like phosphine and thionyl chloride, react with oxygen in the air, reducing the size of the plume described in the SWEIS. The dispersion results show only the chemical with the highest RHI. For those chemicals with lower RHIs, the plumes would be smaller.

Table F.3–4 provides a summary of the *ALOHA* chemical dispersion runs. The affected zones are plotted on Figures F.3–1 through F.3–12. In addition to showing a dispersion plume extending to the north-northeast, a circle is included to illustrate the areas that could be affected if the wind was blowing into another direction.

Table F.3-5 identifies receptors that could be exposed to a chemical release from a building. Only the arsine and phosphene plumes are long enough to reach any receptors. The likelihood of the plume migrating in the specific direction of any core receptor can also be determined from Table F.3-3a.

The dominant impact would be from the release of arsine from Building 893, Compound Semiconductor Research Laboratory [CSRL] for all alternatives. If implemented, the MESA Complex configuration for the Expanded Operations Alternative dominant impact would be from the release of arsine. In the case of

Table F.3–3a. Probability of Wind Direction for Tower A21 During Daytime and Nighttime Conditions

WIND DIRECTION		PROBABILITY	
FROM	TO	DAY	NIGHT
N	S	6.09	7.52
NNE	SSW	2.17	5.06
NE	SW	1.98	9.04
ENE	WSW	4.07	18.50
E	W	4.76	13.99
ESE	WNW	3.24	6.52
SE	NW	2.65	6.63
SSE	NNW	3.28	7.90
S	N	7.48	4.56
SSW	NNE	10.89	2.83
SW	NE	8.65	2.47
WSW	ENE	8.76	2.39
W	E	8.90	2.37
WNW	ESE	7.94	2.21
NW	SE	9.27	2.68
NNW	SSE	9.87	5.34
All Directions		100.0	100.0

Source: SNL/NM 1999b
Note: Daytime from 7 am to 7 pm; nighttime from 7 pm to 7 am.

Building 893, arsine is run at the building inventory level of 65 lb, based on data obtained from a facility walk-through and meeting with facility representatives. The release of the building inventory of arsine from Building 893 would result in a potential affected zone, at or above the ERPG-2 level, to a distance of 6,891 ft.

Table F.3–6 presents an estimate of the number of people that could be located within the ERPG-2 plume for a release of the building inventory. As can be seen, the potential number of people within the ERPG-2 plume can range from 2 to 558. The average onsite population density over the northern part of KAFB is 0.00019 person per square ft and for the offsite population the density is 0.000112 person per square ft. At any specific location onsite or offsite, the population density could be higher or lower than these averages.

If implemented, the MESA Complex configuration for the Expanded Operations Alternative would have a building inventory of 80 lb of arsine, which could be stored in one or two separate locations. The arsine values shown in Tables F.3–4 and F.3–6 assume all of the arsine is in one location and represents the dominant impacts. If two separate locations are used to store arsine at the MESA Complex, the impacts of a catastrophic accident would be less. For those rare instances when the amount of arsine in the building exceeds 80 lb, the combination of the probability of the instance and the probability of the accident would result in a total accident probability much less than 10^{-6} per year.

The dominant chemical accident is 80 lb of arsine released at the MESA Complex. The release of the building inventory of arsine from the MESA Complex would result in a potential affected zone to a distance of

Table F.3–4. Dispersion Modeling Results for Chemicals with Highest Risk Hazard Indexes

BUILDING NAME	BUILDING NUMBER	CHEMICAL NAME	AMOUNT RELEASED (p s)	ERPG-2 LEVEL (ppm)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)
Systems Research and Development	823	Nitrous Oxide	32.17	125	351
Microelectronics Development Laboratory (MDL)	858	Chlorine	106.4	3	3,726
Microsystems qnd Engineering Sciences Applications (MESA) Complex		Arsine	80	0.5	7,920
Industrial Hygiene Instrumentation Laboratory	869	Nitric Acid	18.6	15	666
Advanced Manufacturing Processes Laboratory	878	Nitrous Oxide	50.0	125	426
Computing uilding	880	Hydrofluoric Acid	2.0	20	NR
Photovoltaic Device Fabrication Laboratory	883	Phosphine	6.8	0.5	3,357
6-Me Tandem an Der Graaf Generator	884	Hydrofluoric Acid	10.0	20	504
Lightning Simulation Facility	888	Fluorine	0.07	1	NR
Compound Semiconductor Laboratory (CSRL) Gas Storage Location	893 Gas Storage Location	Arsine	65.0	0.5	6,891
Integrated Materials Research Laboratory	897	Chlorine	4.4	3	699
Explosive Components Facility	905	Thionyl Chloride	101.1	5	2,067

Source: Original
ERPG-2: Emergency Response Planning Guideline Level 2
ppm: parts per million
ALOHA: Areal Location of Hazardous Atmospheres computer code
NR: Not Reported. The model did not provide a plume footprint because the effects of near-field patchiness made dispersion prediction unreliable for short distances.

Table F.3-5. Receptor Locations Potentially within Emergency Response Planning Guideline Level 2

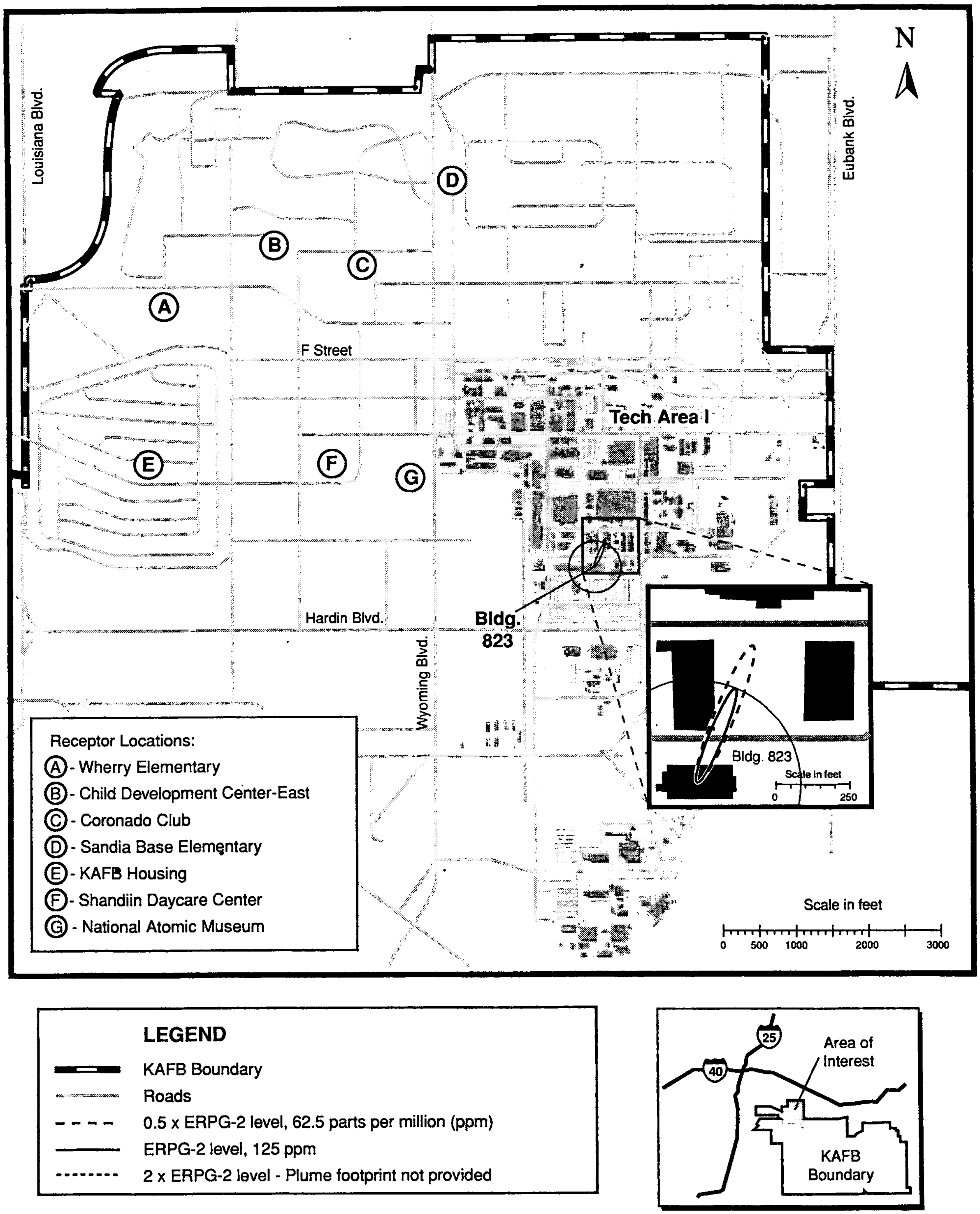
RECEPTOR LOCATION	DIRECTION FROM RELEASE POINT	RELEASE POINT	CHEMICAL RELEASED
A	WNW	Building 893 (CSRL)	Arsine
	NW	Building 893 (CSRL)	Arsine
	WNW	MESA Complex	Arsine
C	NW	Building 893 (CSRL)	Arsine
	WNW	MESA Complex	Arsine
D	NNW	Building 893 (CSRL)	Arsine
	NW	MESA Complex	Arsine
E	W	Building 893 (CSRL)	Arsine
	W	MESA Complex	Arsine
F	W	MESA Complex	Arsine
	W	Building 893 (CSRL)	Arsine
G	WNW	Building 893 (CSRL)	Phosphine
	W	MESA Complex	Arsine
	W	Building 893 (CSRL)	Arsine

Source: Original
CSRL: Compound Semiconductor Research Laboratory
MESA: Microsystems and Engineering Sciences Applications
Note: See Figures F.3-6, F.3-9, and F.3-12

Table F.3–6. Potential Number of People at Risk of Exposure to Chemical Concentrations Above Emergency Response Planning Guideline Level 2

BUILDING NAME	BUILDING NUMBER	CHEMICAL NAME	BUILDING INVENTORYL ARGEST SINGLE SOURCE (p s)	ALOHA DISTANCE – REQUIRED TO REACH ERPG-2 LEVEL (ft)	POTENTIAL NUMBER OF PEOPLE WITHIN ERPG-2 LEVEL PLUME –
Systems Research and Development	823	Nitrous oxide	32.17	351	2
Microelectronics Development Laboratory (MDL)	858	Chlorine	106.41	3,726	141
Microsystems and Engineering Sciences Applications (MESA) Complex		Arsine	80	7,920	558
Industrial Hygiene Instrumentation Laboratory	869	Nitric acid	18.6	666	6
Advanced Manufacturing Processes Laboratory	878	Nitrous oxide	50	426	3
Computing uilding	880	Hydrofluoric acid	2	NR	NR
Photovoltaic Device Fabrication Laboratory	883	Phosphine	6.8	3,357	100
6-Me Tandem an Der Graaf Generator	884	Hydrofluoric acid	10	504	2
Lightning Simulation Facility	888	Fluorine	0.07	NR	NR
Compound Semiconductor Laboratory (CSRL)	893	Arsine	65	6,891	409
Integrated Materials Research Laboratory	897	Chlorine	4.4	699	5
Explosive Components Facility	905	Thionyl chloride	101.1	2,067	55

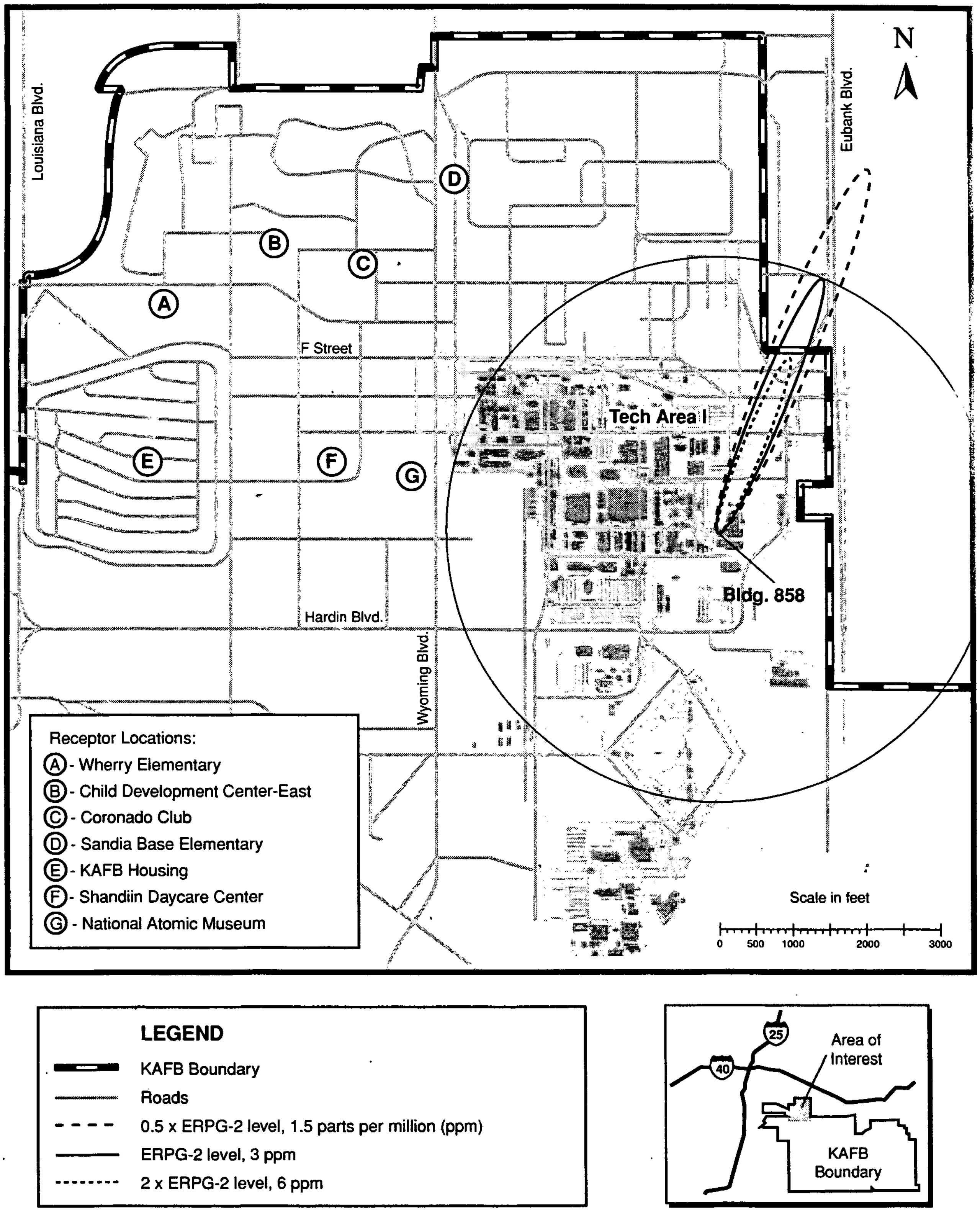
Source: Original
ALOHA: Areal Location of Hazardous Atmospheres computer code
ERPG-2: Emergency Response Planning Guideline Level 2
ft: feet
NR: Not reported. The *ALOHA* model did not provide a plume footprint because the effects of near-field patchiness made dispersion prediction unreliable for short distances. Therefore, no population estimates are available.
[a] Assume all arsine is stored in one location.
Note: 1) See Table F.3–4
2) Dispersion analysis assumes the building inventory is released into the atmosphere within 10 minutes.
3) Number of people is based on the area of plume and a uniform density both onsite (0.00019 person per square foot) and offsite (0.000112 person per square foot).



Source: Original
Note: See Table F.3–4.

Figure F.3–1. Accidental Release of Nitrous Oxide from Building 823

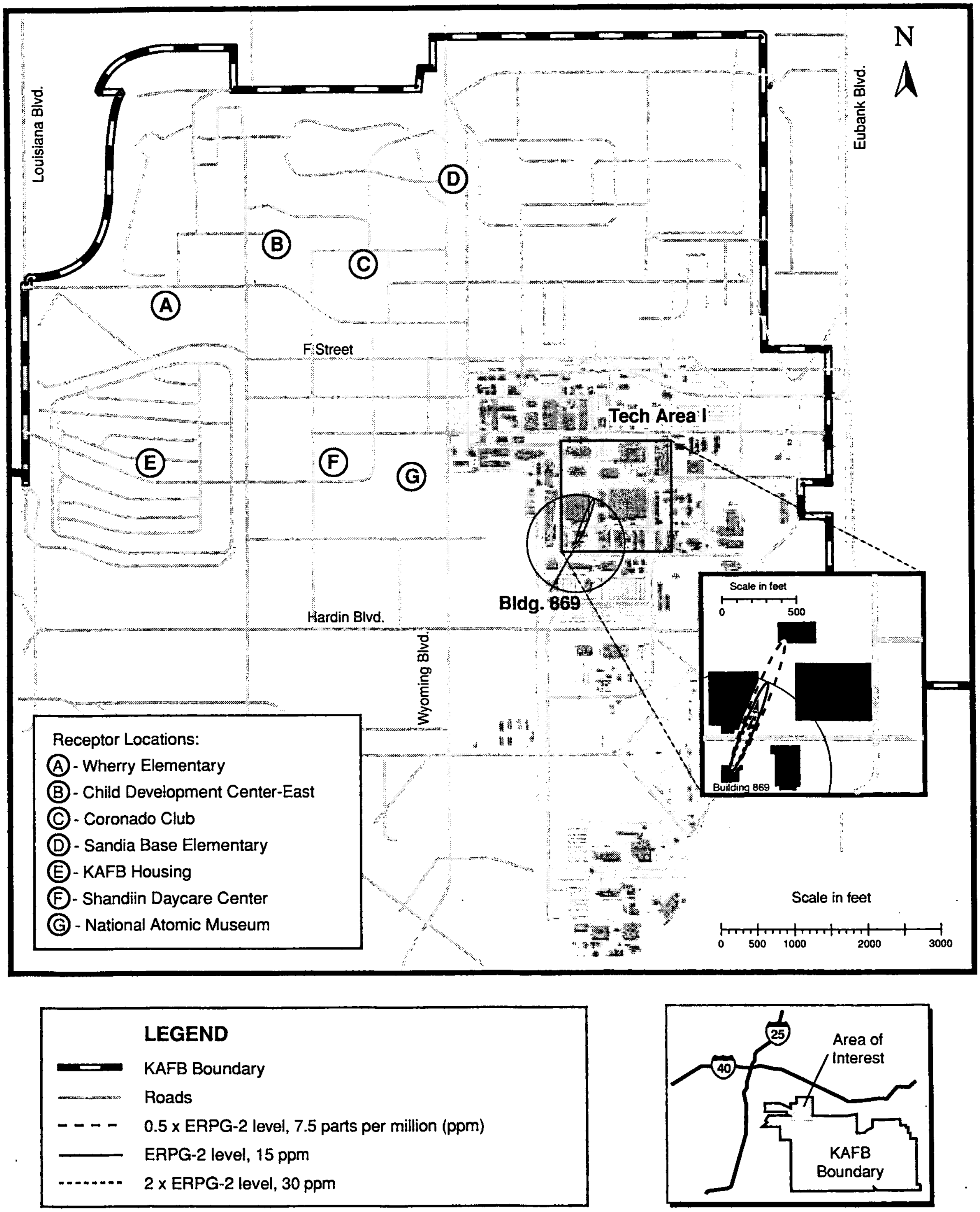
An accidental release of nitrous oxide from Building 823 could affect an area with ERPG-2 levels of exposure extending as far as 351 ft from the source.



Source: Original
See Table F.3–4.

Figure F.3–2. Accidental Release of Chlorine from Building 858

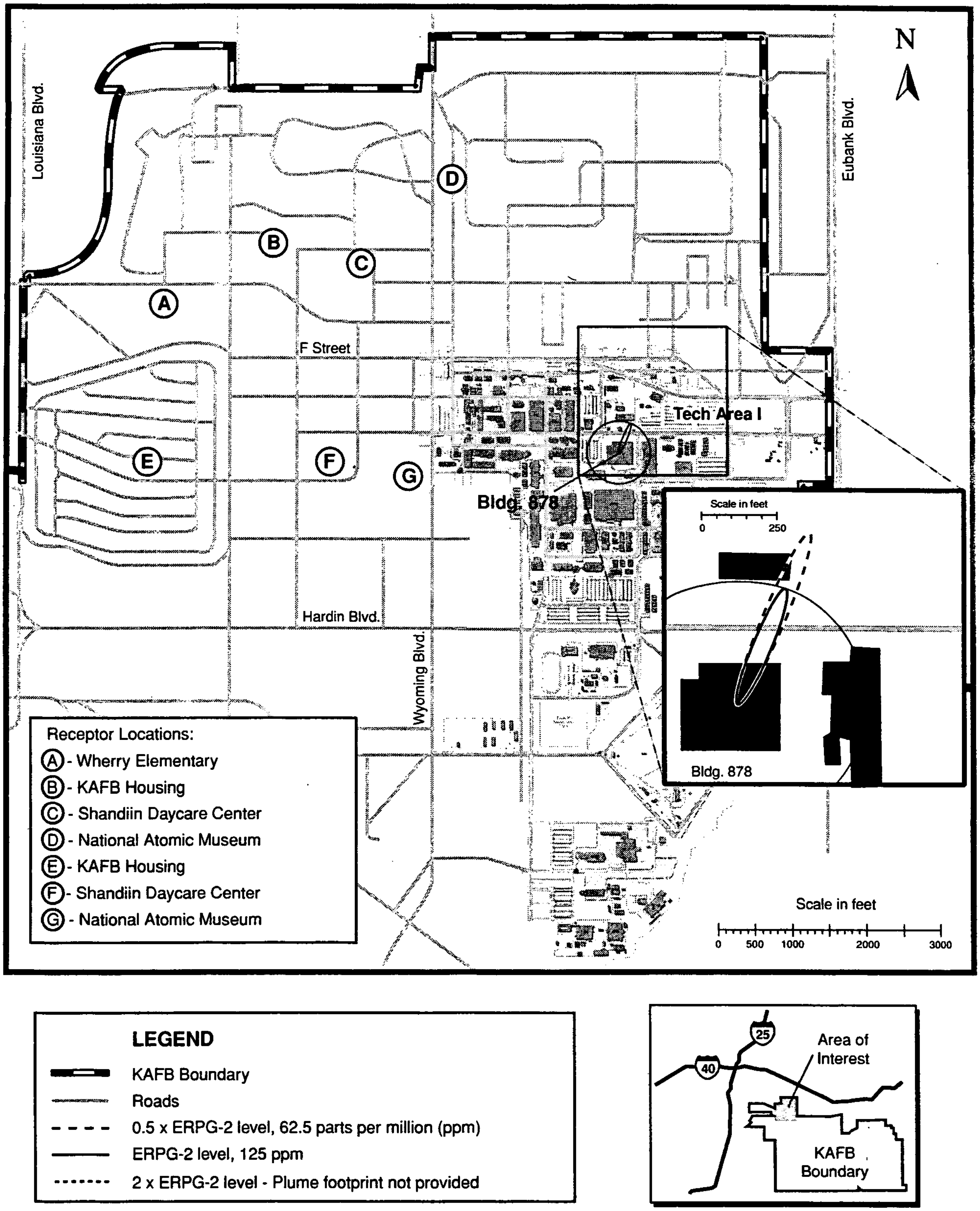
An accidental release of chlorine from Building 858 could affect an area with ERPG-2 levels of exposure extending as far as 3,726 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–3. Accidental Release of Nitric Acid from Building 869

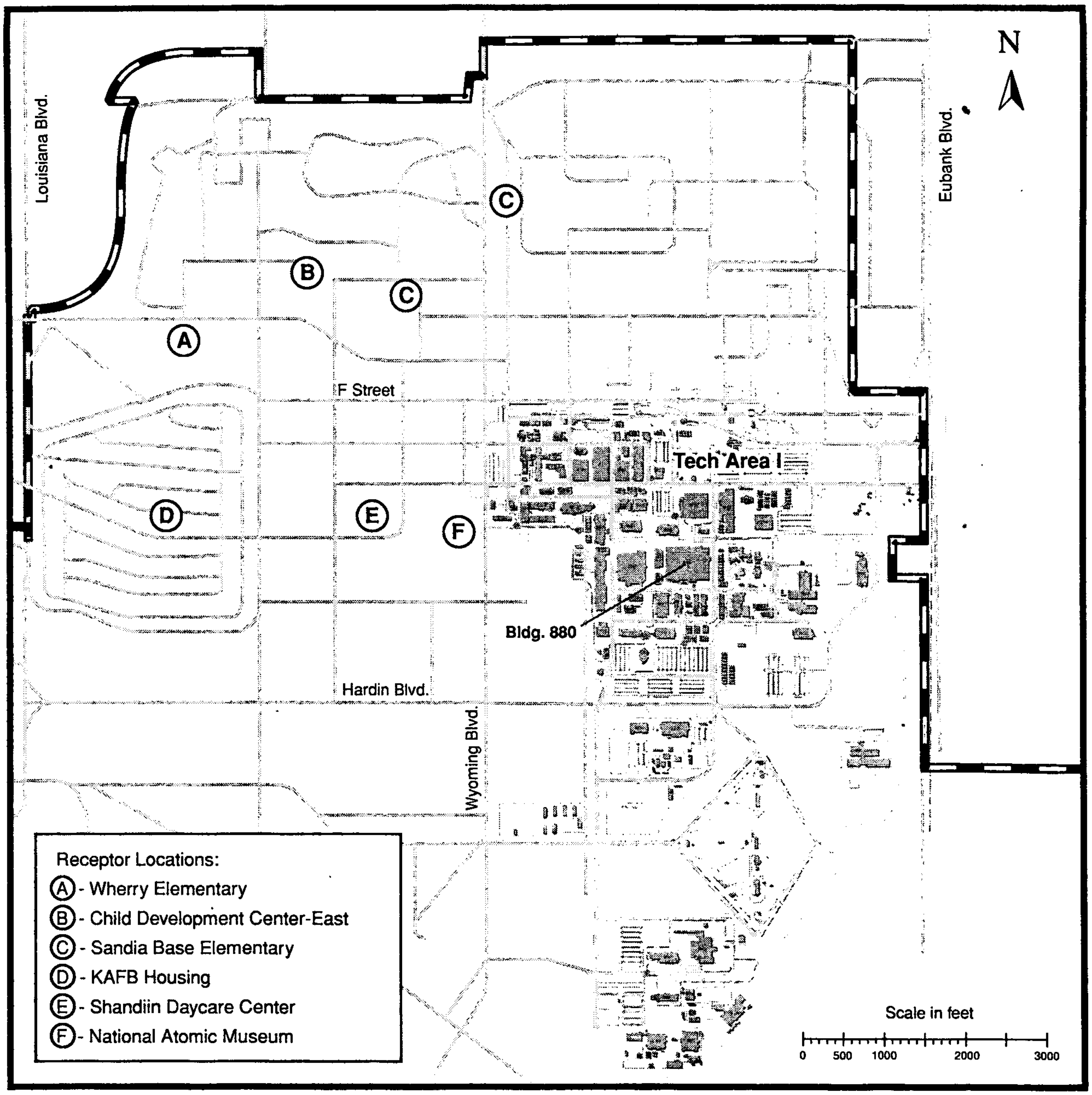
An accidental release of nitric acid from Building 869 could affect an area with ERPG-2 levels of exposure extending as far as 666 ft from the source.

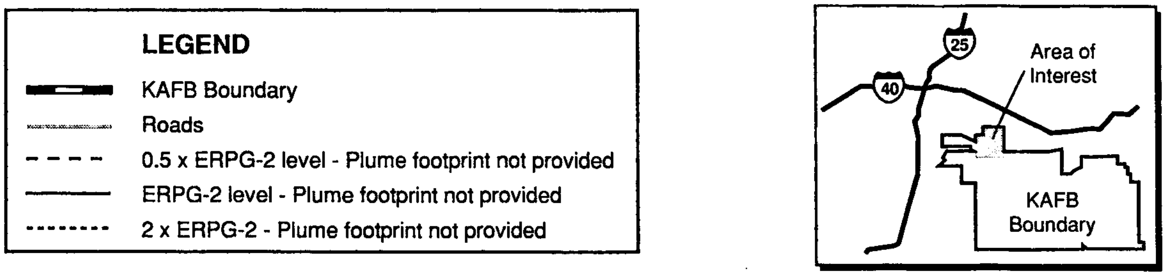


Source: Original
Note: See Table F.3–4.

Figure F.3–4. Accidental Release of Nitrous Oxide from Building 878

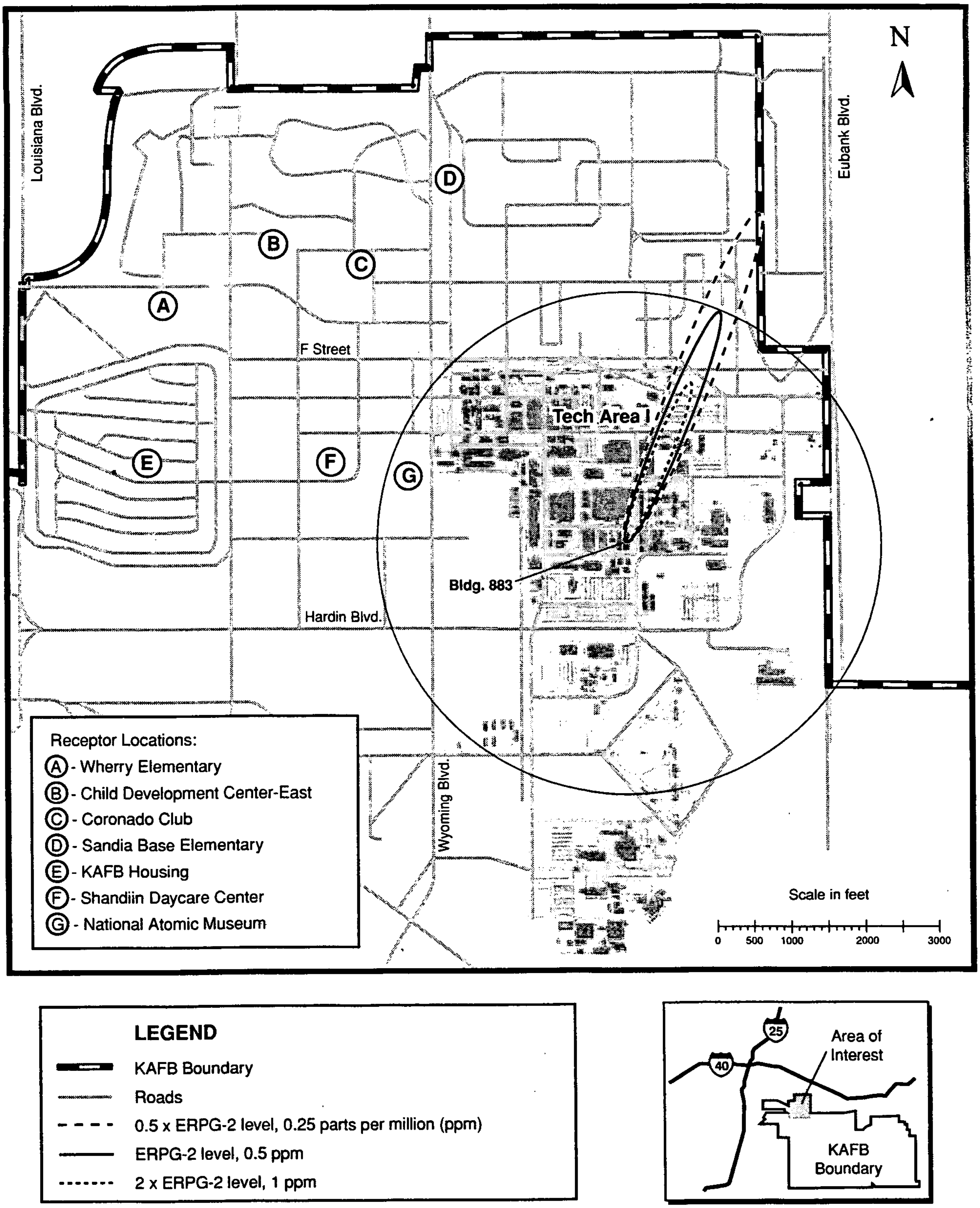
An accidental release of nitrous oxide from Building 878 could affect an area with ERPG-2 levels of exposure extending as far as 426 ft from the source.





Source: Original
Note: See Table F.3–4.

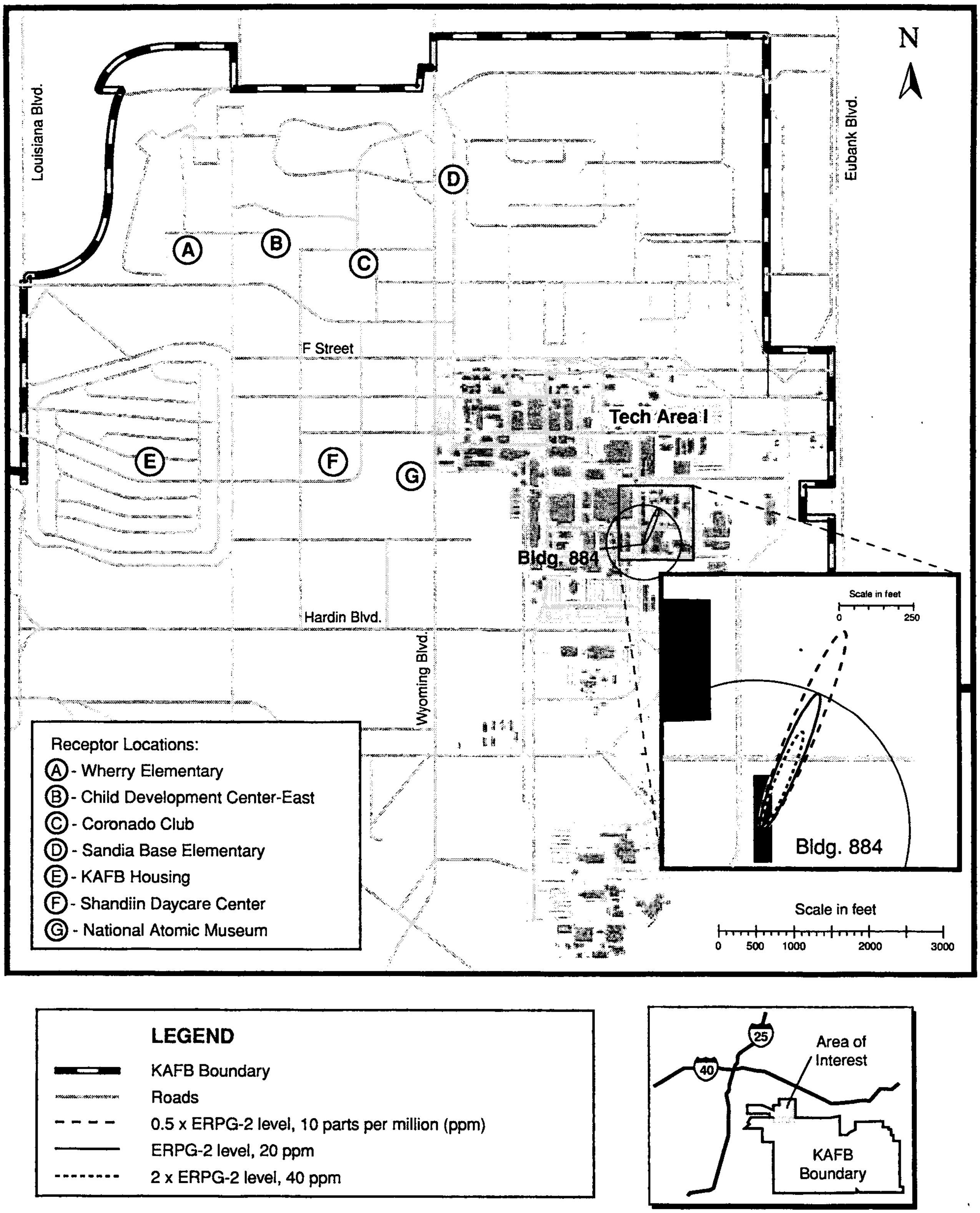
Figure F.3–5. Accidental Release of Hydrofluoric Acid from Building 880
The three plumes are too small to be shown and do not extend outside of Building 880.



Source: Original
Note: See Table F.3–4.

Figure F.3–6. Accidental Release of Phosphine from Building 883

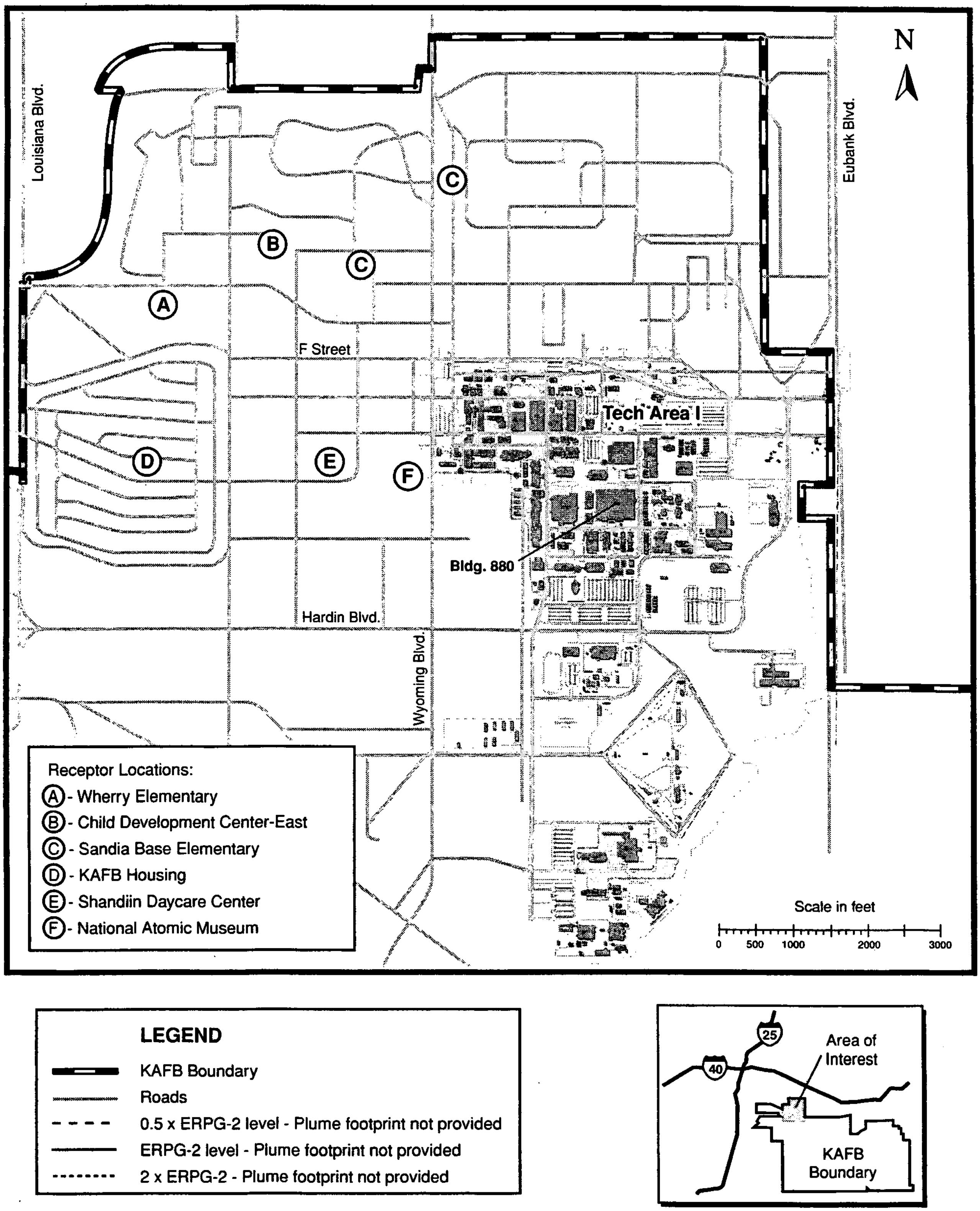
An accidental release of phosphine from Building 883 could affect an area with ERPG-2 levels of exposure extending as far as 3,357 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–7. Accidental Release of Hydrofluoric Acid from Building 884

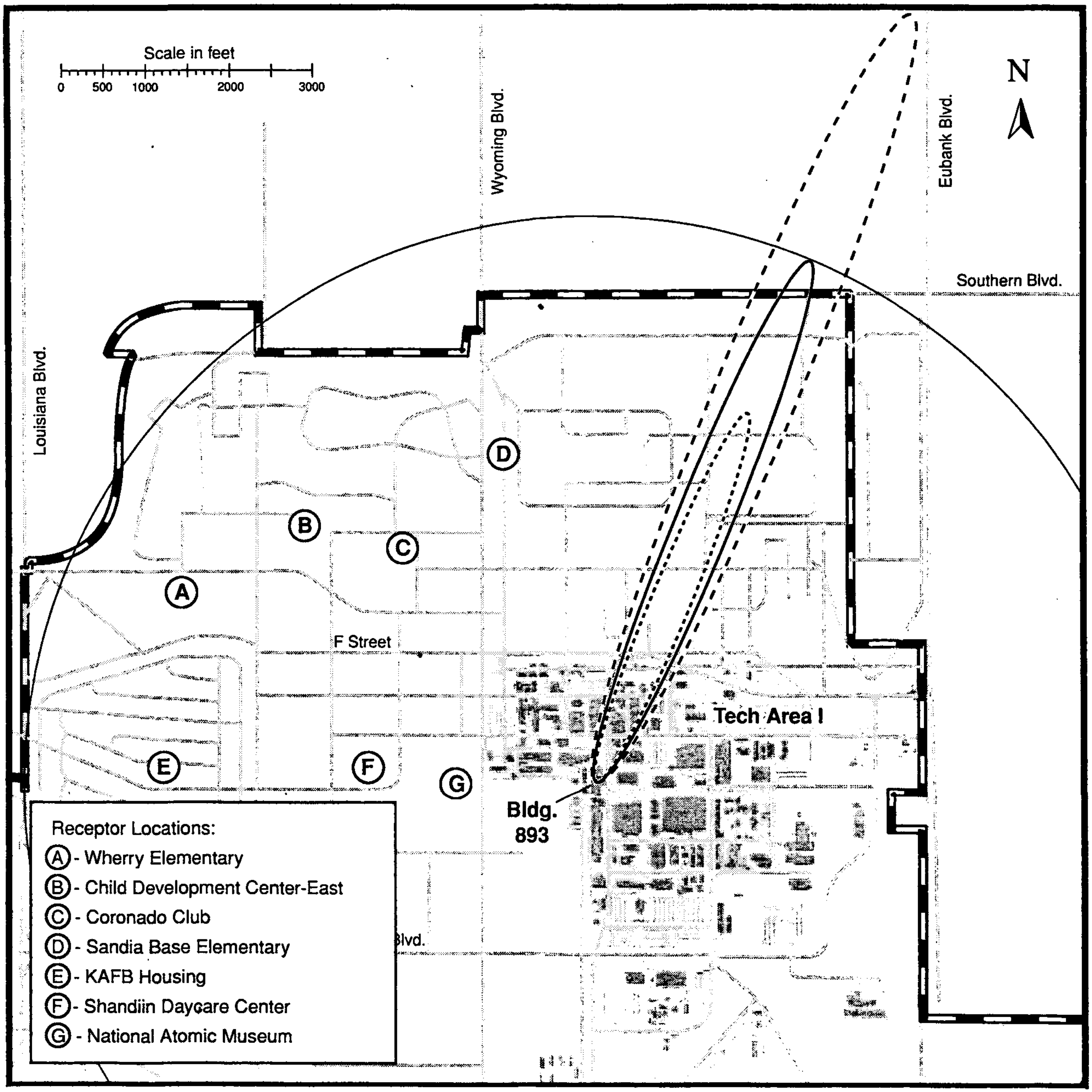
An accidental release of hydrofluoric acid from Building 884 could affct an area with ERPG-2 levels of exposure extrending as far as 504 ft from the source.



Source: Original
Note: See Table F.3–4.

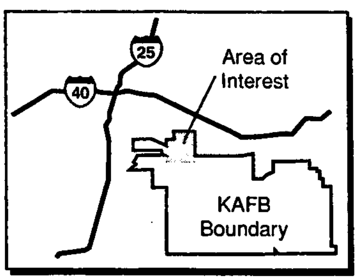
Figure F.3–8. Accidental Release of Fluorine from Building 888

The three plumes are too small to be shown and do not extend outside of Building 888.



LEGEND

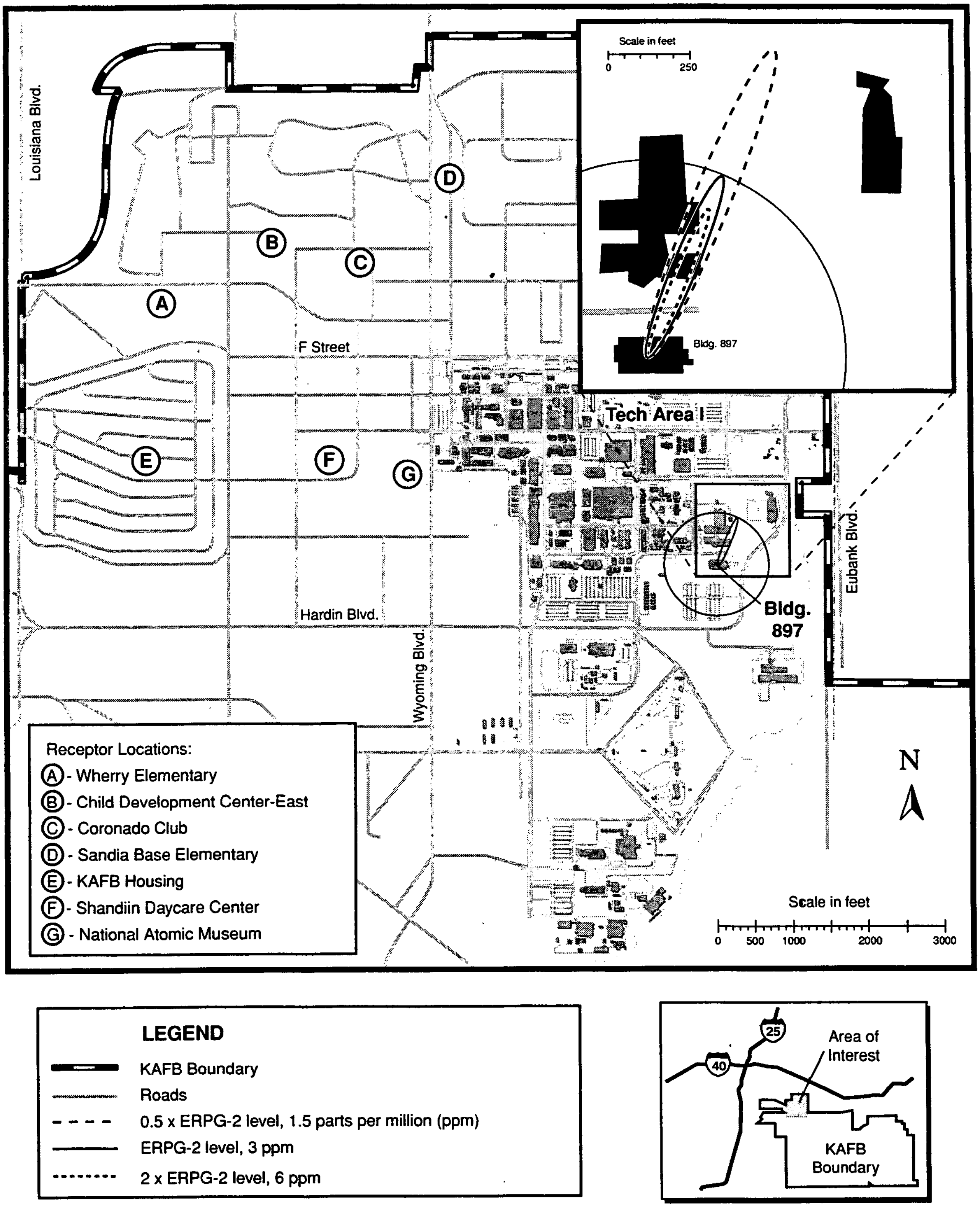
- KAFB Boundary
- Roads
- 0.5 x ERPG-2 level, 0.25 parts per million (ppm)
- ERPG-2 level, 0.5 ppm
- 2 x ERPG-2 level, 1 ppm



Source: Original
Note: See Table F.3–4.

Figure F.3–9. Accidental Release of Arsine from Building 893

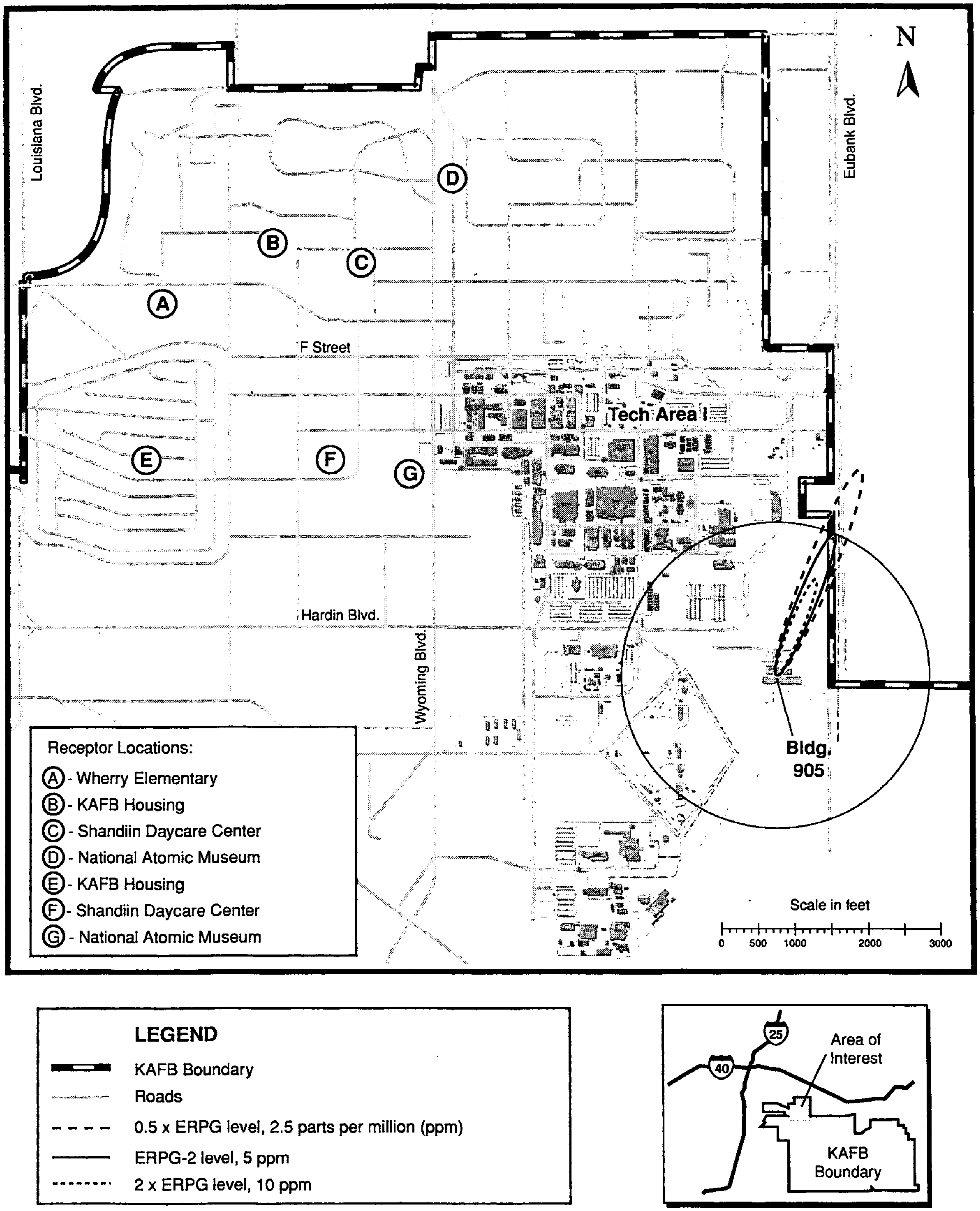
An accidental release of arsine from Building 893 could affect an area with ERPG-2 levels of exposure extending as far as 6,891 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–10. Accidental Release of Chlorine from Building 897

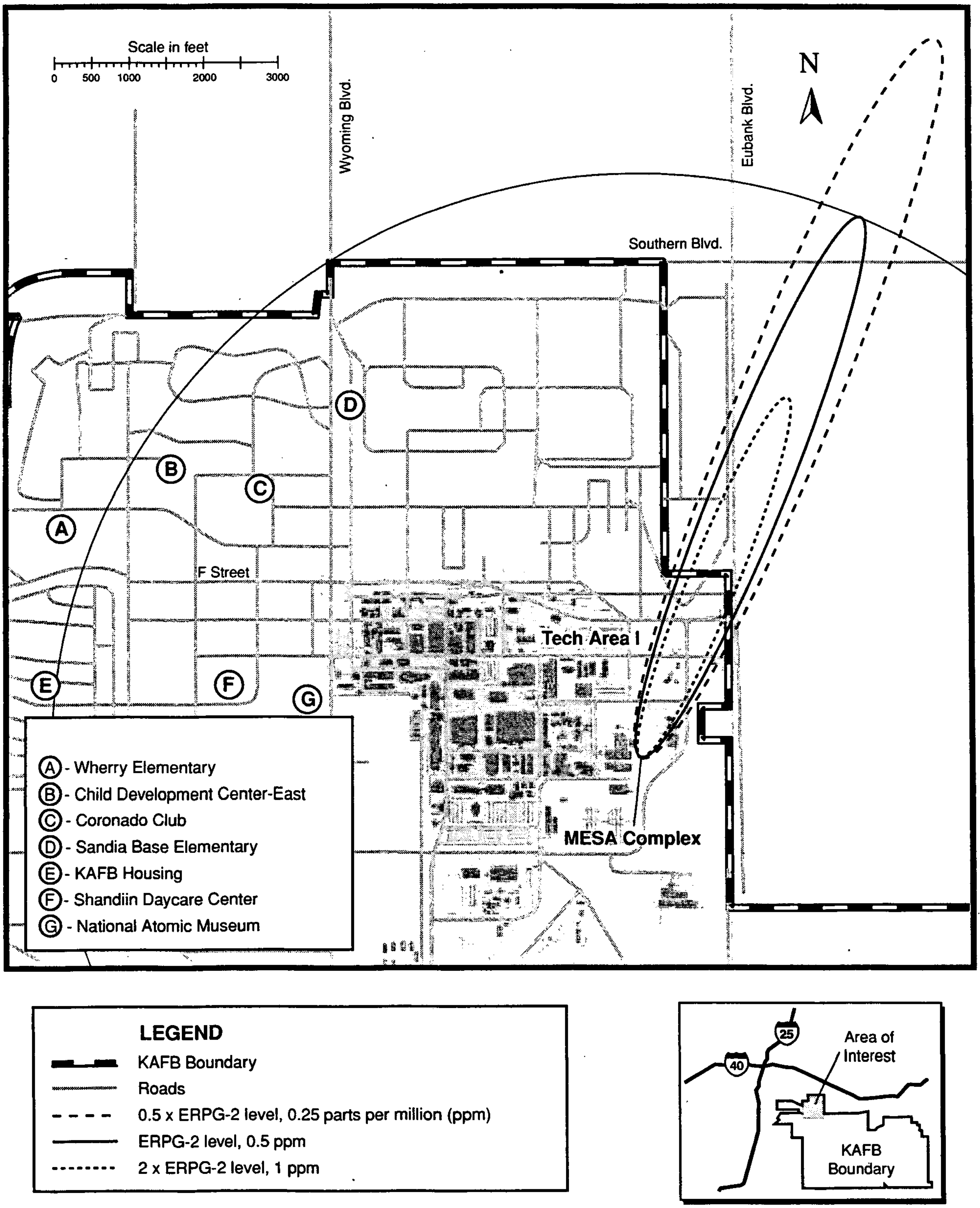
An accidental release of chlorine from Building 897 could affect an area with ERPG-2 levels of exposure extending as far as 699 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–11. Accidental Release of Thionyl Chloride from Building 905

An accidental release of thionyl chloride from Building 905 could affect an area with ERPG-2 levels of exposure extending as far as 2,067 ft from the source.



Source: Original
Note: See Table F.3–4

Figure F.3–12. Accidental Release of Arsine from MESA Complex

If implemented, an accidental release of arsine from the MESA Complex could affect an area with ERPG-2 levels of exposure extending as far as 7,920 ft from the source.

7,920 ft. The *ALOHA* model analysis shows that the area enclosed by the ERPG-2 plume is 4,871,008 ft^2, some extending offsite. This accident could expose 558 individuals to concentrations exceeding ERPG-2 levels. The plume would have a limited area; because, as it diffuses to a larger area, the concentration decreases below ERPG-2 levels. The ERPG-2 concentration area is shown in Figure F.3-12, along with two other concentrations to illustrate the shape and limited width of the plume. All other chemical accidents were estimated to have smaller areas exposed to ERPG-2 levels than the arsine plume.

Uncertainties due to various causes can affect the estimated chemical impacts. For instance, different chemicals released in an accident can interact to produce other chemicals. Such interactions are very complex, particularly in a fire, and are therefore difficult to model. Some chemicals, like phosphine and thionyl chloride, will react with oxygen when exposed to air, possibly limiting their dispersion. The *ALOHA* model is not capable of representing these effects, and, as a result, the impacts shown for phosphine and thionyl chloride are conservative. The actual forces and effects of a catastrophic accident like an airplane crash are similarly very complex. It is uncertain how much of a building's chemical inventory would be affected in an accident. The assumption was made that all of the building's expected chemical inventory would be released, which results in conservative impacts. Similarly, in the event of an earthquake, damage to buildings and effects on the building's chemical inventory are complex and difficult to predict. If a building was not expected to be intact following an earthquake (see Table F.7–3), it was conservatively assumed that the entire building's chemical inventory was released.

The actual population exposed to a chemical plume is also a source of uncertainty. The number of people at any one place and time is a variable. Particularly in the event of an earthquake or airplane crash, considerable chaos and unpredictable individual behavior will be present. Changing wind conditions will affect the direction of the plume. Buildings and other obstacles will affect the shape and direction of a plume. People located within buildings would be afforded some protection by the structure. It was assumed that the plume would travel in the highest frequency wind direction; that is, buildings and other obstacles would not affect the plume, and that no credit would be taken for the protection afforded by the building's structure. These assumptions all produce conservative impacts.

There is uncertainty in the level or seriousness of exposures to a chemical plume at various distances from the point of release. Although the exceedance distance for ERPG-2 was selected to distinguish between serious and reversible effects (ERPG-2) and minor or no effects (ERPG-1), chemical concentrations and the effects on exposed individuals vary over the entire range covered by a plume, from irreversible illness closest to the release (ERPG-3) to no effect at large distances from the point of release. As a result, the number of persons estimated to receive exposures in excess of ERPG-2 is a reasonable metric for comparing alternatives, but the actual health effects for exposed persons at any distance cannot be predicted.

F.4 IMPACTS FROM POSTULATED EXPLOSIONS

F.4.1 Introduction

This section documents the consequences of potential accidental explosions at SNL/NM. There are many potential sources of accidental explosions; however, this analysis evaluates the impacts from storage or transportation of flammable chemicals (Section F.4.2) and transportation of high explosives (Section F.4.3).

F.4.2 Explosions of Flammable Chemicals

In the Draft SWEIS, as a result of the review of available documentation, such as SARs, SAs, and HAs, and facility walk-throughs and meetings, the accident assessment team concluded that two separate cases of hydrogen tank explosion would bound the explosions of flammable chemicals. The first case involves a tanker truck containing about 40,000 ft^3 of hydrogen. This tanker truck could be stored at any of three locations: behind the Advanced Manufacturing Processes Laboratory (AMPL), in a remote location in TA-III, or next to Building 891; or it could be moving between locations within SNL/NM. Impacts from an explosion of this tanker truck, while located at the AMPL, are presented in the hydrogen tanker SAR. The second case involves approximately 90,000 ft^3 of hydrogen located adjacent to Building 893, the CSRL.

Since the Draft SWEIS was published, additional information revealed that a third case of hydrogen tank explosion would bound the explosions of flammable chemicals. The third case involves approximately 493,000 ft^3 of hydrogen located adjacent to Building

858, the Microelectronics Development Laboratory (MDL).

The first case examined is an explosion of the tanker truck while it is being moved within SNL/NM (either from TA-III to the AMPL or from offsite to the storage location within TA-III). According to the U.S. Department of Transportation (DOT) *Hazardous Materials Information System* database, there were six highway accidents resulting in explosions from compressed hydrogen and one resulting in a propane explosion during the 25-year period of 1971 through 1995. It could not be ascertained if these incidents were of a similar kind to that postulated for SNL/NM (LANL 1998). Such a low frequency of incidents, generically described as "explosions," involving these materials suggests that such incidents are extremely unlikely to occur. The data collected are for interstate shipments only; data for intrastate shipments resulting in accidents involving hazardous materials are not available because there are no DOT reporting requirements.

Assuming approximately 4 M mi of highways in the U.S., these data could be represented as $1x10^{-8}$ propane explosions per year per mile of highway, and $6x10^{-8}$ hydrogen explosions per year per mile of highway. Assuming this as the approximate rate for an accident and conservatively assuming 50 mi of network roads within SNL/NM (includes all TAs), the occurrence of this type of accident scenario is conservatively estimated to be on the order of $1x10^{-6}$ per year (or in the low end of the extremely unlikely frequency category).

The second case examined is an explosion postulated to occur from the inadvertent release of hydrogen stored outside the CSRL, Building 893. A set of horizontally mounted cylinders, having a combined volume capacity of approximately 90,000 ft^3 at standard temperature and pressure, is stored immediately east of the CSRL building (Kaczor 1998).

The third case examined is an explosion postulated to occur from the inadvertent release of hydrogen stored in a cryogenic tank located outside Building 858. The cryogenic tank, which holds about 493,000 ft^3 at standard temperature and pressure, is stored immediately north of Building 858 .

An explosion postulated in either the second or third case would occur from an accidental uncontrolled release of hydrogen caused by human error (such as mishandling activities) or equipment failure (such as a pipe joint failure) and the presence of an ignition source (such as a spark) near the location of release. Due to the number of failures that would have to occur for an uncontrolled release of hydrogen and explosion to occur, this accident scenario is considered to e extremely unlikely (between $1x10^{-6}$ and $1x10^{-4}$ per year).

The potential effects of hydrogen explosions are estimated using the trinitrotoluene (TNT)-equivalence model. The TNT-equivalence model relates the amount of flammable material to an equivalent amount of TNT, based on the relative heats of combustion, as shown in the following equation:

$$W = \frac{\eta M H_c}{H_{c-TNT}}$$

(Eq. F.4–1)

Where: W = equivalent mass of TNT (lb),

h = empirical explosion yield (or efficiency) (dimensionless) (0.03 for hydrogen [FEMA 1989]),

M = mass of flammable material released (516 lb of hydrogen for 90,000 ft^3 or 2,400 lb for 493,000 ft^3)

H_c = net heat of combustion of flammable material ($6.1x10^4$ British Thermal Units [BTU]/lb) (LANL 1998),

$H_{c\text{-}TNT}$ = heat of combustion of TNT, approximately 2,000 BTU/lb,

For example, the TNT equivalence of 90,000 ft^3 of hydrogen is

$$W = \frac{0.03*516lbm*6.1x10^4}{2{,}000} = 472lb(TNTequivalence)$$

(Eq. F.4–2)

Table F.4–1 shows the TNT equivalence for 40,000 ft^3, 90,000 ft^3, and 493,000 ft^3 of hydrogen.

Once the TNT equivalence is calculated, the peak positive normal reflected pressure (P_r) can be determined from empirically derived curves such as Figure 4.13 from *A Manual for the Prediction of Blast and Fragment Loadings on Structures* (DOE 1992b). P_r is the pressure that the exterior walls of buildings or structures in the proximity of the explosion will experience from a blast wave traveling normally (perpendicular) to the walls.

To use Figure 4.13 from the DOE manual to determine P_r for SNL/NM, the TNT equivalence is used to calculate the "scaled ground distance" (Z_G in ft/lb$^{1/3}$).

$$Z_G = R_G/W^{1/3}$$

(Eq. F.4-3)

Where: R_G is the distance in ft, and W is the weight in pounds TNT equivalence for the explosion.

Values for Z_G and P_r are given in Table F.4–1 for the postulated flammable gas explosions.

The ears and lungs are the most vulnerable organs in the human body that are affected by shock explosions because these organs contain air or other gases. The damage is done at the gas-tissue interface, where flaking and tearing can occur. It has been found, however, that both the ear and the lung responses are dependent not only on the pressure but also on impulse and body orientation. The shorter the pulse width, the higher the pressure the body can tolerate. Depending on the body orientation, for a square-pressure wave and a pulse duration greater than 10 milliseconds, resulting in 50 percent survival, the pressure is about 50 pounds per square inch (psi). For eardrum rupture, the pressure is about 10 psi.

Structural damage produced by air blasts depends on the type of structural material. For partial demolition of houses (making them uninhabitable), overpressures of about 1 psi are needed. An overpressure of 2 to 3 psi will shatter unreinforced concrete or cinder block walls. At 10 psi, total destruction of buildings would be expected to occur (Glasstone & Doland n.d.).

For the CSRL hydrogen explosion, structural damage to buildings (that is, damage to cinder block walls) could occur out to distances of about 370 ft. Fatalities would be expected to occur within 61 ft, while eardrum ruptures could occur at distances up to about 126 ft. Figure F.4–1 shows the area affected at various pressure levels for the postulated CSRL hydrogen explosion. Figure F.4–2 shows similar information for the postulated explosion at MDL.

The actual number of persons in the vicinity of the accident depends upon many factors and the actual number of potential fatalities is uncertain. Factors include the time of day (start of work day, lunchtime, after hours), the actual location of the people (amount of shielding between the hydrogen tank and the person), and the actual spread of the pressure waves in a very complex arrangement of buildings, alleys, and walkways.

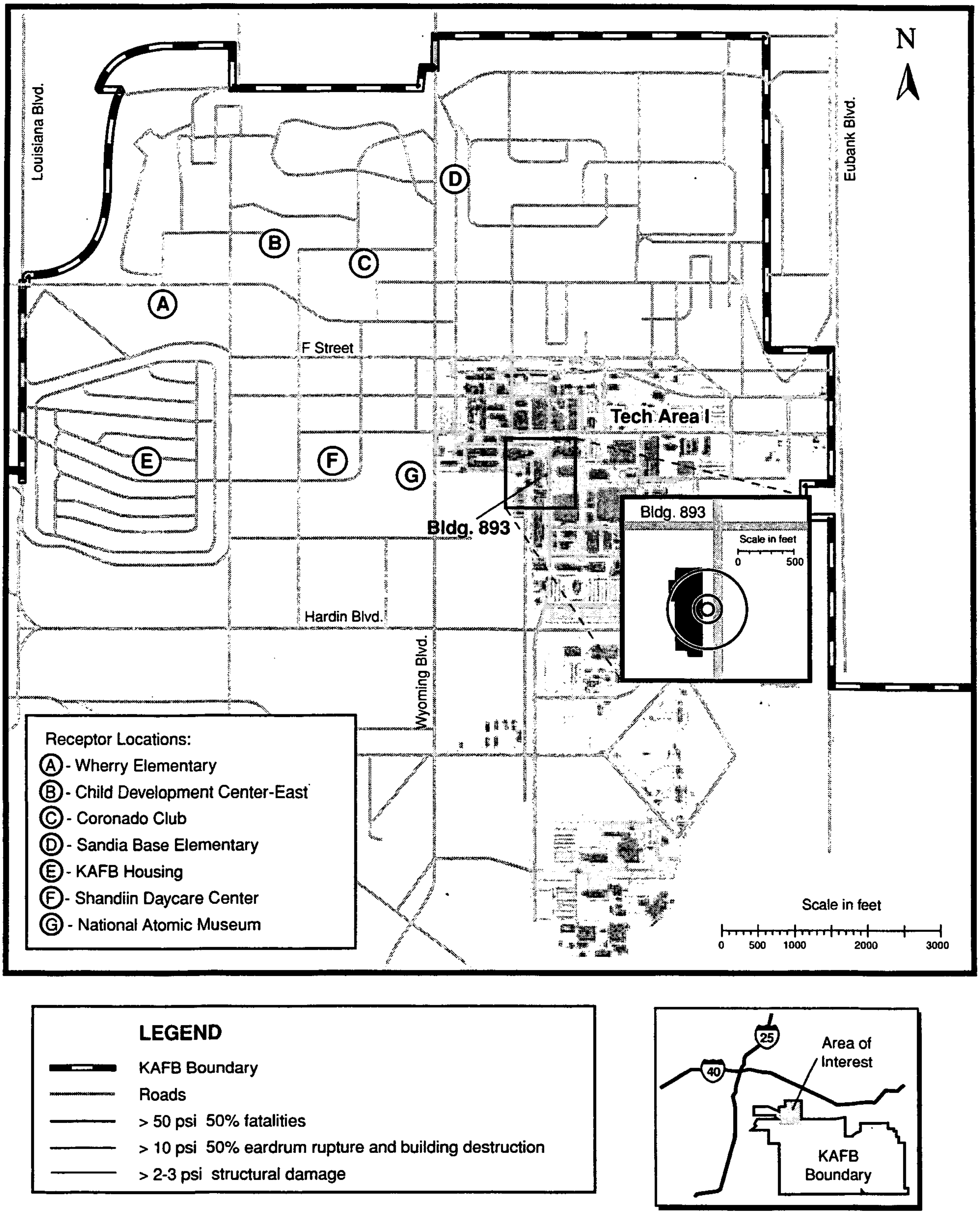
F.4.3 Explosions Involving High Explosives

Several scenarios are postulated involving the shipment of high explosives. The maximum allowable amount of high explosives that can be transported onsite,

Table F.4–1. Peak Reflective Pressures and Physical Effects as a Function of Distance for the Postulated Flammable Gas Explosions

Z_G (ft/lbs$^{1/3}$)	P_r (psi)	PHYSICAL EFFECTS	DISTANCE (ft)		
			472-lb TNT	209-lb TNT	2,203-lb TNT[a]
7.8	50	50% survival rate for pressures in excess of 50 psi	61	46	101
16.2	10	50% rate of eardrum rupture and total destruction of buildings for pressures in excess of 10 psi	126	96	210
47.5	2.0	Pressures in excess of 2-3 psi will cause concrete or cinder block walls to shatter.	370	282	617
84.4	1.0	Pressures in excess of 1 psi will cause a house to be demolished.	657	501	1,096

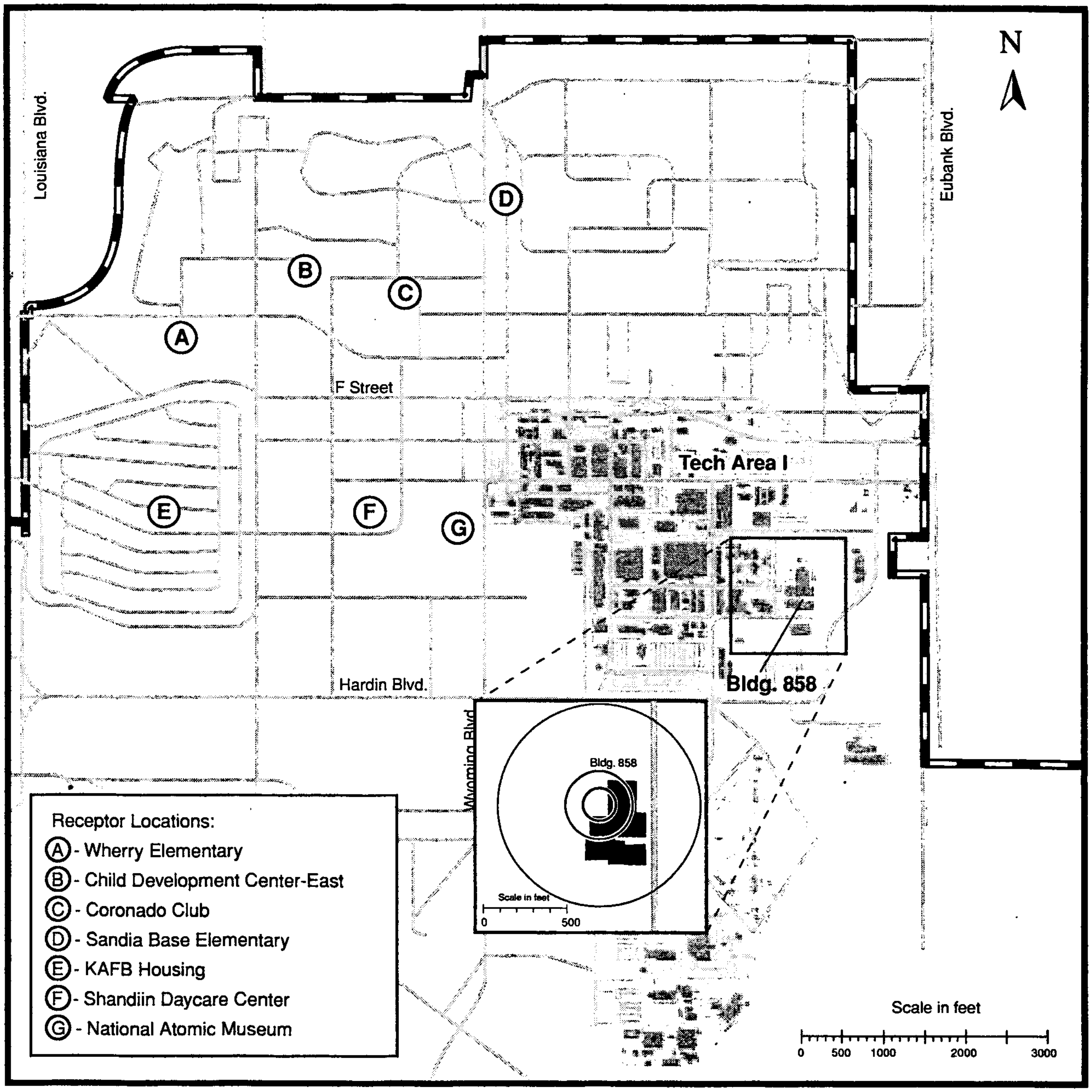
Source: Original
ft: feet
lb TNT: weight expressed as equivalent pounds of trinitrotoluene.
P_r: reflected pressure
psi: pounds per square inch
Z_G: scaled ground distance
[a] Dominant impact

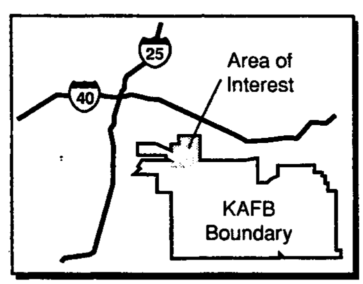


Source: Original
Note: See Table F.4-1

Figure F.4-1. Hydrogen Explosion at Building 893.

The postulated hydrogen explosion at Building 893 would result in 50 percent fatalities at 61 ft, eardrum rupture and building destruction at 126 ft, and structural damage at up to 370 ft.





Source: Original
Note: See Table F.4-1

Figure F.4–2. Hydrogen Explosion at Building 858

The postulated hydrogen explosion at Building 858 would result in 50 percent fatalities at 101 feet, eardrum rupture and building destruction at approximately 210 feet, and structural damage at up to 617 feet.

unescorted, is 25 lb. The typical amount of escorted high explosives transported onsite is 25 kg (55 lb). The maximum amount of high explosives transported onsite (atypical) is 4,600 kg (10,120 lb). Table F.4–2 presents the Z_G values and P_r values as a function of distance for the three magnitudes of explosive accidents.

For the maximum explosive transportation accident (10,120-lb TNT), structural damage to buildings (damage to cinder block walls [2-3 psi]) could occur at distances of up to 1,000 ft. Fatalities would be expected to occur within 175 ft, while eardrum ruptures could occur at distances up to approximately 350 ft.

As a check of the impact, the direct static overpressures (ignoring reflective pressure) should be well below the reflective peak pressures. The correlation to calculate the direct static overpressure is found in the literature; a typical correlation is given below. This equation is used to correlate the distance to a given direct static overpressure (AICE 1989).

$$X = 0.3967 M^{1/3}{}_{TNT}\, Exp\left(3.5031 - 0.724(\ln O_p) + 0.0398(\ln O_p)^2\right)$$

(Eq. F.4–4)

Where: X = the distance to a given overpressure (m),

O_p = the peak static overpressure (psi),

M_{TNT} = the TNT-equivalent weight (kg),

Exp = exponent, and

ln = natural log.

Using the TNT-equivalent weight for the CSRL explosion and an overpressure of 10 psi, the distance to such overpressure would be about 60 ft. This compares to the results for the peak reflective pressure of 10 psi at 126 ft.

F.5 AIRPLANE CRASH FREQUENCY ANALYSIS

F.5.1 Introduction

This section documents the evaluation of potential airplane crashes into SNL/NM facilities. It discusses the selection of representative facilities for the airplane crash analysis, the sources of information on flight activities or frequencies, distances to the facilities from various airports around the Albuquerque metropolitan area, and the results of the analyses. A DOE standard (DOE-STD-3014) for airplane crash frequency analysis was issued in 1996 to help standardize the evaluation of aircraft crashes into facilities (DOE 1996f). Prior to the availability of the DOE standard, the frequencies of aircraft crashes into hazardous facilities at SNL/NM were calculated in various safety documents (for example, SARs and SAs) by other methodologies. In order to update the aircraft crash frequencies for SNL/NM facilities, the standard was used to produce aircraft crash frequencies for use in the SWEIS.

Table F.4–2. Scaled Ground Distance Peak Reflective Pressures as a Function of Distance for the Postulated Explosive Shipment Scenarios

TARGET (ft)	2 - TNT		- TNT		2 - TNT	
	Z_G (ft)	P (ps)	Z_G (ft)	P (ps)	Z_G (ft)	P (ps)
25	1.2	>1,000	6.6	60	8.6	38
50	2.3	>1,000	13.1	18	17.1	8
100	4.6	200	26.3	4	34.2	3
200	9.3	28	52.6	1.5	68.5	1.4
300	13.9	17	78.9	1.3	102.7	<1
400	18.5	6.5	105	<1	136.9	<1
500	23.2	5	131	<1	171.2	<1
750	34.8	3	197	<1	256.8	<1
1,000	46.4	2	262	<1	342.4	<1

Source: Original
ft: feet
lb TNT: weight expressed as equivalent pounds of trinitrotoluene
P_r: peak reflective pressure
psi: pounds per square inch
Z_G: scaled ground distance

Representative facilities within SNL/NM were selected for analysis based on their potential for public consequences. **Table** F.5–1 lists the facilities that were selected for analysis.

As indicated in **Table** F.5–1, several facilities were identified to represent TA-I due to the wide variation in building sizes and locations. The SPR was selected for analysis because it is representative of the other buildings in TA-V. The Radioactive and Mixed Waste Management Facility (RMWMF) was selected because it handles radioactive waste.

F.5.2 Methodology

Aircraft crash impact frequencies for facilities are determined using the "four-factor formula" from the DOE standard (DOE-STD-3014). This formula considers the number of aircraft operations; the probability that an aircraft will crash; the probability that, given a crash, the aircraft will crash into a 1-mi^2 area where the facility of interest is located; and the size of the facility. The formula from DOE-STD-3014 is

Table F.5–1. Selected Facilities for Aircraft Crash Frequency Calculations

REPRESENTATIVE FACILITY	TECHNICAL AREA
Integrated Materials Research Laboratory	I
Microelectronics Development Laboratory	I
Neutron Generator Facility	I
Advanced Manufacturing Processes Laboratory	I
Compound Semiconductor Research Laboratory	I
Microsystems and Engineering Sciences Applications Complex	I
Explosive Components Facility	II
Z-Machine	IV
Radioactive and Mixed Waste Management Facility	III
Sandia Pulsed Reactor	V

Source: Original

$$F = \Sigma N_{ijk} \bullet P_{ijk} \bullet f_{ijk}(x,y) \bullet A_{ij}$$

(Eq. F.5–1)

Where: F = estimated annual aircraft crash impact frequency for the facility of interest (number per year);

N_{ijk} = estimated annual number of site-specific airport operations takeoffs, landings, and in-flights for each applicable summation parameter;

P_{ijk} = aircraft crash rate for each applicable summation parameter;

$f_{ijk}(x,y)$ = aircraft crash location conditional probability (per square mile), given a crash valuated at the facility location for each applicable summation parameter;

A_{ij} = site-specific effective area for the facility of interest that includes the skid and fly-in effective areas (mi^2) for each applicable summation parameter;

i = index for flight phases (takeoff, in-flight, and landing);

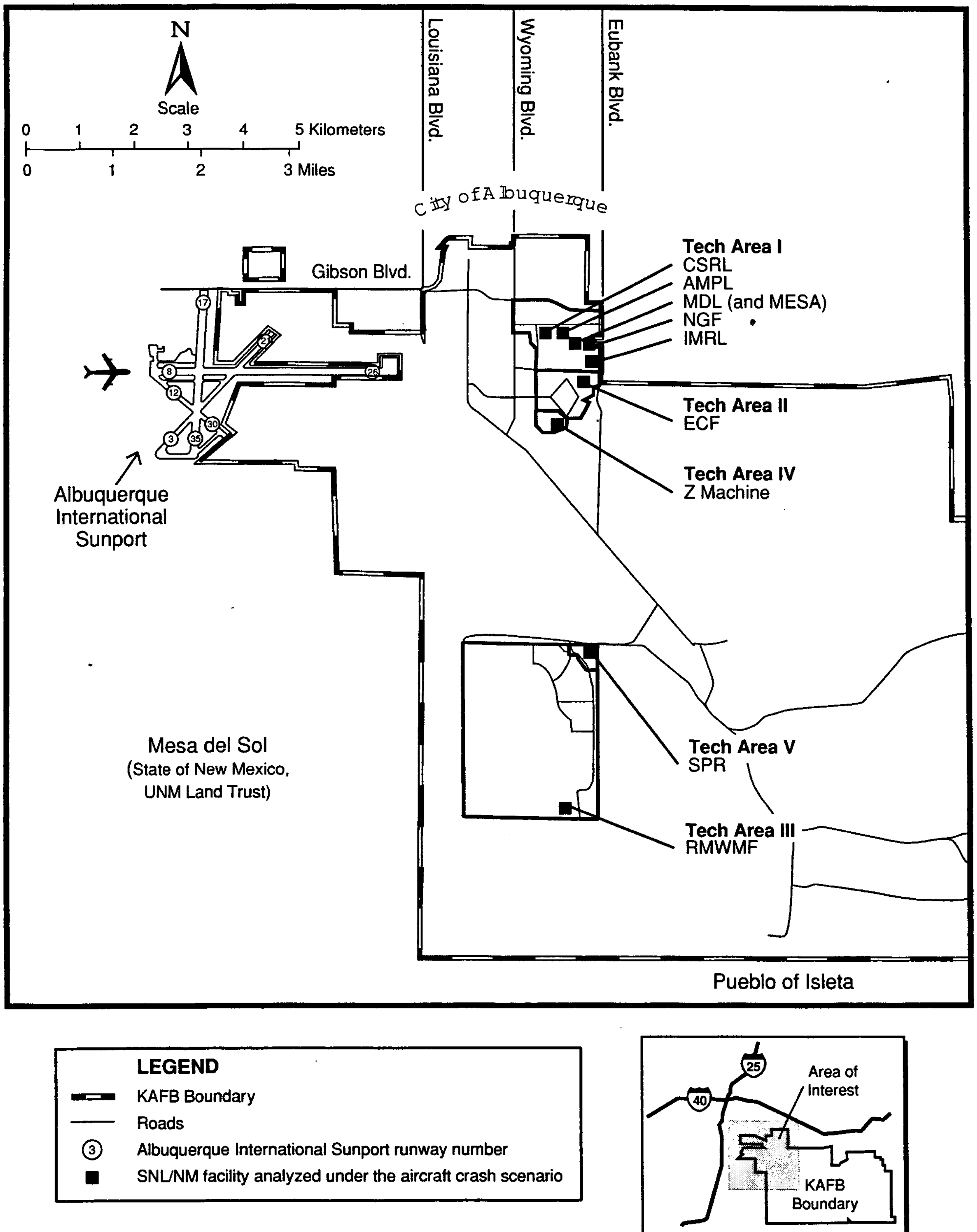
j = index for aircraft category or subcategory; and

k = index for flight source (specific runways).

The results of this analysis and a discussion of how the four-factor formula was applied to SNL/NM facilities follow.

F.5.3 Site-Specific Input Data

The Albuquerque International Sunport is the airport with the largest potential to affect SNL/NM facilities. There are other airports in the general area of SNL/NM. These airports include the Coronado Airport, Sandia Airpark, Alexander Airport, Mid-Valley Airport, and Double Eagle Airport. All of the aircraft operations at these airports are general aviation or helicopter, and the distances from the SNL/NM facilities to these airports are all greater than 10 mi. Although DOE-STD-3014 does not provide screening criteria for airports, the probability of general aviation aircraft crashes for airport operations presented in DOE-STD-3014 is considered insignificant at distances



Source: Original

Figure F.5–1. Releationship between Albuquerque International Sunport Runways and Selected Sandia National Laboratories/New Mexico Facilities

The Albuquerque International Sunport runways are shown relative to selected Sandia National Laboratories/New Mexico facilities.

greater than 8 mi. Aircraft operations at airports other than the Sunport are not evaluated in this analysis because the distances from the other area airports to the SNL/NM facilities are greater than 8 mi and because of the high number of aircraft operations at the Albuquerque International Sunport. Flights from these distant airports that could go over SNL/NM are covered in the section on nonairport impact frequencies (Section F.5.5). Figure F.5–1 shows the relationship of the Albuquerque International Sunport to the selected facilities on SNL/NM.

Table F.5–2 shows the number of takeoffs and landings by runway and aircraft type. In addition to the number of takeoffs and landings at nearby airports, the distances and directions from each runway to each facility (Table F.5–3) are also required as input. Table F.5–3 presents the orthonormal distances relative to the center of each runway. These distances are required as part of the look-up of the aircraft crash location conditional probability ($f_{ijk}[x,y]$) given in Tables B–2 through B–13 in DOE-STD-3014. Table F.5–4 presents each facility's length, width, and height, which are needed in the calculation of the effective building area (A_{ij}).

F.5.4 Potential Aircraft Crash Frequencies

Table F.5–5 presents the total annual aircraft impact frequencies for facilities at SNL/NM. These frequencies, using the data in Tables F.5–2 through F.5–4 and the data in Appendix B of DOE-STD-3014, were calculated using the four-factor formula discussed above. Tables F.5–6 through F.5–15 provide a summary of the aircraft crash frequencies for each facility for each type of aircraft operation. The tables are further defined by airport-type crashes (due to takeoffs or landings) and nonairport type crashes (in-flights). The last row of each summary table sums the aircraft crash frequencies for each type of aircraft to give an overall aircraft impact frequency for each selected facility at SNL/NM.

F.5.4.1 Impact Frequencies from Airport Operations

The potential impact frequencies for aircraft crashes into SNL/NM facilities due to airport operations at the Albuquerque International Sunport were calculated according to the methodology in DOE-STD-3009 (DOE 1994c).

According to DOE-STD-3014, helicopters must fly over a facility for the flight to pose a hazard to the facility. Most helicopter operations will not fly near the SNL/NM facilities.

Tables B–4 through B–14 of Appendix B of DOE-STD-3014 list the probability that, given a crash upon takeoff or landing of a specific type of aircraft, the crash will occur in the 1-mi^2 area where the facility of interest is located. For military aircraft operations, for conservatism, the landing pattern side of the approach was assumed to be the side of the airport that resulted in the highest impact probability.

The takeoff and landing crash rates (P_{ijk}) for each type of aircraft are taken from Table B-1 of DOE-STD-3014. This table lists the probability that a given type of aircraft will crash upon takeoff or landing.

The calculation of the effective area is based on two components: the aircraft can crash directly into the facility or the aircraft can skid into the facility. The effective area of the facility is, therefore, dependent on the type of aircraft and the actual dimensions of the facility. Multiple factors affect the facility's effective area depending on the type of aircraft. The wingspan dictates how close the aircraft can come to the facility and still impact it. The type of aircraft also dictates the angle of impact into the facility, and the cotangent of this angle is used in the calculation. The skid distance of the aircraft is also defined by the type of aircraft and is a function of the aircraft airspeed. These variables are given in DOE-STD-3014 (Tables B-17 and B-18) for each type of aircraft.

The aircraft impact frequency per year for airport operations is determined by multiplying the number of operations, the conditional crash probability, the crash probability, and the effective area of the facility as described in the four-factor formula. The sums of the impact frequencies by aircraft type are presented in Tables F.5–6 through F.5–15.

F.5.4.2 Impact Frequency for Nonairport Operations

Although typically small, the impact frequency contribution for nonairport operations cannot be overlooked when following the DOE-STD-3014 methodology. The impact frequency for nonairport operations is calculated from the same four-factor formula used for airport operations, except that the first three terms are combined and given in DOE-STD-3014 (Tables B-14 and B-15). The standard provides site-specific values for the probability of an impact occurring in a 1-mi^2 area at the center of the site for each type of aircraft.

These frequencies are listed in Tables F.5–6 through F.5–15 and used along with the airport impact frequencies to determine the overall aircraft impact frequency per year for the facility of interest.

Table F.5–2. Number of Takeoffs and Landings at Albuquerque International Sunport

AIRCRAFT TYPE	LANDINGS BY RUNWAY								
		2				2	2		TOTALS
Fixed-Wing Single	5,349	1,070	856	1070	11,554	0	214	1,284	21,396
Fixed-Wing Twin	1,783	357	285	357	3,851	0	71	428	7,132
Fixed-Wing Turbojet	297	59	48	59	642	0	12	71	1,189
Air Carrier	13,224	5,731	1,322	1,322	22,481	0	0	0	44,081
Air Taxi	4,080	1,632	490	490	9,140	0	0	490	16,322
Large Military	974	204	47	31	267	0	0	0	1,525
Small High-Performance	5,225	1,096	253	169	1,433	0	0	0	8,175
Helicopter	0	0	0	0	0	0	0	2,305	2,305

AIRCRAFT TYPE	TA EOFFS BY RUNWAY								
		2				2	2		TOTALS
Fixed-Wing Single	7,489	214	642	856	0	2,354	9,628	214	21,396
Fixed-Wing Twin	2,496	71	214	285	0	785	3,209	71	7,132
Fixed-Wing Turbojet	416	12	36	48	0	131	535	12	1,189
Air Carrier	34,383	882	2,645	1,322	0	4,849	0	0	44,081
Air Taxi	12,241	326	979	490	0	1,795	490	0	16,322
Large Military	1,182	187	47	47	0	62	0	0	1,525
Small High-Performance	6,340	1,001	250	250	0	334	0	0	8,175
Helicopter	0	0	0	0	0	0	2,305	0	2,305

Sources: Jacox 1998, Kauffman 1994

Table F.5–3. Orthonormal Distances from Albuquerque International Sunport Runways to Selected Facilities

DISTANCE (miles)					DISTANCE (miles)				
	RUNWAY 17		RUNWAY 35			RUNWAY 3		RUNWAY 21	
Facility	X	Y	X	Y	**Facility**	X	Y	X	Y
IMRL	0.52	4.16	-0.52	-4.16	***IMRL***	3.10	-3.46	-3.10	3.46
MDL	0.39	4.17	-0.39	-4.17	***MDL***	3.21	-3.39	-3.21	3.39
NGF	0.44	4.02	-0.44	-4.02	***NGF***	3.06	-3.31	-3.06	3.31
AMPL	0.19	3.97	-0.19	-3.97	***AMPL***	3.22	-3.11	-3.22	3.11
MESA Complex	0.43	4.50	-0.43	-4.50	***MESA Complex***	3.38	-3.67	-3.38	3.67
CSRL	0.21	3.77	-0.21	-3.77	***CSRL***	3.09	-2.97	-3.09	2.97
ECF	0.80	4.25	-0.80	-4.25	***ECF***	2.94	-3.71	-2.94	3.71
Z-Machine	1.39	3.73	-1.39	-3.73	***Z-Machine***	2.16	-3.69	-2.16	3.69
RMWMF	5.67	3.10	-5.67	-3.10	***RMWMF***	-1.53	-5.96	1.53	5.96
SPR	3.85	3.68	-3.85	-3.68	***SPR***	0.24	-5.24	-0.24	5.24
DISTANCE (miles)					DISTANCE (miles)				
	RUNWAY 8		RUNWAY 26			RUNWAY 12		RUNWAY 30	
Facility	X	Y	X	Y	**Facility**	X	Y	X	Y
IMRL	3.41	-0.41	-3.41	0.41	***IMRL***	3.50	2.60	-3.50	-2.60
MDL	3.42	-0.28	-3.42	0.28	***MDL***	3.43	2.71	-3.43	-2.71
NGF	3.26	-0.34	-3.26	0.34	***NGF***	3.35	2.57	-3.35	-2.57
AMPL	3.21	-0.09	-3.21	0.09	***AMPL***	3.15	2.73	-3.15	-2.73
MESA Complex	3.75	-0.32	-3.75	0.32	***MESA Complex***	3.71	2.89	-3.71	-2.89
CSRL	3.02	-0.10	-3.02	0.10	***CSRL***	3.01	2.59	-3.01	-2.59
ECF	3.49	-0.69	-3.49	0.69	***ECF***	3.75	2.44	-3.75	-2.44
Z-Machine	2.98	-1.28	-2.98	1.28	***Z-Machine***	3.73	1.66	-3.73	-1.66
RMWMF	2.34	-5.56	-2.34	5.56	***RMWMF***	6.00	-2.03	-6.00	2.03
SPR	2.93	-3.74	-2.93	3.74	***SPR***	5.28	-0.26	-5.28	0.26

Sources: USGS 1990, 1991
AMPL: Advanced Manufacturing Processes Laboratory
CSRL: Compound Semiconductor Research Laboratory
ECF: Explosive Components Facility
IMRL: Integrated Materials Research Laboratory
MDL: Microelectronics Development Laboratory
MESA: Microsystems and Engineering Sciences Applications
NGF: Neutron Generator Facility
RMWMF: Radioactive and Mixed Waste Management Facility
SPR: Sandia Pulsed Reactor

Table F.5–4. Length, Width, and Height of Selected Buildings

BUILDING		DIMENSION (feet)		
NAME	NUMBER	LENGTH	WIDTH	HEIGHT
Integrated Materials Research Lab	897	296	151	64.0
Microelectronics Development Lab	858	536	352	46.0
Neutron Generator Facility	870	295	233.5	47.5
Advanced Manufacturing Processes Laboratory	878	362	295.5	46.9
Microsystems and Engineering Sciences Applications (MESA) Complex	MESA	250	85	60.0
Compound Semiconductor Research Laboratory	893	351	101	19.0
Explosive Components Facility	905	523	275	30.8
Z-Machine	983	227	176.5	39.2
Radioactive and Mixed Waste Management Facility	6920	128	80	27.3
Sandia Pulsed Reactor	6593	144	103	22.0

Source: SNL/NM 1998h, 1999b

Table F.5–5. Annual Aircraft Impact Frequencies for SNL/NM Facilities

FACILITY	ANNUAL IMPACT FREQUENCY
Integrated Materials Research Laboratory	$6.6x10^{-5}$
Microelectronics Development Laboratory	$9.7x10^{-5}$
Neutron Generator Facility	$6.0x10^{-5}$
Advanced Manufacturing Processes Laboratory	$3.2x10^{-5}$
Microsystems and Engineering Sciences Applications Complex [a]	$4.9x10^{-5}$
Compound Semiconductor Research Laboratory [b]	$4.3x10^{-5}$
Explosive Components Facility	$9.0x10^{-6}$
Z-Machine	$1.8x10^{-5}$
Radioactive and Mixed Waste Management Facility	$2.8x10^{-6}$
Sandia Pulsed Reactor	$6.3x10^{-6}$

Source: Original
[a] Expanded Operations Only.
[b] No Action and Reduced Operations Alternatives

Table F.5–6. Summary of Aircraft Crash Frequencies for the Integrated Materials Research Laboratory

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	5.6×10^{-6}
	Fixed-Wing – Single Engine (Landing)	6.9×10^{-6}
	Fixed-Wing – Twin Engine (Takeoff)	1.6×10^{-6}
	Fixed-Wing – Twin Engine (Landing)	2.7×10^{-6}
	Fixed-Wing – Turbojet (Takeoff)	4.0×10^{-8}
	Fixed-Wing – Turbojet (Landing)	9.0×10^{-8}
	Commercial Aviation Air Carrier (Takeoff)	6.4×10^{-6}
	Commercial Aviation Air Carrier (Landing)	3.5×10^{-6}
	Commercial Aviation Air Taxi (Takeoff)	1.1×10^{-5}
	Commercial Aviation Air Taxi (Landing)	7.5×10^{-6}
	Military Aviation Large Aircraft (Takeoff)	1.4×10^{-7}
	Military Aviation Large Aircraft (Landing)	3.6×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	5.4×10^{-6}
	Military Aviation Small Aircraft (Landing)	3.3×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		**5.6×10^{-5}**
Nonairport	General Aviation	1.0×10^{-5}
	Commercial Aviation Air Carrier	7.0×10^{-9}
	Commercial Aviation Air Taxi	9.5×10^{-9}
	Military Aviation Large Aircraft	2.9×10^{-9}
	Military Aviation Small Aircraft	9.4×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		**1.0×10^{-5}**
TOTAL AIRCRAFT CRASH FREQUENCY		**6.6×10^{-5}**

Source: Original

Table F.5–7. Summary of Aircraft Crash Frequencies for the Microelectronics Development Laboratory

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	1.0×10^{-5}
	Fixed-Wing – Single Engine (Landing)	1.2×10^{-5}
	Fixed-Wing – Twin Engine (Takeoff)	2.9×10^{-6}
	Fixed-Wing – Twin Engine (Landing)	1.5×10^{-6}
	Fixed-Wing – Turbojet (Takeoff)	7.3×10^{-8}
	Fixed-Wing – Turbojet (Landing)	1.6×10^{-7}
	Commercial Aviation Air Carrier (Takeoff)	1.1×10^{-5}
	Commercial Aviation Air Carrier (Landing)	2.3×10^{-6}
	Commercial Aviation Air Taxi (Takeoff)	1.9×10^{-5}
	Commercial Aviation Air Taxi (Landing)	4.7×10^{-6}
	Military Aviation Large Aircraft (Takeoff)	2.2×10^{-7}
	Military Aviation Large Aircraft (Landing)	4.6×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	9.6×10^{-6}
	Military Aviation Small Aircraft (Landing)	4.1×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		$\mathbf{7.9 \times 10^{-5}}$
Nonairport	General Aviation	1.9×10^{-5}
	Commercial Aviation Air Carrier	1.2×10^{-8}
	Commercial Aviation Air Taxi	1.7×10^{-8}
	Military Aviation Large Aircraft	4.6×10^{-9}
	Military Aviation Small Aircraft	1.6×10^{-7}
Total of Nonairport Operations Aircraft Crash Frequency		$\mathbf{1.9 \times 10^{-5}}$
TOTAL AIRCRAFT CRASH FREQUENCY		$\mathbf{9.7 \times 10^{-5}}$

Source: Original

Table F.5–8. Summary of Aircraft Crash Frequencies for the Neutron Generator Facility

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	5.5×10^{-6}
	Fixed-Wing – Single Engine (Landing)	6.8×10^{-6}
	Fixed-Wing – Twin Engine (Takeoff)	1.6×10^{-6}
	Fixed-Wing – Twin Engine (Landing)	2.6×10^{-6}
	Fixed-Wing – Turbojet (Takeoff)	3.9×10^{-8}
	Fixed-Wing – Turbojet (Landing)	8.9×10^{-8}
	Commercial Aviation Air Carrier (Takeoff)	6.7×10^{-6}
	Commercial Aviation Air Carrier (Landing)	3.7×10^{-6}
	Commercial Aviation Air Taxi (Takeoff)	1.0×10^{-5}
	Commercial Aviation Air Taxi (Landing)	7.0×10^{-6}
	Military Aviation Large Aircraft (Takeoff)	1.4×10^{-6}
	Military Aviation Large Aircraft (Landing)	3.5×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	5.5×10^{-7}
	Military Aviation Small Aircraft (Landing)	3.3×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		**5.0×10^{-5}**
Nonairport	General Aviation	1.0×10^{-5}
	Commercial Aviation Air Carrier	7.3×10^{-9}
	Commercial Aviation Air Taxi	1.0×10^{-8}
	Military Aviation Large Aircraft	3.0×10^{-9}
	Military Aviation Small Aircraft	9.4×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		**1.0×10^{-5}**
TOTAL AIRCRAFT CRASH FREQUENCY		**6.0×10^{-5}**

Source: Original

Table F.5–9. Summary of Aircraft Crash Frequencies for the Advanced Manufacturing Processes Laboratory

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	4.4×10^{-6}
	Fixed-Wing – Single Engine (Landing)	5.3×10^{-6}
	Fixed-Wing – Twin Engine (Takeoff)	1.2×10^{-6}
	Fixed-Wing – Twin Engine (Landing)	2.0×10^{-6}
	Fixed-Wing – Turbojet (Takeoff)	3.1×10^{-8}
	Fixed-Wing – Turbojet (Landing)	6.9×10^{-8}
	Commercial Aviation Air Carrier (Takeoff)	2.8×10^{-6}
	Commercial Aviation Air Carrier (Landing)	1.5×10^{-7}
	Commercial Aviation Air Taxi (Takeoff)	4.3×10^{-6}
	Commercial Aviation Air Taxi (Landing)	2.9×10^{-7}
	Military Aviation Large Aircraft (Takeoff)	8.3×10^{-7}
	Military Aviation Large Aircraft (Landing)	2.4×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	3.6×10^{-7}
	Military Aviation Small Aircraft (Landing)	1.9×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		**2.4×10^{-5}**
Nonairport	General Aviation	7.8×10^{-6}
	Commercial Aviation Air Carrier	3.0×10^{-9}
	Commercial Aviation Air Taxi	3.7×10^{-9}
	Military Aviation Large Aircraft	1.8×10^{-9}
	Military Aviation Small Aircraft	4.6×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		**7.9×10^{-6}**
TOTAL AIRCRAFT CRASH FREQUENCY		**3.2×10^{-5}**

Source: Original

Table F.5–10. Summary of Aircraft Crash Frequencies for the Explosive Components Facility

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	7.3×10^{-6}
	Fixed-Wing – Single Engine (Landing)	8.6×10^{-6}
	Fixed-Wing – Twin Engine (Takeoff)	2.1×10^{-6}
	Fixed-Wing – Twin Engine (Landing)	3.3×10^{-6}
	Fixed-Wing – Turbojet (Takeoff)	5.2×10^{-8}
	Fixed-Wing – Turbojet (Landing)	1.1×10^{-7}
	Commercial Aviation Air Carrier (Takeoff)	9.2×10^{-6}
	Commercial Aviation Air Carrier (Landing)	5.1×10^{-6}
	Commercial Aviation Air Taxi (Takeoff)	1.6×10^{-5}
	Commercial Aviation Air Taxi (Landing)	1.1×10^{-5}
	Military Aviation Large Aircraft (Takeoff)	1.8×10^{-6}
	Military Aviation Large Aircraft (Landing)	4.2×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	7.2×10^{-6}
	Military Aviation Small Aircraft (Landing)	4.4×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		$\mathbf{7.7\times10^{-5}}$
Nonairport	General Aviation	1.3×10^{-5}
	Commercial Aviation Air Carrier	1.0×10^{-8}
	Commercial Aviation Air Taxi	1.4×10^{-8}
	Military Aviation Large Aircraft	3.9×10^{-9}
	Military Aviation Small Aircraft	1.2×10^{-7}
Total of Nonairport Operations Aircraft Crash Frequency		$\mathbf{1.3\times10^{-5}}$
TOTAL AIRCRAFT CRASH FREQUENCY		$\mathbf{9.0\times10^{-5}}$

Source: Original

Table F.5–11. Summary of Aircraft Crash Frequencies for the Z-Machine

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	2.5×10^{-6}
	Fixed-Wing – Single Engine (Landing)	2.0×10^{-6}
	Fixed-Wing – Twin Engine (Takeoff)	7.2×10^{-7}
	Fixed-Wing – Twin Engine (Landing)	7.8×10^{-7}
	Fixed-Wing – Turbojet (Takeoff)	1.8×10^{-8}
	Fixed-Wing – Turbojet (Landing)	2.7×10^{-8}
	Commercial Aviation Air Carrier (Takeoff)	7.0×10^{-7}
	Commercial Aviation Air Carrier (Landing)	8.5×10^{-9}
	Commercial Aviation Air Taxi (Takeoff)	1.2×10^{-6}
	Commercial Aviation Air Taxi (Landing)	3.0×10^{-8}
	Military Aviation Large Aircraft (Takeoff)	3.0×10^{-7}
	Military Aviation Large Aircraft (Landing)	3.2×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	2.5×10^{-6}
	Military Aviation Small Aircraft (Landing)	1.8×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		$\mathbf{1.3 \times 10^{-5}}$
Nonairport	General Aviation	5.1×10^{-6}
	Commercial Aviation Air Carrier	2.6×10^{-9}
	Commercial Aviation Air Taxi	3.0×10^{-9}
	Military Aviation Large Aircraft	1.4×10^{-9}
	Military Aviation Small Aircraft	3.2×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		$\mathbf{5.1 \times 10^{-6}}$
TOTAL AIRCRAFT CRASH FREQUENCY		$\mathbf{1.8 \times 10^{-5}}$

Source: Original

Table F.5–12. Summary of Aircraft Crash Frequencies for the Radioactive and Mixed Waste Management Facility

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	0.0×10^{1}
	Fixed-Wing – Single Engine (Landing)	9.9×10^{-9}
	Fixed-Wing – Twin Engine (Takeoff)	0.0×10^{1}
	Fixed-Wing – Twin Engine (Landing)	3.8×10^{-9}
	Fixed-Wing – Turbojet (Takeoff)	0.0
	Fixed-Wing – Turbojet (Landing)	1.3×10^{-10}
	Commercial Aviation Air Carrier (Takeoff)	7.7×10^{-9}
	Commercial Aviation Air Carrier (Landing)	0.0
	Commercial Aviation Air Taxi (Takeoff)	1.2×10^{-8}
	Commercial Aviation Air Taxi (Landing)	0.0
	Military Aviation Large Aircraft (Takeoff)	0.0
	Military Aviation Large Aircraft (Landing)	7.6×10^{-9}
	Military Aviation Small Aircraft (Takeoff)	2.9×10^{-7}
	Military Aviation Small Aircraft (Landing)	0.0
Total of Airport Operations Aircraft Crash Frequency		**3.3×10^{-7}**
Nonairport	General Aviation	2.4×10^{-6}
	Commercial Aviation Air Carrier	2.0×10^{-9}
	Commercial Aviation Air Taxi	2.2×10^{-9}
	Military Aviation Large Aircraft	8.3×10^{-10}
	Military Aviation Small Aircraft	2.4×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		**2.4×10^{-6}**
TOTAL AIRCRAFT CRASH FREQUENCY		**2.8×10^{-6}**

Source: Original

Table F.5–13. Summary of Aircraft Crash Frequencies for the Sandia Pulsed Reactor

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	1.7×10^{-6}
	Fixed-Wing – Single Engine (Landing)	8.4×10^{-7}
	Fixed-Wing – Twin Engine (Takeoff)	4.9×10^{-7}
	Fixed-Wing – Twin Engine (Landing)	3.2×10^{-7}
	Fixed-Wing – Turbojet (Takeoff)	1.2×10^{-8}
	Fixed-Wing – Turbojet (Landing)	1.1×10^{-8}
	Commercial Aviation Air Carrier (Takeoff)	2.7×10^{-8}
	Commercial Aviation Air Carrier (Landing)	0.0
	Commercial Aviation Air Taxi (Takeoff)	5.3×10^{-8}
	Commercial Aviation Air Taxi (Landing)	1.5×10^{-7}
	Military Aviation Large Aircraft (Takeoff)	0.0
	Military Aviation Large Aircraft (Landing)	4.8×10^{-8}
	Military Aviation Small Aircraft (Takeoff)	1.0×10^{-7}
	Military Aviation Small Aircraft (Landing)	3.4×10^{-8}
Total of Airport Operations Aircraft Crash Frequency		**3.8×10^{-6}**
Nonairport	General Aviation	2.5×10^{-6}
	Commercial Aviation Air Carrier	3.2×10^{-9}
	Commercial Aviation Air Taxi	4.0×10^{-9}
	Military Aviation Large Aircraft	1.4×10^{-9}
	Military Aviation Small Aircraft	3.2×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		**2.5×10^{-6}**
TOTAL AIRCRAFT CRASH FREQUENCY		**6.3×10^{-6}**

Source: Original

Table F.5–14. Summary of Aircraft Crash Frequencies for the Microsystems and Engineering Sciences Applications Complex

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	4.2×10^{-6}
	Fixed-Wing – Single Engine (Landing)	4.5×10^{-6}
	Fixed-Wing – Twin Engine (Takeoff)	1.2×10^{-6}
	Fixed-Wing – Twin Engine (Landing)	1.7×10^{-6}
	Fixed-Wing – Turbojet (Takeoff)	2.9×10^{-8}
	Fixed-Wing – Turbojet (Landing)	5.9×10^{-8}
	Commercial Aviation Air Carrier (Takeoff)	5.1×10^{-6}
	Commercial Aviation Air Carrier (Landing)	2.8×10^{-6}
	Commercial Aviation Air Taxi (Takeoff)	8.5×10^{-6}
	Commercial Aviation Air Taxi (Landing)	5.9×10^{-6}
	Military Aviation Large Aircraft (Takeoff)	1.1×10^{-6}
	Military Aviation Large Aircraft (Landing)	2.7×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	4.1×10^{-6}
	Military Aviation Small Aircraft (Landing)	2.6×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		**4.2×10^{-5}**
Nonairport	General Aviation	7.3×10^{-6}
	Commercial Aviation Air Carrier	5.6×10^{-9}
	Commercial Aviation Air Taxi	7.5×10^{-9}
	Military Aviation Large Aircraft	7.3×10^{-9}
	Military Aviation Small Aircraft	7.3×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		**7.4×10^{-6}**
TOTAL AIRCRAFT CRASH FREQUENCY		**4.9×10^{-5}**

Source: Original

Table F.5–15. Summary of Aircraft Crash Frequencies for the Compound Semiconductor Research Laboratory

TYPE OF CRASH	AIRCRAFT OPERATION	AIRCRAFT CRASH FREQUENCY (per year)
Airport	Fixed-Wing – Single Engine (Takeoff)	2.7×10^{-6}
	Fixed-Wing – Single Engine (Landing)	3.0×10^{-6}
	Fixed-Wing – Twin Engine (Takeoff)	7.6×10^{-7}
	Fixed-Wing – Twin Engine (Landing)	1.2×10^{-6}
	Fixed-Wing – Turbojet (Takeoff)	1.9×10^{-8}
	Fixed-Wing – Turbojet (Landing)	4.0×10^{-8}
	Commercial Aviation Air Carrier (Takeoff)	5.3×10^{-6}
	Commercial Aviation Air Carrier (Landing)	2.9×10^{-6}
	Commercial Aviation Air Taxi (Takeoff)	9.1×10^{-6}
	Commercial Aviation Air Taxi (Landing)	6.3×10^{-6}
	Military Aviation Large Aircraft (Takeoff)	1.0×10^{-6}
	Military Aviation Large Aircraft (Landing)	2.1×10^{-7}
	Military Aviation Small Aircraft (Takeoff)	3.2×10^{-6}
	Military Aviation Small Aircraft (Landing)	2.2×10^{-6}
Total of Airport Operations Aircraft Crash Frequency		**3.9×10^{-5}**
Nonairport	General Aviation	4.8×10^{-6}
	Commercial Aviation Air Carrier	5.8×10^{-9}
	Commercial Aviation Air Taxi	8.0×10^{-9}
	Military Aviation Large Aircraft	2.2×10^{-9}
	Military Aviation Small Aircraft	6.0×10^{-8}
Total of Nonairport Operations Aircraft Crash Frequency		**4.9×10^{-6}**
TOTAL AIRCRAFT CRASH FREQUENCY		**4.3×10^{-5}**

Source: Original

F.6 OTHER FACILITY HAZARDS

Potential accidents and their impacts associated with facility hazards are described in various SNL/NM reports (SNL/NM 1998a). SNL/NM facilities vary in their documentation of hazards and potential accidents. This section summarizes the hazards at SNL/NM facilities in TAs-I, -III, and -IV and the Coyote Test Field (for which accident information is provided in these reports), which are not otherwise addressed in Sections F.2, F.3, and F.4. The results shown for these facilities are considered representative of the potential accidents associated with facility hazards at other facilities in these TAs. The results given are applicable to the No Action, Expanded Operations, and Reduced Operations Alternatives.

Table F.6–1. Frequency Descriptors

LIKELIHOOD	FREQUENCY DESCRIPTOR	FREQUENCY (per year)
A	Likely	$F > 10^{-2}$
B	Unlikely	$10^{-3} < F < 10^{-2}$
C	Occasional	$10^{-4} < F < 10^{-3}$
D	Extremely Unlikely	$10^{-6} < F < 10^{-4}$
E	Incredible	$F < 10^{-6}$

Source: DOE 1994c

Accident frequencies have been categorized as shown in Table F.6–1. The risk matrix in Table F.6–2 shows the severity of hazards qualitatively, reflecting both the accident frequency and consequence (for example, an accident with a risk of III/D is an accident with "significant" consequences and a frequency of "extremely unlikely"). This method of categorization of frequencies and hazard severity follows the format of input information provided in source documents, but differs from other methods of categorizing that follow DOE-STD-3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Report* (DOE 1994c).

Table F.6–3 lists the hazards at many SNL/NM facilities. Many of these hazards represent routine workplace risks of injury and fatality for involved workers.

F.6.1 Technical Area-II

F.6.1.1 Explosive Components Facility

Hazards associated with the ECF are shown in Table F.6–4. The table identifies the accident risk index for nine hazardous events or activities at the facility. Risk matrixes for the worker, onsite individual, and offsite public are shown in Tables F.6–5, F.6–6, and F.6–7, respectively.

F.6.2 Technical Area-III

F.6.2.1 Radioactive and Mixed Waste Management Facility

Hazards associated with the RMWMF are shown in Table F.6–8. The table identifies the accident risk index for 10 hazardous events or activities at the facility. Risk matrixes for the worker, onsite individual, and offsite public are shown in Tables F.6–9, F.6–10, and F.6–11, respectively.

F.6.2.2 Sled Track Complex

Hazards associated with the Sled Track Complex are shown in Table F.6–12. The table identifies the accident risk index for 11 hazardous events or activities at the facility. Risk matrixes for the worker, onsite individual, and offsite public are shown in Tables F.6–13, F.6–14, and F.6–15, respectively.

Table F.6–2. Risk Matrix

LIKELIHOOD	CONSEQUENCE SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A - Likely	I/A	II/A	III/A	IV/A	V/A
B - Unlikely	I/B	II/B	III/B	IV/B	V/B
C - Occasional	I/C	II/C	III/C	IV/C	V/C
D - Extremely Unlikely	I/D	II/D	III/D	IV/D	V/D
E - Incredible	I/E	II/E	III/E	IV/E	V/E

Source: DOE 1994c

Table F.6–3. Facility Hazards

FACILITY	HAZARDS
TECHNICAL AREA-I	
Microelectronics Development Laboratory	Compressed gas cylinders, chemical storage bays, bulk chemical storage, flammable gas bunkers, hydrogen supply tank, and gas cabinets
6-MeV Tandem Van Der Graaf Generator	Ionizing radiation, high voltage, insulating gases, and ammonia
Photovoltaic Device Fabrication Laboratory	Various toxic and hazardous materials
Lightning Simulation Facility	Lasers, fluorine
Integrated Materials Research Laboratory	Various hazardous chemicals
Systems Research and Development Facility	Laser operations, hazardous chemicals, flammable gases, compressed gas, chemical storage containers
Compound Semiconductor Research Laboratory	Hazardous chemicals, chemical storage containers
Advanced Manufacturing Processes Laboratory	Hazardous chemicals, chemical storage containers, tritium
Power Development Laboratory	Hazardous chemicals, chemical storage containers
Ion Beam Materials Research Laboratory	Hazardous chemicals, chemical storage containers, sealed radioactive sources
Neutron Generator Facility	Tritium, hydrogen
TECHNICAL AREA-II	
Explosive Components Facility	Fire, explosion, radiation, toxic or hazardous materials, laser beams
TECHNICAL AREA-III	
Sled Track Complex	Explosive materials, laboratory chemicals, compressed gases, radioactive materials
Radiant Heat Facility	Chemicals, compressed gases, combustible materials
Terminal Ballistics Complex	Flak and shrapnel, large projectiles, rocket motors, X-ray, explosives, flammable materials
Drop/Impact Complex	Noise, metal fragments
Centrifuge Complex	Noise, fragment projectiles

Table F.6–3. Facility Hazards (continued)

FACILITY	HAZARDS
Liquid Metal Processing Laboratory	Carbon monoxide cylinder storage
Hammermill	Normal industrial hazards
TECHNICAL AREA-IV	
High Energy Radiation Megavolt Electron Source (HERMES III)	Electric shock, X-rays, hazardous chemicals and materials, flammables, laser beams
Z-Machine	Electric shock, X-rays, hazardous chemicals and materials, flammables, laser beams
Repetitive High Energy Pulsed Power Unit I (RHEPP I)	Electric shock, X-rays, hazardous chemicals and materials, flammables
Repetitive High Energy Pulsed Power Unit II (RHEPP II)	Electric shock, X-rays, hazardous chemicals and materials, flammables
Sandia Accelerator & Beam Research Experiment (SABRE)	Electric shock, X-rays, hazardous chemicals and materials, flammables, laser beams
SATURN	Electric shock, X-rays, hazardous chemicals and materials, flammables
Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)	Electric shock, X-rays, hazardous chemicals and materials, flammables
Tera-Electron Volt Semiconducting Linear Accelator (TESLA)	Electric shock, X-rays, hazardous chemicals and materials, flammables
High Power Microwave Laboratory	Electric shock, X-rays, hazardous chemicals and materials, flammables
Advanced Pulsed Power Research Module	Electric shock, X-rays, hazardous chemicals and materials, flammables, laser beams
Pelletron	Electric shock, X-rays, hazardous chemicals and materials, flammables
Excimer Laser Processing Laboratory	Hazardous chemicals, laser operations
TECHNICAL AREA-V	
Annular Core Research Reactor	Radioactive fission products, high energy sources, high pressures, explosives
Sandia Pulsed Reactor	Radioactive fission products, liquid nitrogen
Hot Cell Facility	Radioactive fission products, hazardous chemicals, compressed gases
Gamma Irradiation Facility	High-intensity radioactive sources, ozone

Table F.6–3. Facility Hazards (concluded)

FACILITY	HAZARDS
COYOTE TEST FIELD	
Manzano Waste Storage Facilities	Radioactive wastes, toxic wastes
Aerial Cable Facility	Rocket motors and explosives, missiles, artillery, hot test debris, radioactive materials
Containment Technology Test Facility-West	Airborne fragments, noise
National Solar Thermal Test Facility	Concentrated solar energy
Explosives Application Laboratory	Explosives, acetylene welding, X-rays
Lurance Canyon Burn Site	Radioactive materials, rocket propellant, aviation fuel, toxic plumes
Exterior Sensor Field	Hazardous wastes
Photovoltaic Systems Evaluation Laboratory	Lead acid-battery chemicals, electricity
INFRASTRUCTURE	
Steam Plant	Natural gas, diesel fuel, steam
Hazardous Waste Management Facility	Hazardous chemical wastes
Radioactive and Mixed Waste Management Facility	Flammable and combustible waste, reactive waste, radioactive waste

Source: SNL/NM 1998a
MeV: million electron volts

Table F.6–4. Explosive Components Facility Accident Risk

EVENT	RISK INDEX		
	INVOLVED WORKER	ONSITE INDIVIDUAL	OFFSITE PUBLIC
Unintentional detonation of 1,000 g of high explosives in shipping and receiving	I/D	V/D	V/D
Unintentional detonation of 500 g of high explosives during transportation inside of Explosive Components Facility	I/D	V/D	V/D
Unintentional detonation of 5 lb of high explosives in magazine area	I/D	V/D	V/D
Unintentional detonation of 500 g of high explosives during physical testing	I/D	V/D	V/D
Unintentional detonation of 1,000 g of high explosives during explosive test firing	I/D	V/D	V/D
Premature detonation of 50 g of high explosives during gas gun testing	I/D	V/D	V/D
Unintentional deflagration of 1,500 g of high propellant during abuse testing	I/D	V/D	V/D
Violent rupture of lithium cell or expulsion of thionyl chloride during battery testing	II/B	V/B	V/B
Aircraft crash	II/B	V/B	V/B

Source: SNL/NM 1998a
g: gram
lb: pound

Table F.6–5. Explosive Components Facility Involved Worker Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely		II/B			
C-Occasional					
D-Extremely Unlikely	I/D				
E-Incredible					

Source: SNL/NM 1998a

Table F.6–6. Explosive Components Facility Onsite Individual Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					V/B
C-Occasional					
D-Extremely Unlikely					V/D
E-Incredible					

Source: SNL/NM 1998a

Table F.6–7. Explosive Components Facility Offsite Public Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					V/B
C-Occasional					
D-Extremely Unlikely					V/D
E-Incredible					

Source: SNL/NM 1998a

Table F.6–8. Radioactive and Mixed Waste Management Facility Accident Risk

EVENT	RISK INDEX		
	INVOLVED WORKER	ONSITE INDIVIDUAL	OFFSITE PUBLIC
Severe earthquake	I/D	V/D	V/D
Severe wind	II/B	V/B	V/B
Aircraft crash	I/D	V/D	V/D
Waste container fire (outside building)	IV/B	V/B	V/B
Waste container ruptured by forklift	IV/A	V/A	V/A
Waste container rupture from internal pressure	IV/B	V/B	V/B
Local fire in building	IV/B	V/B	V/B
Liquified petroleum gas tank explosion	II/D	V/D	V/D
Fire in reactive waste storage building	IV/B	V/B	V/B
Fire in flammable waste storage building	IV/B	V/B	V/B

Source: SNL/NM 1998a

Table F.6–9. Radioactive and Mixed Waste Management Facility Involved Worker Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely				IV/A	
B-Unlikely		II/B		IV/B	
C-Occasional					
D-Extremely Unlikely	I/D	II/D			
E-Incredible					

Source: SNL/NM 1998a

Table F.6–10. Radioactive and Mixed Waste Management Facility Onsite Individual Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					V/A
B-Unlikely					V/B
C-Occasional					
D-Extremely Unlikely					V/D
E-Incredible					

Source: SNL/NM 1998a

Table F.6–11. Radioactive and Mixed Waste Management Facility Offsite Public Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					V/A
B-Unlikely					V/B
C-Occasional					
D-Extremely Unlikely					V/D
E-Incredible					

Source: SNL/NM 1998a

Table F.6–12. Sled Track Complex Accident Risk

EVENT	RISK INDEX		
	INVOLVED WORKER	ONSITE INDIVIDUAL	OFFSITE PUBLIC
Explosives transportation	I/E	III/E	V/E
Explosives storage	I/D	II/D	V/D
Explosives assembly	I/D	III/D	N/A
Explosives arming	I/D	III/E	N/A
Explosives firing	I/D	III/D	N/A
Rocket motor transportation	I/E	III/E	V/E
Rocket motor storage	I/D	IV/D	V/D
Rocket motor assembly	I/D	III/D	N/A
Rocket motor arming	I/D	III/D	N/A
Fire set electrocution	I/E	N/A	N/A
Missiles and projectiles	I/E	V/E	II/E

Source: SNL/NM 1998a N/A: none applicable

Table F.6–13. Sled Track Complex Involved Worker Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					
C-Occasional					
D-Extremely Unlikely	I/D				
E-Incredible	I/E				

Source: SNL/NM 1998a

Table F.6–14. Sled Track Complex Onsite Individual Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					
C-Occasional					
D-Extremely Unlikely		II/D	III/D	IV/D	
E-Incredible			III/E		V/E

Source: SNL/NM 1998a

Table F.6–15. Sled Track Complex Offsite Public Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					
C-Occasional					
D-Extremely Unlikely					V/D
E-Incredible		II/E			V/E

Source: SNL/NM 1998a

F.6.3 Technical Area-IV

F.6.3.1 Z-Machine

Hazards associated with the Z-Machine are shown in Table F.6–16. There are a number of other accelerators in TA-IV with potential accident hazards that are equivalent to the Z-Machine. The table identifies the accident risk index for 10 hazardous events or activities at the facility. Risk matrixes for the worker, onsite individual, and offsite public are shown in Tables F.6–17, F.6–18, and F.6–19, respectively.

Table F.6–16. Z-Machine Accident Risk

EVENT	RISK INDEX		
	INVOLVED WORKER	ONSITE INDIVIDUAL	OFFSITE PUBLIC
Electric shock	II/D	V/D	V/D
Radiation exposure	V/B	V/B	V/B
Fire	IV/E	V/E	V/E
Asphyxiation	I/D	V/D	V/D
Earthquake	V/B	V/B	V/B
Tornado	I/B	V/B	V/B
High winds	V/A	V/A	V/A
Flood	V/B	V/B	V/B
Aircraft crash	II/D	V/D	V/D
External oil spill	II/D	V/D	V/D

Source: SNL/NM 1998a

F.6.4 Aerial Cable Facility

F.6.4.1 Existing Hazards

Hazards associated with the Aerial Cable Facility and presented in the Aerial Cable Facility SAR are shown in Table F.6–20. The table identifies the accident risk index for 11 hazardous events or activities at the facility. Risk matrixes for the worker, onsite individual, and offsite public are shown in Tables F.6–21, F.6–22, and F.6–23, respectively.

F.6.4.2 New Proposed Activity

The accidental detonation of high explosives at the Aerial Cable Facility, not involving nuclear materials, has been estimated to have no impact on the public and potentially catastrophic consequences for involved workers (fatalities). The frequency of such an event has been estimated to beyond extremely unlikely (that is, less than 10^{-4} per year). An accident involving the release of nuclear materials at the Aerial Cable Facility, not involving explosives, has been estimated to have no impact on the public and no permanent effect on workers. These types of events include mechanical failures, such as a breach of the casing or component containing the nuclear material, that can cause localized contamination. Cleaning up the area would reduce any effects of ground contamination. There would be minimal worker exposure to radioactivity and no public exposure. The frequency of such an event has been estimated to be in the range of 10^{-6} to 10^{-4} per year. (SNL/NM 1995q).

Test activities proposed at the Aerial Cable Facility could include test specimens containing both explosives and nuclear material, which introduces the possibility of dispersal of the nuclear material by an accidental

Table F.6–17. Z-Machine Involved Worker Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					V/A
B-Unlikely	I/B				V/B
C-Occasional					
D-Extremely Unlikely	I/D	II/D			
E-Incredible				IV/E	

Source: SNL/NM 1998a

Table F.6–18. Z-Machine Onsite Individual Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					V/A
B-Unlikely					V/B
C-Occasional					
D-Extremely Unlikely					V/D
E-Incredible					V/E

Source: SNL/NM 1998a

Table F.6–19. Z-Machine Offsite Public Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					V/B
C-Occasional					
D-Extremely Unlikely					V/D
E-Incredible					V/E

Source: SNL/NM 1998a

Table F.6–20. Aerial Cable Facility Accident Risk for Historical Activities

EVENT	RISK INDEX		
	INVOLVED WORKER	ONSITE INDIVIDUAL	OFFSITE PUBLIC
Explosives transportation	I/D	IV/D	IV/D
Explosives storage	I/D	IV/D	IV/D
Explosives assembly	II/C	IV/D	N/A
Explosives arming	I/D	IV/D	N/A
Explosives firing	I/D	IV/D	N/A
Rocket motor transportation	I/D	IV/D	IV/D
Rocket motor storage	I/D	IV/D	IV/D
Rocket motor assembly	I/C	IV/D	N/A
Rocket motor arming	I/D	IV/D	N/A
Fire set electrocution	I/C	N/A	N/A

Source: SNL/NM 1998a
N/A: not applicable

Table F.6–21. Aerial Cable Facility Involved Worker Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					
C-Occasional	I/C	II/C			
D-Extremely Unlikely	I/D				
E-Incredible					

Source: SNL/NM 1998a

Table F.6–22. Aerial Cable Facility Onsite Individual Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					
C-Occasional					
D-Extremely Unlikely				IV/D	
E-Incredible					

Source: SNL/NM 1998a

Table F.6–23. Aerial Cable Facility Offsite Public Risk Matrix

LIKELIHOOD	HAZARD SEVERITY				
	CATASTROPHIC I	CRITICAL II	SIGNIFICANT III	MARGINAL IV	NEGLIGIBLE V
A-Likely					
B-Unlikely					
C-Occasional					
D-Extremely Unlikely	I/D			IV/D	
E-Incredible					

Source: SNL/NM 1998a

detonation of the explosives or a fire involving the explosives. Typical test specimens contain up to 734 lb of depleted uranium, 44 lb of enriched uranium, and 83 lb of insensitive high explosive (IHE) of the type PBX-9502 or LX-17 (Johns 1998). The specific activities of depleted uranium and enriched uranium are 3.3×10^{-7} Ci/g and 2.13×10^{-6} Ci/g, respectively. These specimens are nuclear weapon mockups, but they do not contain the materials and component configurations necessary to produce a nuclear yield even in the event of an accidental detonation of the explosives. Dispersal of nuclear material would be the worst possible consequence of an accident involving these specimens. Tests of assemblies with any possibility of producing nuclear yield are prohibited at SNL/NM. Tables F.6–24 through F.6–26 present the population distribution, the distance by direction for the core receptors, and the distance by direction to the KAFB boundary.

Scenario 1: Fire Causing IHE Deflagration

During testing, staging, or local transport, a fire starts external to the specimen and progresses to and ignites the IHE. Such a fire at the Aerial Cable Facility is unlikely. The test area is clear of vegetation and most other combustible materials. The fuel from vehicles is one possible source of a fire, however.

Only deflagration of the IHE is postulated for this scenario, even though the IHE is in a confined configuration. It is assumed that the heat of the fire does not detonate the explosives. To bound the radiological consequences of this scenario, the IHE deflagration is postulated to completely consume and oxidize the enriched uranium present in the specimen. The uranium will not be in an exposed metal configuration and any oxidation, no less complete oxidation, is unlikely. In addition, the uranium is assumed to be pure uranium-235 even though the enriched uranium in the test specimen will be less than 100 percent uranium-235. The depleted uranium is not considered as a source for

Table F.6–24. Population Distribution Surrounding the Aerial Cable Facility

DIRECTION	DISTANCE (miles)									
	0.12	0.5	1	1.5	2	2.5	3	3.5	4	4.5
N	0	0	0	0	0	0	0	0	73	82
NNE	0	0	0	0	0	0	0	0	68	81
NE	0	0	0	0	0	0	0	0	75	84
ENE	0	0	0	0	0	0	0	0	71	88
E	0	0	0	0	0	0	0	0	71	80
ESE	0	0	0	0	0	0	0	0	71	80
SE	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	74	77
S	0	0	0	0	0	0	0	66	66	80
SSW	0	0	0	0	0	0	0	0	72	77
SW	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	61	71	88
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**127**	**712**	**817**

DIRECTION	DISTANCE (miles)								
	5	7.5	10	15	20	30	40	50	0-50
N	92	603	844	2,412	650	819	1,147	1,474	8,196
NNE	92	824	935	2,431	1,362	1,516	2,760	8,835	18,904
NE	90	604	844	2,004	1,079	2,331	3,260	4,131	14,502
ENE	87	604	849	820	805	2,325	3,256	1,751	10,656
E	100	602	844	157	137	2,229	1,142	526	5,888
ESE	99	591	847	2,341	894	277	388	498	6,086
SE	95	602	837	980	96	654	387	498	4,149
SSE	99	592	546	69	97	276	1,381	498	3,709
S	99	479	177	77	229	1,009	1,780	337	4,399
SSW	89	473	277	856	1,250	3,572	3,189	174	10,029
SW	0	601	549	911	1,269	7,334	10,534	1,371	22,569
WSW	0	0	5,035	9,065	6,762	10,080	5,545	5,324	41,811
W	0	0	17,291	40,769	7,877	9,644	10,710	2,603	88,894
WNW	0	0	3,840	58,181	63,847	37,314	10,020	4,160	177,362
NW	48	13,267	24,150	76,281	91,327	66,918	1,159	1,491	274,641
NNW	89	3,186	14,832	39,764	8,768	24,124	1,132	1,455	93,570
Total	**1,079**	**23,028**	**72,697**	**237,118**	**186,449**	**170,422**	**57,790**	**35,126**	**785,365**

Source: SNL/NM 1998dd

Table F.6–25. Distance and Direction to Core Receptor Locations from the Aerial Cable Facility

CORE RECEPTOR LOCATION	DIRECTION	DISTANCE (meters)
Base Housing	WNW	14,100
Child Development Center-East	WNW	14,300
Child Development Center-West	WNW	17,900
Coronado Club	WNW	14,100
Golf Course	WNW	9,600
Kirtland Elementary School	WNW	18,200
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	W	11,700
Lovelace Hospital	WNW	16,200
National Atomic Energy Museum	WNW	13,600
Riding Stables	WNW	9,100
Sandia Base Elementary School	NW-WNW	13,900-14,000
Shandiin Day Care Center	WNW	14,100
Veterans Affairs Medical Center	WNW	15,800
Wherry Elementary School	WNW	14,700

Source: SNL/NM 1998dd
Notes:
1) If more than one direction is indicated, the core receptor location spans more than one section. The range in distance is also provided.
2) Distances are rounded to the nearest 100 m

Table F.6–26. Distance and Direction from Aerial Cable Facility to KAFB Boundary

DIRECTION	DISTANCE (meters)
N	5,000
NNE	5,100
NE	5,000
ENE	4,800
E	5,000
ESE	5,100
SE	6,000
SSE	5,100
S	4,900
SSW	4,900
SW	5,900
WSW	8,700
W	13,500
WNW	10,700
NW	4,100
NNW	4,200

Source: SNL/NM 1998dd
Note: Distances rounded to the nearest 100 m

radioactive release because its contribution to the dose consequences will be insignificant relative to the enriched uranium due to its low specific activity relative to enriched uranium. The likelihood of this scenario has been estimated to be in the frequency range of 10^{-6} to 10^{-4} per year.

Scenario 2: IHE Detonation

Similar to Scenario 1, a fire external to the test specimen starts during testing, staging, or local transport of the specimen. In this scenario, however, the fire progresses to the IHE, burns without intervention, and produces sufficient heat in the necessary spatial locations relative to the explosives to detonate the confined IHE. As in Scenario 1, bounding assumptions are postulated. The enriched uranium is assumed to be in an exposed metal form and to be pure uranium-235, and the depleted uranium is not included in the analysis because it will not contribute to the consequences. The likelihood of this scenario has been estimated to be in the frequency range of 10^{-6} to 10^{-4} per year.

Detonation of the IHE from the drop test impact has been identified as another possible initiator for this scenario. Detonation from impact is estimated to be in the frequency range of 10^{-5} to 10^{-4} per year for PBX-9502 IHE, and 10^{-7} to 10^{-5} per year for LX-17 IHE.

The radiological consequences of Scenarios 1 and 2 were determined based on the above descriptions and assumptions. For Scenario 1, the ARF and RF for thermal release of metallic uranium were used. These ARF/RF values are $1x10^{-3}$ and 1.0, respectively (DOE 1994b) (see Section 4.1, page 4–3). The buoyant plume model was used, assuming a 1-MW fire (see Section F.2.2) for an explanation of the basis for the fire size). For Scenario 2, the explosion was assumed to disperse the entire inventory of enriched uranium (such as, ARF/RF = 1.0/1.0). This is consistent with the recommendations in DOE-HDBK-3010-94 for the quantity of explosives present (DOE 1994b; see Section 4.1, page 4–3). The nonbuoyant plume model was used because the radioactive material is dispersed by the explosive pressure and not a thermal plume.

The calculated radiological consequences from Scenarios 1 and 2 are provided in Tables F.6–27 through F.6–29. If Scenario 1 were to occur, a noninvolved worker located as a distance of 100 m from the fire would receive an estimated dose of $3.8x10^{-4}$ rem and an increased probability of a latent cancer fatality of $1.5x10^{-7}$. Involved workers in closer proximity to the accident could receive injuries resulting from the fire and exposure to airborne radioactive material that is released. The MEI would receive an estimated dose of $4.4x10^{-7}$ rem and an increased probability of a latent cancer fatality of $2.2x10^{-10}$. The public, out to a distance of 50 miles, would receive an estimated dose of $4.3x10^{-3}$ person-rem and an increased number of latent cancer fatalities of $2.1x10^{-6}$.

If Scenario 2 were to occur, a noninvolved worker located at a distance of 100 m from the detonation would receive an estimated dose of 2.6 rem and an increased probability of a latent cancer fatality of $1.0x10^{-3}$. Involved workers in close proximity to the accident could receive injuries resulting from the detonation and exposure to airborne radioactive material and radioactive debris that are released. The MEI would receive an estimated dose of $4.0x10^{-4}$ rem and an increased probability of a latent cancer fatality of $2.0x10^{-7}$. The public, out to a distance of 50 mi, would receive an estimated dose of 3.5 person-rem and an increased number of latent cancer fatalities of $1.8x10^{-3}$.

For all scenarios discussed in this section, cleaning up the area would reduce the effects of ground contamination.

Dispersal of Hazardous Chemicals

In addition to the radiological hazards evaluated in the previous section, hazardous chemicals may also be present in some test specimens. A fire involving certain chemicals present in the specimens might generate toxic fumes. These chemical hazards would not affect the public because of the quantities involved and the dispersion that will occur over the distances involved (Table F.6–24). Involved workers could suffer minor consequences. It is assumed that involved workers will evacuate the area if a fire is initiated around a test specimen containing explosives, thereby limiting the impact. An accident scenario involving an explosion would have less impact than a scenario involving a fire because the explosion would disperse the chemicals locally without generating toxic fumes.

Table F.6–27. Aerial Cable Facility Radiological Consequences to Maximally Exposed Individual and Noninvolved Worker

Accident ID[a]	Accident Scenario Description	Accident Frequency (per year)	Applicable Alternative[b]	Maximally Exposed Individual[c]		Noninvolved Worker	
				Dose (rem)	Increased Probability of Latent Cancer Fatality	Dose (rem)	Increased Probability of Latent Cancer Fatality
ACF-1	IHE Deflagration	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$4.4x10^{-7}$	$2.2x10^{-10}$	$3.8x10^{-4}$	$1.5x10^{-7}$
ACF-2	IHE Explosion	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$4.0x10^{-4}$	$2.0x10^{-7}$	2.6	$1.0x10^{-3}$

Source: Original
IHE: insensitive high explosive
[a] Facility Accident Descriptors:
Aerial Cable Facility: ACF-1, ACF-2
[b] Applicable Alternative:
All–Scenario applicable to all three alternatives
[c] Maximally exposed individual located at site boundary

Table F.6–28. Aerial Cable Facility Radiological Consequences to the 50-Mile Population

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (person-rem)	ADDITIONAL LATENT CANCER FATALITY
ALL ALTERNATIVES				
ACF-1	IHE Deflagration	$1.0x10^{-4}$ to $1.0x10^{-6}$	$4.3x10^{-3}$	$2.1x10^{-6}$
ACF-2	IHE Explosion	$1.0x10^{-4}$ to $1.0x10^{-6}$	3.5	$1.8x10^{-3}$

Source: Original
IHE: insensitive high explosive
[a] Facility Accident Descriptors:
Aerial Cable Facility: ACF-1, ACF-2

Table F.6–29. Aerial Cable Facility Radiological Consequences to Core Receptor Locations

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	APPLICABLE ALTERNATIVE[b]	DOSE (person-rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (person-rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
				Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC) (8.1-12.1 km to W)		***Golf Course, Riding Stables (8.1 - 12.1 km to WNW)***	
ACF-1	IHE Deflagration	1.0×10^{-4} to 1.0×10^{-6}	All	4.6×10^{-8}	2.3×10^{-11}	3.6×10^{-8}	1.8×10^{-11}
ACF-2	IHE Explosion	1.0×10^{-4} to 1.0×10^{-6}	All	3.9×10^{-5}	1.9×10^{-8}	3.1×10^{-5}	1.5×10^{-8}
				Sandia Base Elementary (12.1 - 16.1 km to NW)		***Kirtland Elementary, Child Development Center - West, Lovelace Hospital (16.1 - 24.1 to NW)***	
ACF-1	IHE Deflagration	1.0×10^{-4} to 1.0×10^{-6}	All	2.3×10^{-8}	1.2×10^{-11}	9.9×10^{-9}	4.9×10^{-12}
ACF-2	IHE Explosion	1.0×10^{-4} to 1.0×10^{-6}	All	1.8×10^{-5}	9.0×10^{-9}	8.3×10^{-6}	4.2×10^{-9}
				Sandia Base Elementary, Wherry Elementary, Coronado Club, National Atomic Museum, Base Housing, Child Development Center - East, Shandiin Day Care Center, Veterans Affairs Medical Center (12.1 - 16.1 km to WNW)			
ACF-1	IHE Deflagration	1.0×10^{-4} to 1.0×10^{-6}	All	1.9×10^{-10}	9.4×10^{-14}		
ACF-2	IHE Explosion	1.0×10^{-4} to 1.0×10^{-6}	All	1.6×10^{-5}	7.9×10^{-9}		

Source: Original
IHE: insensitive high explosive

[a] Facility Accident Descriptors:
Aerial Cable Facility: ACF-1, ACF-2

[b] Applicable Alternative:
All–Scenario is applicable to all three alternatives

F.7 SITE-WIDE EARTHQUAKE

This section presents the impacts from a site-wide earthquake. The section is divided into three subsections. The first describes the methodology used to determine which buildings would remain intact after an earthquake of sufficient energy to destroy buildings throughout SNL/NM. The second describes the resulting radiological impacts, while the third describes the resulting chemical impacts.

F.7.1 Building Status Methodology

This subsection discusses the methodology for determining the structural status of selected buildings following an earthquake. The earthquake considered in this section is of an intensity specified in the UBC applicable for the SNL/NM area (SNL/NM 1995a). This earthquake is approximately 0.17 *g* acceleration.

All SNL/NM buildings were screened from 1997-1998 for life safety in response to Executive Order (EO) 12941 (59 FR 62545). This EO requested an inventory of all Federally owned or leased buildings and an estimate of the cost of mitigating unacceptable risks for the Federally owned buildings.

Paragon Structural Engineering, LLP, prepared a study for SNL/NM (Paragon 1997 & 1998) that complies with EO 12941. Paragon used the "LANL Seismic Screening Method" (LANL 1997) to determine the status of each building at SNL/NM. The Los Alamos National Laboratory (LANL) method uses two phases to determine the status of each facility. Phase I consists of a review of construction drawings and a visual inspection of the building. Phase II, through the use of capacity/demand ratios, identifies the buildings having inadequate strength to resist a lateral load. Phase II is a very conservative assessment; a more rigorous structural analysis may reveal additional structural capacity or lower seismic demand. For the SWEIS, if a building was designed after the benchmark year but failed Phase II, it was felt that a detailed analysis would show that the building would remain intact, because a detailed seismic study would have been performed to document that the building would meet the UBC. The benchmark year is the edition of the UBC where ductile detailing requirements were first incorporated.

Table F.7–1 shows the results of the study in two phases. For the SWEIS, it was assumed that all buildings or portions of buildings that were designed in years after the benchmark year and had passed Phase I would remain intact. If the buildings were designed prior to the benchmark year and had passed both Phase I and Phase II studies, the buildings were assumed to remain intact. Regardless of the year that the buildings were designed, if they did not pass Phase I, they were considered to fail. If the buildings were designed prior to the benchmark year, passed Phase I, and failed Phase II, they were also considered to fail. This logic is presented in Table F.7–2. Table F.7–3 presents the building responses for the purposes of the SWEIS. If a building was considered to remain intact for the purposes of the study, it means that the building did not receive enough damage to cause a catastrophic release from the building. If a building was considered not to remain intact for the purposes of the study, it means that the building would receive enough damage to cause a catastrophic release. This study did not evaluate in detail the amount of a building's collapse. The study's intent was to evaluate where the building would remain intact enough to allow occupants to evacuate the building safely.

The Paragon Study did not include the MESA Complex, because this facility has not yet even been designed. If implemented, the new MESA Complex would be designed to withstand the UBC earthquake.

F.7.2 Frequency of Earthquakes

The UBC, which is used in the design of buildings and facilities at SNL/NM, specifies different levels of earthquake severity depending on the proposed use of the building. For office and other nonhazardous use buildings, such as many of those in TA-I, the 0.17 *g* level is used as the design criteria. For facilities in TA-V, the design criteria are established at a higher level of loading (0.22 *g*).

Based on recently completed probabilistic ground motion estimates, the U.S. Geological Survey revised the mean annual frequency versus peak acceleration (USGS 1996). For SNL/NM stiff soil, an acceleration of 0.17 *g* has a frequency of 1.0×10^{-3}, while an acceleration of 0.22 *g* has a frequency of 7.0×10^{-4}. For a site-wide earthquake-induced release of chemicals, an acceleration of 0.17 *g* with a frequency of 1.0×10^{-3} is used. For an earthquake-induced release of radiological material, a ground acceleration of 0.22 *g* with a frequency of 7.0×10^{-4} is used. The Manzano Waste Storage Facilities, which may contain notable inventories of radioactive material, do not contribute to the site-wide earthquake accident. Accidents at these facilities are evaluated in Section F.2.8. The Manzano Waste Storage Facilities include four storage bunkers: two are drilled out of rock and two are reinforced concrete covered with several feet of soil. The Paragon study did not evaluate the underground bunkers, noting that these buildings will not require seismic upgrades (Paragon 1997 & 1998). The SAR for these facilities (SNL/NM 1997q) includes a detailed structural analysis that concludes that these

Table F.7–1. Summary of Results of Life Safety Study

BUILDING		AFTER BENCHMARK YEAR	RESULT	
NUMBER	NAME		PHASE I	PHASE II
823	*Systems Research and Development Facility*	yes	Passed	Failed
858	*Microelectronics Development Laboratory*	yes	North and south wings failed	Not calculated
			Clean room passed	Clean room failed
869	*Environmental Health Laboratory*	no	Failed	Not calculated
870	*Neutron Generator Facility*	yes	Passed	Passed
878	*Advanced Manufacturing Processes Laboratory*	yes	Passed	Failed
880	*Computing*	no	Failed	Not calculated
884	*Ion Beam Materials Research Laboratory*	no	Passed	Failed
888	*Lightning Simulation Facility*	yes	Passed	Passed
893	*Compound Semiconductor Research Laboratory*	yes	Equipment room addition (gas bunker) passed	Passed
			Clean room passed	Passed
			Rest of building failed	Not calculated
897	*Integrated Materials Research Laboratory*	yes	Passed	Failed
905	*Explosive Components Facility*	yes	Passed	Southwest wing passed
				Southeast wing (south half), passed
				Rest failed
6580	*Hot Cell Facility*	no	Failed	not calculated
6588	*Annular Core Research Reactor*	no	Failed	not calculated
6593	*Sandia Pulsed Reactor*	no	Kiva passed	not calculated
			Vault addition failed	not calculated

Source: Paragon 1997 &1998

Table F.7–2. Logic Used in Applying Life Safety Study

AFTER BENCHMARK YEAR	PHASE I	PHASE II	BUILDING STATUS
Yes	Passed	—	Intact
Yes	Failed	—	Not intact
No	Passed	Passed	Intact
No	Passed	Failed	Not intact
No	Failed	—	Not intact

Source: Original

Table F.7–3. Building Status as Applied for SWEIS Site-Wide Earthquake

NUMBER	BUILDING NAME	SNL/NM SWEIS BUILDING RESPONSE
823	*Systems Research and Development Facility*	Intact
858	*Microelectronics Development Laboratory*	Only clean room intact
869	*Environmental Health Laboratory*	Non intact
	Microsystems and Engineering Sciences Applications Complex	Only clean room intact
878	*Advanced Manufacturing Processes Laboratory*	Intact
880	*Computing*	Not intact
883 [a]	*Photovoltaic Device Fabrication Facility*	Assumed failed
884	*Ion Beam Materials Research Laboratory*	Not intact
888	*Lightning Simulation Facility*	Intact
893	*Compound Semiconductor Research Laboratory*	Gas bunker and clean room intact
897	*Integrated Materials Research Laboratory*	Intact
905	*Explosive Components Facility*	Not intact (areas with thionyl chloride assumed failed and explosive bunkers failed)
6580	*Hot Cell Facility*	Not intact
6588	*Annular Core Research Reactor*	Not intact
6593	*Sandia Pulsed Reactor*	Kiva intact; North Vault not intact

Source: Original
[a] Not included in Paragon study; therefore, the SWEIS analysis assumed failure of the building.

bunkers have sufficient structural capacity to withstand a UBC earthquake of 0.17 *g*. The SAR noted that even if one of these bunkers were to collapse in the event of a larger earthquake, any material stored inside would be buried in the soil and rubble and would not be released in any significant quantity.

F.7.3 Radiological Impact

The radiological impacts of a site-wide earthquake are shown in Tables F.7–4 through F.7–6. It is assumed that, in the event of an earthquake, all the TA-V facilities would fail except for the SPR Kiva. The highest impact accident on the site would be SP-1 for all alternatives. Under all alternatives except No Action, the ACRR would be configured for medical isotopes production. Under the No Action Alternative and in an emergency,

Table F.7–4. Site-Wide Earthquake Radiological Consequences to the Maximally Exposed Individual and Noninvolved Worker

ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	MAXIMALLY EXPOSED INDIVIDUAL		NONINVOLVED WORKER	
			DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
NO ACTION ALTERNATIVE						
Technical Area-I						
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.9×10^{-6}	1.4×10^{-9}	7.9×10^{-3}	3.2×10^{-6}
Technical Area-II						
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.1×10^{-7}	1.5×10^{-10}	4.6×10^{-4}	1.9×10^{-7}
Technical Area-V						
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	4.8×10^{-4}	2.4×10^{-7}	1.9×10^{-1}	7.4×10^{-5}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-2}	6.9×10^{-6}	3.7×10^{1}	3.0×10^{-2}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	5.8×10^{-7}	6.9×10^{-1}	2.7×10^{-4}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	1.7×10^{-3}	8.4×10^{-7}	5.6×10^{-1}	2.2×10^{-4}
NO ACTION ALTERNATIVE TOTALS			**1.7×10^{-2}**	**8.6×10^{-6}**	c	c
EXPANDED OPERATIONS ALTERNATIVE						
Technical Area-I						
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.9×10^{-6}	1.4×10^{-9}	7.9×10^{-3}	3.2×10^{-6}
Technical Area-II						
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.1×10^{-7}	1.5×10^{-10}	4.6×10^{-4}	1.9×10^{-7}

Table F.7–4. Site-Wide Earthquake Radiological Consequences to the Maximally Exposed Individual and Noninvolved Worker (concluded)

ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	MAXIMALLY EXPOSED INDIVIDUAL		NONINVOLVED WORKER	
			DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
Technical Area-V						
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	4.8×10^{-4}	2.4×10^{-7}	1.9×10^{-1}	7.4×10^{-5}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-2}	6.9×10^{-6}	3.7×10^{1}	3.0×10^{-2}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	5.8×10^{-7}	6.9×10^{-1}	2.7×10^{-4}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**1.6×10^{-2}**	**7.8×10^{-6}**	[c]	[c]
REDUCED OPERATIONS ALTERNATIVE						
Technical Area-I						
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.9×10^{-6}	1.4×10^{-9}	7.9×10^{-3}	3.2×10^{-6}
Technical Area-II						
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.1×10^{-7}	1.5×10^{-10}	4.6×10^{-4}	1.9×10^{-7}
Technical Area-V						
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	4.8×10^{-4}	2.4×10^{-7}	1.9×10^{-1}	7.4×10^{-5}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-2}	6.9×10^{-6}	3.7×10^{1}	3.0×10^{-2}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	5.8×10^{-7}	6.9×10^{-1}	2.7×10^{-4}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**1.6×10^{-2}**	**7.8×10^{-6}**	[c]	[c]

Source: Original

[a] Facility Accident Descriptors:

- Annular Core Research Reactor-Defense Programs: AR-5
- Annular Core Research Reactor-Medical Isotopes Production: AM-2
- Explosive Component Facility: ECF-1
- Hot Cell Facility: HC-1
- Neutron Generator Facility: NG-1
- Sandia Pulsed Reactor: SP-1

[b] The maximally exposed individual would be located at the Golf Course and the consequences can be added.

[c] Because the noninvolved worker would be 100 meters from the release, he would be located at different places for each technical area, therefore, the consequences cannot be added across technical areas.

Notes: 1) Under the No Action Alternative, the Annular Core Research Reactor can be operated in either the medical isotopes production or Defense Programs configuration. The highest consequence (AR-5) was used.

2) Under the Expanded Operations Alternative, the earthquake for the Annular Core Research Reactor-Defense Programs configuration is not applicable because the location or facility was not selected. It was assumed that the new facility would be designed to withstand the Uniform Building Code earthquake.

Table F.7–5. Site-Wide Earthquake Radiological Consequence to the 50-Mile Population

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (person-rem)	ADDITIONAL LATENT CANCER FATALITY
NO ACTION ALTERNATIVE				
Technical Area-I				
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.0×10^{-1}	5.1×10^{-5}
Technical Area-II				
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	5.9×10^{-3}	3.0×10^{-6}
Technical Area-V				
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.9	2.0×10^{-3}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.3×10^{2}	6.4×10^{-2}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{1}	9.2×10^{-3}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	1.2×10^{1}	5.9×10^{-3}
TOTALS FOR NO ACTION ALTERNATIVE			**1.6×10^{2}**	**8.2×10^{-2}**
EXPANDED OPERATIONS ALTERNATIVE				
Technical Area-I				
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.0×10^{-1}	5.1×10^{-5}
Technical Area-II				
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	5.9×10^{-3}	3.0×10^{-6}
Technical Area-V				
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.9	2.0×10^{-3}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.3×10^{2}	6.4×10^{-2}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{1}	9.2×10^{-3}
TOTALS FOR EXPANDED OPERATIONS ALTERNATIVE			**1.5×10^{2}**	**7.6×10^{-2}**
REDUCED OPERATIONS ALTERNATIVE				
Technical Area-I				
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.0×10^{-1}	5.1×10^{-5}
Technical Area-II				
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	5.9×10^{-3}	3.0×10^{-6}
Technical Area-V				
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.9	2.0×10^{-3}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.3×10^{2}	6.4×10^{-2}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{1}	9.2×10^{-3}
TOTALS FOR REDUCED OPERATIONS ALTERNATIVE			**1.5×10^{2}**	**7.6×10^{-2}**

Source: Original
[a] Facility Accident Descriptors:
Neutron Generator Facility: NG-1
Explosive Component Facility: ECF-1
Annular Core Research Reactor-Medical Isotopes Production: AM-2
Annular Core Research Reactor-Defense Programs: AR-5
Hot Cell Facility: HC-1
Sandia Pulsed Reactor: SP-1

Notes: 1) Under the No Action Alternative, the Annular Core Research Reactor can be operated in either the medical isotopes production or Defense Programs configuration. The highest consequence (AR-5) was used.
2) Under the Expanded Operations Alternative, the earthquake for the Annular Core Research Reactor-Defense Programs configuration would not be applicable because the location or facility was not selected. It was assumed that the new facility would be designed to withstand the Uniform Building Code earthquake.

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
NO ACTION ALTERNATIVE						
			Golf Course		***Riding Stables***	
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$2.9x10^{-6}$	$1.4x10^{-9}$	$1.4x10^{-6}$	$6.8x10^{-10}$
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$3.1x10^{-7}$	$1.5x10^{-10}$	$7.9x10^{-8}$	$4.0x10^{-11}$
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$4.8x10^{-4}$	$2.4x10^{-7}$	$4.7x10^{-4}$	$2.4x10^{-7}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.4x10^{-2}$	$6.9x10^{-6}$	$1.3x10^{-2}$	$6.3x10^{-6}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.2x10^{-3}$	$5.8x10^{-7}$	$1.1x10^{-3}$	$5.3x10^{-7}$
AR-5	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$1.7x10^{-3}$	$8.4x10^{-7}$	$1.6x10^{-3}$	$8.1x10^{-7}$
NO ACTION ALTERNATIVE			**$1.7x10^{-2}$**	**$8.3x10^{-6}$**	**$1.5x10^{-2}$**	**$7.6x10^{-6}$**
			Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)		***National Atomic Museum***	
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$1.1x10^{-6}$	$5.6x10^{-10}$	$5.7x10^{-6}$	$2.8x10^{-9}$
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$7.1x10^{-8}$	$3.5x10^{-11}$	$1.4x10^{-7}$	$7.0x10^{-11}$
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$3.7x10^{-4}$	$1.9x10^{-7}$	$7.7x10^{-5}$	$3.9x10^{-8}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.1x10^{-2}$	$5.5x10^{-6}$	$1.5x10^{-3}$	$7.7x10^{-7}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$9.7x10^{-4}$	$4.8x10^{-7}$	$2.1x10^{-4}$	$1.1x10^{-7}$
AR-5	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$1.3x10^{-3}$	$6.5x10^{-7}$	$2.4x10^{-4}$	$1.2x10^{-7}$
NO ACTION ALTERNATIVE TOTALS			**$1.3x10^{-2}$**	**$6.6x10^{-6}$**	**$2.0x10^{-3}$**	**$9.9x10^{-7}$**
			Base Housing		***Shandiin Day Care Center***	
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$2.5x10^{-6}$	$1.2x10^{-9}$	$2.5x10^{-6}$	$1.2x10^{-9}$
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$1.4x10^{-7}$	$7.0x10^{-11}$	$1.4x10^{-7}$	$7.0x10^{-11}$
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$7.7x10^{-5}$	$3.9x10^{-8}$	$7.7x10^{-5}$	$3.9x10^{-8}$

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations (continued)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.5×10^{-3}	7.7×10^{-7}	1.5×10^{-3}	7.7×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	2.1×10^{-4}	1.1×10^{-7}	2.1×10^{-4}	1.1×10^{-7}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	2.4×10^{-4}	1.2×10^{-7}	2.4×10^{-4}	1.2×10^{-7}
NO ACTION ALTERNATIVE TOTALS			**2.0×10^{-3}**	**9.9×10^{-7}**	**2.0×10^{-3}**	**9.9×10^{-7}**
			Sandia Base Elementary School		***Wherry Elementary School***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	7.8×10^{-6}	3.9×10^{-9}	2.4×10^{-6}	1.2×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.0×10^{-7}	9.8×10^{-11}	8.3×10^{-8}	4.2×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	7.5×10^{-5}	3.8×10^{-8}	6.4×10^{-5}	3.2×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-3}	6.9×10^{-7}	1.2×10^{-3}	6.2×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	2.1×10^{-4}	1.0×10^{-7}	1.8×10^{-4}	8.9×10^{-8}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	2.2×10^{-4}	1.1×10^{-7}	1.9×10^{-4}	9.7×10^{-8}
NO ACTION ALTERNATIVE TOTALS			**1.8×10^{-3}**	**9.0×10^{-7}**	**1.6×10^{-3}**	**8.1×10^{-7}**
			Coronado Club		***Child Development Center-East***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	6.2×10^{-6}	3.1×10^{-9}	2.6×10^{-6}	1.3×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.0×10^{-7}	9.8×10^{-11}	8.3×10^{-8}	4.2×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	6.4×10^{-5}	3.2×10^{-8}	6.4×10^{-5}	3.2×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	6.2×10^{-7}	1.2×10^{-3}	6.2×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{-4}	8.9×10^{-8}	1.8×10^{-4}	8.9×10^{-8}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	1.9×10^{-4}	9.7×10^{-8}	1.9×10^{-4}	9.7×10^{-8}
NO ACTION ALTERNATIVE TOTALS			**1.6×10^{-3}**	**8.1×10^{-7}**	**1.6×10^{-3}**	**8.1×10^{-7}**
			Veterans Affairs Medical Center		***Lovelace Hospital***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	8.2×10^{-7}	4.1×10^{-10}	8.1×10^{-7}	4.0×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.3×10^{-8}	1.7×10^{-11}	3.3×10^{-8}	1.7×10^{-11}

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations (continued)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	6.4×10^{-5}	3.2×10^{-8}	5.4×10^{-5}	2.7×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	6.2×10^{-7}	1.0×10^{-3}	5.1×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{-4}	8.9×10^{-8}	1.5×10^{-4}	7.4×10^{-8}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	1.9×10^{-4}	9.7×10^{-8}	1.6×10^{-4}	7.9×10^{-8}
NO ACTION ALTERNATIVE TOTALS			**1.6×10^{-3}**	**8.1×10^{-7}**	**1.3×10^{-3}**	**6.6×10^{-7}**
			Kirtland Elementary School		***Child Development Center-West***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.3×10^{-7}	1.7×10^{-10}	4.3×10^{-7}	2.1×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.5×10^{-8}	7.6×10^{-12}	1.9×10^{-8}	9.4×10^{-12}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.0×10^{-5}	1.5×10^{-8}	3.0×10^{-5}	1.5×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	5.2×10^{-4}	2.6×10^{-7}	5.2×10^{-4}	2.6×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	8.0×10^{-5}	4.0×10^{-8}	8.0×10^{-5}	4.0×10^{-8}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	8.2×10^{-5}	4.1×10^{-8}	8.2×10^{-5}	4.1×10^{-8}
NO ACTION ALTERNATIVE TOTALS			**6.8×10^{-4}**	**3.4×10^{-7}**	**6.8×10^{-4}**	**3.4×10^{-7}**
EXPANDED OPERATIONS ALTERNATIVE						
			Golf Course		***Riding Stables***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.9×10^{-6}	1.4×10^{-9}	1.4×10^{-6}	6.8×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.1×10^{-7}	1.5×10^{-10}	7.9×10^{-8}	4.0×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	4.8×10^{-4}	2.4×10^{-7}	4.7×10^{-4}	2.4×10^{-7}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-2}	6.9×10^{-6}	1.3×10^{-2}	6.3×10^{-6}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	5.8×10^{-7}	1.1×10^{-3}	5.3×10^{-7}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**1.5×10^{-2}**	**7.7×10^{-6}**	**1.4×10^{-2}**	**7.1×10^{-6}**

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations (continued)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
			Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)		*National Atomic Museum*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.1×10^{-6}	5.6×10^{-10}	5.7×10^{-6}	2.8×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	7.1×10^{-8}	3.5×10^{-11}	1.4×10^{-7}	7.0×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.7×10^{-4}	1.9×10^{-7}	7.7×10^{-5}	3.9×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.1×10^{-2}	5.5×10^{-6}	1.5×10^{-3}	7.7×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	9.7×10^{-4}	4.8×10^{-7}	2.1×10^{-4}	1.1×10^{-7}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			$\mathbf{1.2 \times 10^{-2}}$	$\mathbf{6.1 \times 10^{-6}}$	$\mathbf{1.8 \times 10^{-3}}$	$\mathbf{9.1 \times 10^{-7}}$
			Base Housing		*Shandiin Day Care Center*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.5×10^{-6}	1.2×10^{-9}	2.5×10^{-6}	1.2×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.4×10^{-7}	7.0×10^{-11}	1.4×10^{-7}	7.0×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	7.7×10^{-5}	3.9×10^{-8}	7.7×10^{-5}	3.9×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.5×10^{-3}	7.7×10^{-7}	1.5×10^{-3}	7.7×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	2.1×10^{-4}	1.1×10^{-7}	2.1×10^{-4}	1.1×10^{-7}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			$\mathbf{1.8 \times 10^{-3}}$	$\mathbf{9.1 \times 10^{-7}}$	$\mathbf{1.8 \times 10^{-3}}$	$\mathbf{9.1 \times 10^{-7}}$
			Sandia Base Elementary School		*Wherry Elementary School*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	7.8×10^{-6}	3.9×10^{-9}	2.4×10^{-6}	1.2×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.0×10^{-7}	9.8×10^{-11}	8.3×10^{-8}	4.2×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	7.5×10^{-5}	3.8×10^{-8}	6.4×10^{-5}	3.2×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-3}	6.9×10^{-7}	1.2×10^{-3}	6.2×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	2.1×10^{-4}	1.0×10^{-7}	1.8×10^{-4}	8.9×10^{-8}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			$\mathbf{1.7 \times 10^{-3}}$	$\mathbf{8.3 \times 10^{-7}}$	$\mathbf{1.5 \times 10^{-3}}$	$\mathbf{7.4 \times 10^{-7}}$

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations (continued)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
			Coronado Club		*Child Development Center-East*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	6.2×10^{-6}	3.1×10^{-9}	2.6×10^{-6}	1.3×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.0×10^{-7}	9.8×10^{-11}	8.3×10^{-8}	4.2×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	6.4×10^{-5}	3.2×10^{-8}	6.4×10^{-5}	3.2×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	6.2×10^{-7}	1.2×10^{-3}	6.2×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{-4}	8.9×10^{-8}	1.8×10^{-4}	8.9×10^{-8}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**1.5×10^{-3}**	**7.4×10^{-7}**	**1.5×10^{-3}**	**7.4×10^{-7}**
			Veterans Affairs Medical Center		*Lovelace Hospital*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	8.2×10^{-7}	4.1×10^{-10}	8.1×10^{-7}	4.0×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.3×10^{-8}	1.7×10^{-11}	3.3×10^{-8}	1.7×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	6.4×10^{-5}	3.2×10^{-8}	5.4×10^{-5}	2.7×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	6.2×10^{-7}	1.0×10^{-3}	5.1×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{-4}	8.9×10^{-8}	1.5×10^{-4}	7.4×10^{-8}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**1.5×10^{-3}**	**7.4×10^{-7}**	**1.2×10^{-3}**	**6.1×10^{-7}**
			Kirtland Elementary School		*Child Development Center-West*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.3×10^{-7}	1.7×10^{-10}	4.3×10^{-7}	2.1×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.5×10^{-8}	7.6×10^{-12}	1.9×10^{-8}	9.4×10^{-12}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.0×10^{-5}	1.5×10^{-8}	3.0×10^{-5}	1.5×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	5.2×10^{-4}	2.6×10^{-7}	5.2×10^{-4}	2.6×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	8.0×10^{-5}	4.0×10^{-8}	8.0×10^{-5}	4.0×10^{-8}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**6.3×10^{-4}**	**3.2×10^{-7}**	**6.3×10^{-4}**	**3.2×10^{-7}**

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations (continued)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
REDUCED OPERATIONS ALTERNATIVE						
			Golf Course		***Riding Stables***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.9×10^{-6}	1.4×10^{-9}	1.4×10^{-6}	6.8×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.1×10^{-7}	1.5×10^{-10}	7.9×10^{-8}	4.0×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	4.8×10^{-4}	2.4×10^{-7}	4.7×10^{-4}	2.4×10^{-7}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-2}	6.9×10^{-6}	1.3×10^{-2}	6.3×10^{-6}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	5.8×10^{-7}	1.1×10^{-3}	5.3×10^{-7}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**1.5×10^{-2}**	**7.7×10^{-6}**	**1.4×10^{-2}**	**7.1×10^{-6}**
			Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)		***National Atomic Museum***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.1×10^{-6}	5.6×10^{-10}	5.7×10^{-6}	2.8×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	7.1×10^{-8}	3.5×10^{-11}	1.4×10^{-7}	7.0×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.7×10^{-4}	1.9×10^{-7}	7.7×10^{-5}	3.9×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.1×10^{-2}	5.5×10^{-6}	1.5×10^{-3}	7.7×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	9.7×10^{-4}	4.8×10^{-7}	2.1×10^{-4}	1.1×10^{-7}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**1.2×10^{-2}**	**6.1×10^{-6}**	**1.8×10^{-3}**	**9.1×10^{-7}**
			Base Housing		***Shandiin Day Care Center***	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.5×10^{-6}	1.2×10^{-9}	2.5×10^{-6}	1.2×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.4×10^{-7}	7.0×10^{-11}	1.4×10^{-7}	7.0×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	7.7×10^{-5}	3.9×10^{-8}	7.7×10^{-5}	3.9×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.5×10^{-3}	7.7×10^{-7}	1.5×10^{-3}	7.7×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	2.1×10^{-4}	1.1×10^{-7}	2.1×10^{-4}	1.1×10^{-7}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**1.8×10^{-3}**	**9.1×10^{-7}**	**1.8×10^{-3}**	**9.1×10^{-7}**

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations (continued)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
			Sandia Base Elementary School		*Wherry Elementary School*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	7.8×10^{-6}	3.9×10^{-9}	2.4×10^{-6}	1.2×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.0×10^{-7}	9.8×10^{-11}	8.3×10^{-8}	4.2×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	7.5×10^{-5}	3.8×10^{-8}	6.4×10^{-5}	3.2×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.4×10^{-3}	6.9×10^{-7}	1.2×10^{-3}	6.2×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	2.1×10^{-4}	1.0×10^{-7}	1.8×10^{-4}	8.9×10^{-8}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**1.7×10^{-3}**	**8.3×10^{-7}**	**1.5×10^{-3}**	**7.4×10^{-7}**
			Coronado Club		*Child Development Center-East*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	6.2×10^{-6}	3.1×10^{-9}	2.6×10^{-6}	1.3×10^{-9}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	2.0×10^{-7}	9.8×10^{-11}	8.3×10^{-8}	4.2×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	6.4×10^{-5}	3.2×10^{-8}	6.4×10^{-5}	3.2×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	6.2×10^{-7}	1.2×10^{-3}	6.2×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{-4}	8.9×10^{-8}	1.8×10^{-4}	8.9×10^{-8}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**1.5×10^{-3}**	**7.4×10^{-7}**	**1.5×10^{-3}**	**7.4×10^{-7}**
			Veterans Affairs Medical Center		*Lovelace Hospital*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	8.2×10^{-7}	4.1×10^{-10}	8.1×10^{-7}	4.0×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.3×10^{-8}	1.7×10^{-11}	3.3×10^{-8}	1.7×10^{-11}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	6.4×10^{-5}	3.2×10^{-8}	5.4×10^{-5}	2.7×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	1.2×10^{-3}	6.2×10^{-7}	1.0×10^{-3}	5.1×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	1.8×10^{-4}	8.9×10^{-8}	1.5×10^{-4}	7.4×10^{-8}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**1.5×10^{-3}**	**7.4×10^{-7}**	**1.2×10^{-3}**	**6.1×10^{-7}**

Table F.7–6. Site-Wide Increased Probability of Latent Cancer Fatalities for Core Receptor Locations (continued)

ACCIDENT ID[a]	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY	DOSE (rem)	INCREASED PROBABILITY OF LATENT CANCER FATALITY
			Kirtland Elementary School		*Child Development Center-West*	
NG-1	Catastrophic release of building's tritium	7.0×10^{-4}	3.3×10^{-7}	1.7×10^{-10}	4.3×10^{-7}	2.1×10^{-10}
ECF-1	Catastrophic release of building's tritium	7.0×10^{-4}	1.5×10^{-8}	7.6×10^{-12}	1.9×10^{-8}	9.4×10^{-12}
AM-2	Earthquake - collapse of bridge crane	7.0×10^{-4}	3.0×10^{-5}	1.5×10^{-8}	3.0×10^{-5}	1.5×10^{-8}
HC-1	Earthquake - building collapse	7.0×10^{-4}	5.2×10^{-4}	2.6×10^{-7}	5.2×10^{-4}	2.6×10^{-7}
SP-1	Earthquake - building collapse	7.0×10^{-4}	8.0×10^{-5}	4.0×10^{-8}	8.0×10^{-5}	4.0×10^{-8}
REDUCED OPERATIONS ALTERNATIVE TOTALS			**6.3×10^{-4}**	**3.2×10^{-7}**	**6.3×10^{-4}**	**3.2×10^{-7}**

Source: Original

[a] Facility Accident Descriptors:
Neutron Generator Facility: NG-1
Explosive Component Facility: ECF-1
Annular Core Research Reactor-Medical Isotope Production: AM-2
Annular Core Research Reactor-Defense Programs: AR-5
Hot Cell Facility: HC-1
Sandia Pulsed Reactor: SP-1

Notes: 1) Under the No Action Alternative, the Annular Core Research Reactor can be operated in either the medical isotopes production or Defense Programs configuration. The highest consequence (AR-2) was used.
2) Under the Expanded Operations Alternative, the earthquake for the Annular Core Research Reactor-Defense Programs is not applicable because the location or facility was not selected. It was assumed that the new facility would be designed to withstand the Uniform Building Code earthquake.

the ACRR could be configured in a DP configuration. For the ACRR under the No Action Alternative and in a DP configuration, the highest impact accident is AR-5. In a medical isotopes production configuration, the highest impact accident is AM-2. Under the Reduced Operations Alternative, the highest impact ACRR accident is AM-2 because there are no plans for ACRR operation in a DP configuration. Under the Expanded Operations Alternative, the existing ACRR would only be operated in the medical isotopes production configuration. Any DP requirements for ACRR-type testing would be performed in a new unspecified facility, assumed to be designed to survive an earthquake. The NGF in TA-I and ECF in TA-II could also release radioactive materials during an earthquake, and are included in Tables F.7–4 through F.7–6.

Total consequences for the accidents listed are shown in Tables F.7–4 through F.7–6 for the maximally exposed individual and 50-mile population. Totals are not shown for the noninvolved worker because that receptor's location is not the same for all accidents.

The 50-mi population dose is 160 person-rem (Table F.7–5). The MEI for the earthquake is at the Golf Course and receives a dose of 0.017 rem under the No Action Alternative (Table F.7–6). This dose is the sum of contributions from the individual facilities listed and summed in Table F.7–6.

F.7.4 Chemical Impacts

Based on the Paragon life safety study, the following buildings or portions of buildings would fail during a UBC (0.17 *g*) earthquake, releasing the contents of the chemicals stored within the building: Buildings 858, 869, 880, 884, 893, and 905 (Paragon 1997 & 1998). One building, 883, was not included in the Paragon life safety study. It was assumed to fail (see Table F.7–3). Table F.7–7 presents, by chemical, the building and the potential amounts released. It should be noted that for Building 893, the gas storage location would remain intact. In a similar fashion, the clean room in Building 858 would remain intact. If implemented, the MESA Complex clean room is also assumed to remain intact. Therefore, not all chemicals shown in Table F.3–3 would be released during an earthquake. The shaded cells in Table F.7–7 contain the high risk chemical for that building. Figures F.7–1 and F.7–2 show the ERPG-2 plumes, based on the high risk chemicals for each building. It should be noted that the entire area encircled represents locations where approximately 423 people under the No Action Alternative, Reduced Operations Alternative, and Expanded Operations Alternative without the MESA Complex. Under the Expanded Operations Alternative, if the MESA Complex configuration is implemented, 306 people could be exposed to concentrations of chemicals above ERPG-2 levels. The encircled area represents the area potentially affected if the wind were blowing in another direction when the earthquake occurred.

Because there are several chemicals that could be released from one or more buildings, locations of possible overlapping plumes of the same chemical need to be examined. The overlapping areas need to be examined for any that could be above the ERPG-2 concentrations, but that are not already included within the total encircled area. There are only seven chemicals that are released from multiple buildings. Depending on the wind direction, there is a possibility that plumes of the same chemical released from different buildings could overlap. The overlapping area could contain concentrations of the chemical that are below the ERPG-2 level within each plume, but, when combined could yield a concentration above the ERPG-2 level. If this situation existed, the additional area above the ERPG-2 level would be small relative to the area of either contributing plume.

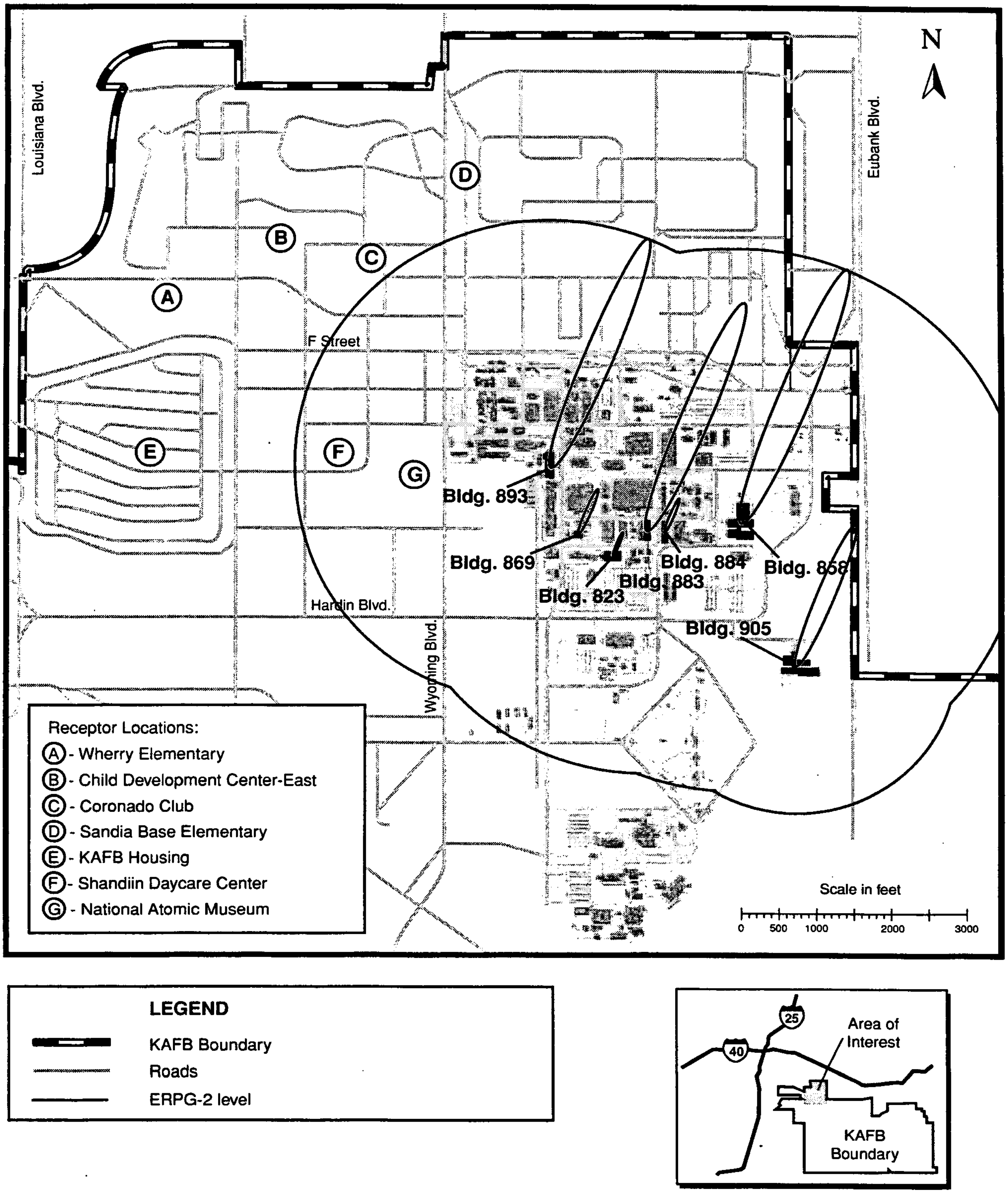
Table F.7–7. Chemicals Released By Failed Building (in Pounds)

CHEMICAL	BUILDING NUMBER						
	858	869	880	883	884	893	905
Ammonia					34.2	31	
Phosphine	4.84			6.8		5	
Hydrogen Fluoride	0.033						0.054
Hydrofluoric Acid			2		10		
Nitric Acid		18.6			9.8	250.9	
Carbon Disulfide		0.03					
Carbon Monoxide					0.78		
Arsine	2						
Bromine						1.37	
Chlorine	106.41						
Hydrochloric Acid						300.5	
Silane	47.1						
Fluorine	0.16						
Diborane	7.7						
Thionyl Chloride							101.1

Source: Original

Notes: 1) See Tables F.3–4 and F.7–3

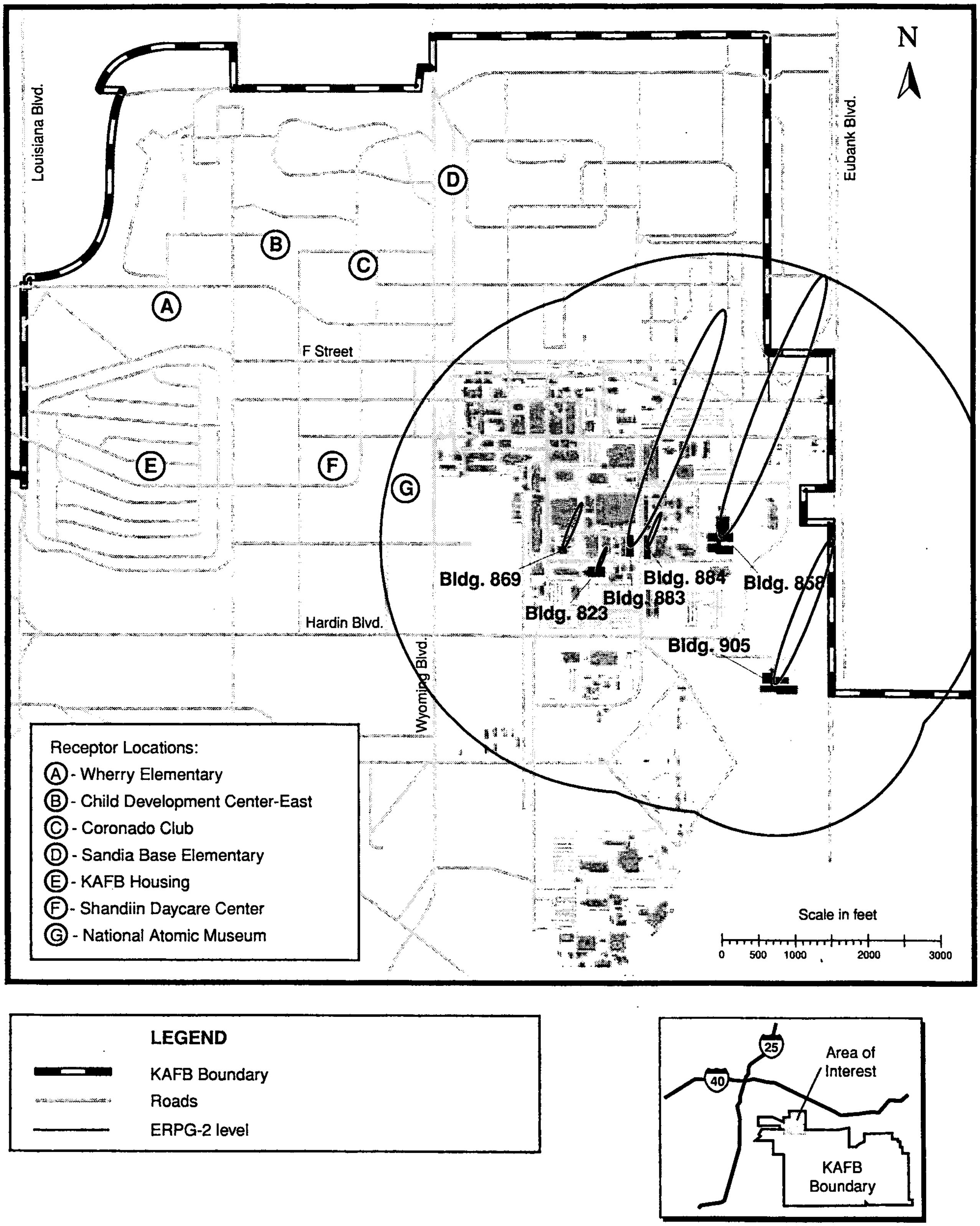
2) Shaded areas identify the high risk chemical for that building.



Source: Original

Figure F.7–1. Areas Above ERGP-2 Levels Resulting from Site-Wide Earthquake for the No Action, Reduced Operations, and Expanded Operations Alternatives Without the Microsystems and Engineering Sciences Applications Complex

The encircled areas represent potential locations that could be above ERPG-2 levels depending upon the wind direction.



Source: Original

Figure F.7–2. Areas above ERGP-2 Levels Resulting from Site-Wide Earthquake for the Expanded Operations Alternative With the Microsystems and Engineering Sciences Applications Complex

The encircled areas represent potential locations that could be above ERPG-2 levels depending upon the wind direction.

APPENDIX G – TRANSPORTATION

G.1 INTRODUCTION

This appendix contains material supporting the transportation impacts analysis. It details Sandia National Laboratories/New Mexico (SNL/NM)-related transportation activities pertaining to waste and other material. The information is taken from various documents, databases, and reports. Referenced documents used in the analysis include facility source documents (SNL/NM 1998a); the *SNL/NM Environmental Information Document* (SNL/NM 1997h); the *Environmental Assessment for SNL/NM Offsite Transportation of Low-level Radioactive Waste*, DOE/EA-1180 (DOE 1996h); and the *Medical Isotopes Production Project* [MIPP]: *Molybdenum-99 and Related Isotopes Environmental Impact Statement* [EIS], DOE/EIS-0249F (DOE 1996b). For additional information on air transportation issues, see the MIPP EIS, the *Hazardous Materials Shipments Report* (DOT 1998a), and the *Transportation Evaluation Report* [TER] *for Ross Aviation, Inc.* (Ross Aviation 1994). For additional information on waste generation, see Appendix H and Sections 5.3.10, 5.4.10, 5.5.10.

G.2 SCOPE OF THE ANALYSIS

The transportation-related impacts evaluation included the calculation of

- incident-free radiological doses and corresponding potential latent cancer fatalities (LCFs) to the crew and the public from radiation exposure,
- dose risks due to transportation accidents,
- nonradiological impacts due to traffic fatalities, and
- LCFs due to potential vehicle emissions of air pollutants.

These calculations were for combined lifetime fatalities from the transportation shipments of each material type. Overall impacts from all potential transportation activities for each of the alternatives considered in the SNL/NM Site-Wide Environmental Impact Statement (SWEIS) were also evaluated. The analysis focused on regular (or routine) shipments and identified shipment origins and destinations that posed the largest risks. Due to the nature of SNL/NM operations, irregular (nonroutine) or one-time shipments of hazardous materials from around the world are possible. However, the nonroutine shipments pertaining to transuranic (TRU) waste and special projects, such as legacy waste and Environmental Restoration (ER) Project wastes, were analyzed. The routine transportation operations analysis was conservative and bounding.

Air transportation-related impacts are bounded by truck transportation impacts. Three areas of air transportation were considered:

- air transportation of medical isotopes, as discussed in the MIPP EIS, including an accident analysis;
- air transportation of other materials, as discussed in the Office of Hazardous Materials Safety Research and Special Programs Administration's *Hazardous Materials Shipments Report* (DOT 1998a) (see Section G.8 for details)
- air transportation of the U.S. Department of Energy (DOE) and SNL/NM materials by Ross Aviation, as discussed in the *Transportation Evaluation Report for Ross Aviation, Inc. (Ross Aviation 1994)*

The MIPP EIS discusses the shipment of medical isotopes from the Albuquerque International Sunport to Boston, Chicago, and St. Louis. The number of shipments would be limited due to the number of direct flights (passenger or cargo) and the locations of the medical isotope distributors. Shipments would be transported to distribution airfreight hubs connecting with each of these three cities. Air traffic data were not available for the distribution airfreight hubs.

The MIPP EIS discussed radiological impacts to the public and onsite individuals due to routine transportation. The public included airplane passengers and people in the airport terminals. The *RADTRAN 4* computer model was used to perform these calculations.

Air transportation of other materials is discussed briefly in the *Hazardous Materials Shipment Report* (DOE 1998a). The Sunport freight center moved 130 M lb of cargo in 1998. It is estimated the Sunport would handle approximately 20 tons of hazardous materials per day. Nine major commercial carriers and five airfreight carriers serve the airport. Additional information is provided in Section G.8.

Air transportation by Ross Aviation is discussed in detail in the TER (Ross Aviation 1994). Appendix 2A of the TER describes the number of total air shipments and maximum quantities per shipment, including flammable liquids, compressed gases, explosives, and radioactives. Other information in the TER document includes environment, safety, and health (ES&H) management programs, types of aircraft, and operational safety requirements.

G.3 MATERIAL SHIPMENTS AND RECEIPTS

The various material types that have the potential for transportation impacts resulting from SNL/NM operations include radioactive, chemical, explosive, and waste materials. Radioactive waste includes low-level waste (LLW); low-level mixed waste (LLMW); TRU waste; municipal and construction solid waste; hazardous waste and other waste, including asbestos, biohazardous waste (medical), and polychlorinated biphenyls (PCBs).

The information required to determine the transportation impacts includes the number of shipments of each material type, potential origins of shipments, and potential destinations of shipments. This information was generated from available baseline data, projected material inventories, projected material usage, and projected waste generation presented in the facility source documents (SNL/NM 1998a) and associated inventory databases (such as the *Chemical Information System* [CIS]).

If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the number of material (or waste) shipments. The current and projected material (or waste) shipments would accommodate any increases resulting from the MESA Complex operations. This condition has been extensively used in the following text and tables and is not cited repeatedly.

G.3.1 Radioactive Material

Shipping and receiving records from 1995, 1996, and 1997 were used to calculate related transportation impacts for radioactive material. This information included the number of shipments and receipts, origins, and destinations. SNL/NM ships and receives radioactive material from various locations in the U.S.

For each alternative, the number of potential radioactive material shipments was calculated using the normalized activity multipliers presented in Appendix A. The results are shown in Table G.3–1.

The longest and most representative route was selected for a bounding analysis. This was accomplished by reviewing baseline shipments and receipts information. The route from SNL/NM to Mountain Top, Pennsylvania, was selected to model from the many routes used in 1997 for radioactive material shipments and receipts (Table G.3–2). The modeled route was screened and represented the route with the largest number of shipments, longest distance, and highest population distribution (Section G.6).

In 1997, according to data reflected in Table G.3–1, 36 tests/shots resulted in 305 shipments or receipts. The projected tests/shots in the table are used to estimate projected shipments. Projected tests/shots presented in the SNL/NM facility source documents would require shipments or receipts ranging from 140 under the Reduced Operations Alternative to 1,782 under the Expanded Operations Alternative.

G.3.2 Chemicals

A review of the CIS database and inventories and usage information on chemicals determined that approximately 80 percent of the chemicals supplied to SNL/NM were

Table G.3–1. Estimated Total Annual Shipments and Receipts of Radioactive Material by Alternative

ACTIVITY	BASE YEAR 1997	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Tests/Shots	36	66.3	70.4	210.3	16.5
Shipments/Receipts	305	562	597	1,782	140

Source: SNL/NM 1998a

Table G.3–2. Truck Traffic Bounding Case Distances

MATERIAL TYPES[a]	ORIGIN-DESTINATION	DISTANCE (km)
Radioactive[b]	SNL/NM—Bounding distance to Mountain Top, PA	3,022
Chemical	Albuquerque to SNL/NM	40
Explosive	SNL/NM to Silverdale, WA	2,406
LLW	SNL/NM to Clive, UT	1,722
LLMW[c] *(Receipt)*	SNL/CA to SNL/NM	1,780
LLMW (Shipment)	SNL/NM to Savannah River Site, SC	2,548
Hazardous Waste (Shipment)	SNL/NM to Clive, UT	1,722
Hazardous Waste (Receipt)	Local	13
Hazardous Waste (California) (Recyclable)	SNL/NM to Anaheim, CA	1,306
Hazardous Waste (Local) (Recyclable)	SNL/NM to Albuquerque, NM	32
Hazardous Solid Waste (D&D)	Local	32
Nonhazardous Solid Waste (Recyclable)	Local	32
Nonhazardous Landscaping (Recyclable)	SNL/NM to Rio Rancho, NM	50
Solid Waste (Municipal and C&D)	SNL/NM to Rio Rancho Sanitary Landfill, NM	50
TRU/MTRU[d] *Waste*	SNL/NM to Los Alamos National Laboratory, NM	167
Hazardous Waste TSCA-PCBs (D&D)	SNL/NM to Clive, UT	1,722
Hazardous Waste TSCA-Asbestos (D&D)	SNL/NM to Mountainair, NM	190
LLW (D&D)	SNL/NM to Clive, UT	1,722
Biohazardous Waste (Medical)	SNL/NM to Aragonite, UT	1,114
Legacy LLW (Storage)	SNL/NM to Clive, UT	1,722
Legacy LLMW (Storage)	SNL/NM to Savannah River Site, SC	2,548
Legacy TRU/MTRU (Storage)	SNL/NM to Los Alamos National Laboratory, NM	167
LLW (ER Project)	SNL/NM to Clive, UT	1,722
LLMW (ER Project)	SNL/NM to Savannah River Site, SC	2,548
RCRA Hazardous Waste (ER Project)	SNL/NM to Clive, UT	1,722
Nonhazardous Solid Waste (ER Project)	SNL/NM to Rio Rancho, NM	50

Sources: DOE 1996h, SNL 1992a, SNL/NM 1998a
C&D: construction and demolition
Ci: curies
D&D: decontamination and decommissioning
ER: Environmental Restoration
kg: kilograms
km: kilometer
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Material types are used in or generated from normal operations unless otherwise noted.
[b] Shipment consists of 100 kg of depleted uranium. The composition is given in Table G.4–2.
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium -24; Transport Index = 0.1.
[d] 1997 shipment of americium -241, europium-152, cesium-137; Transport Index = 1.0.

from 11 vendors making approximately 1 delivery per day, excluding bulk chemicals such as liquid nitrogen.

$$11 \text{ vendors/day} \times 1 \text{ shipment/vendor} \times 5 \text{ days/week} \times 50 \text{ weeks/year} = 2{,}750 \text{ shipments/year}$$

(Eq. G.3-1)

These chemicals included a variety of hazardous and nonhazardous materials, including solvents, corrosives, and flammables.

For the SWEIS analysis, the bounding calculation assumed the supplies would be located within 40 km of SNL/NM and delivered from a centralized facility. Using the following equation, the calculated number of annual shipments would be 2,750.

The number of shipments would not vary by alternative, but the amount of material shipped could vary to accommodate the material requirements under each alternative. Table G.3–3 shows 2,750 shipments per year for each alternative.

G.3.3 Explosives

Most of the transportation involving explosives is expected to be by onsite transfer. These transfers are typically small in quantity, of short duration, and do not contribute a notable portion to the transportation impacts. Offsite transportation impacts are considered risk-dominant and bound onsite transfers of explosive materials.

For the SWEIS analysis, the longest route for explosives was selected for a bounding analysis. The longest route is from Albuquerque, New Mexico, to Silverdale, Washington, a distance of approximately 2,406 km. The projected consumption rates of explosive materials were similarly based on the facility source document projections for the baseline and activity multipliers presented in Appendix A. In 1997, 303 offsite explosive material shipments and receipts were recorded (Table G.3–3).

For each alternative, the numbers of potential explosive material shipments were calculated using the projected number of shipments compared to the baseline ratio of explosive shipments to the number of activities (see Appendix A). Table G.3–3 presents the potential total number of explosives shipments/receipts by alternative.

G.3.4 Wastes

Various types of waste are generated at SNL/NM, including LLW, LLMW, and hazardous waste. For a detailed discussion of these waste types and other waste generation impacts by alternative, see Sections 5.3.10, 5.4.10, and 5.5.10 and Appendix H.

Shipments of LLW, LLMW, hazardous waste, TRU waste, and solid waste were considered in the transportation impacts analysis. For completeness, recyclable hazardous waste, decontamination and decommissioning (D&D) waste, other solid waste, legacy waste, and ER Project waste were also included in the analysis. These waste categories (see Table G.3–3) are discussed in the following sections, and the number of shipments for each waste type for the base year and for each of the alternatives was evaluated for transportation impacts.

G.3.4.1 Low-Level Waste

The *Environmental Assessment for SNL/NM Offsite Transportation of Low-Level Radioactive Waste, DOE/EA-1180* (DOE 1996h), considered four potential LLW disposal sites: Hanford, Washington; Nevada Test Site (NTS), Nevada; Savannah River Site (SRS), South Carolina; and Clive, Utah. The DOE anticipates that the disposal of LLW would continue at facilities such as the Envirocare facility located outside of Clive, Utah. There were four shipments in 1996, the base year for analysis. Following are the projected numbers of LLW shipments: No Action Alternative–13, Expanded Operations Alternative–21, and Reduced Operations Alternative–8 (Table G.3–3). Other routine shipments would be possible between SNL/NM and Hanford or SNL/NM and NTS. However, Table G.3–4 shows that the impacts in person-rem per shipment would be comparable among all four disposal sites (DOE 1996h).

G.3.4.2 Low-Level Mixed Waste

In the future, LLMW would be shipped to facilities such as the Idaho National Engineering and Environmental Laboratory, Envirocare, Diversified Scientific Services, Inc., Waste Control Specialists, Inc., Oak Ridge, and SRS for treatment or disposal. For bounding purposes, SRS shipments (approximately 2,548 km) were considered representative. For the base year (1996), one offsite LLMW shipment and one onsite receipt from SNL/California (CA) were considered. The projected numbers of LLMW shipments would remain constant under all alternatives (see Table G.3–3).

Table G.3–3. Summary of Annual Shipments or Receipts for Transportation Impacts

MATERIAL TYPE[a]	BASE YEAR (TYPICALLY 1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Radioactive	305	562	597	1,782	140
Radioactive MIPP (Receipt)	0	16	16	55	2
Radioactive MIPP (Shipment)	0	1,140	1,140	1,140	1,140
Chemical	2,750	2,750	2,750	2,750	2,750
Explosive	303	557	593	1,771	138
LLW	4	13	13	21	8
LLMW (Receipt)	0	1	1	1	1
LLMW (Shipment)	1	3	3	3	3
RCRA Hazardous Waste (Shipment)	64	80	84	112	58
RCRA Hazardous Waste (Receipt)	12	25	25	25	25
Hazardous Waste (California) (Recyclable)	2	3	3	4	2
Hazardous Waste (Local) (Recyclable)	6	8	8	11	6
Hazardous Waste (D&D)	22	22	22	22	22
Nonhazardous Solid Waste (Recyclable)	78	78	78	78	78
Nonhazardous Landscaping (Recyclable)[b]	NA	142	142	142	142
Solid Waste	51	51	51	51	51
Construction And Demolition[b] *Solid Waste (KAFB)*	NA	599	599	599	599
TRU/MTRU Waste	0	1	3	4	2
Hazardous Waste TSCA-PCBs (D&D)	1	1	1	1	1
Hazardous Waste TSCA-Asbestos (D&D)	14	14	14	14	14
LLW (D&D)	4	4	4	4	4
Biohazardous Waste (Medical)	1	1	1	1	1

Sources: DOE 1996h, SNL 1992a, SNL/NM 1998a
D&D: decontamination and decommissioning
ER: Environmental Restoration
KAFB: Kirtland Air Force Base
LLMW: low-level mixed waste
LLW: low-level waste
MESA: Microsystems and Engineering Sciences Applications
MIPP: Medical Isotopes Production Project
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Material type is used or generated during normal operations unless otherwise noted
[b] Recycled and solid waste currently handled by the KAFB landfill could be shipped offsite in the future.
Note: If implemented, the MESA Complex configuration under the Expanded Operations Alternative would not change the number of material (or waste) shipments.

Table G.3–4. Low-Level Waste Disposal Sites

DISPOSAL ROUTE/SITE FROM SNL/NM	CLASSIFICATION DISTANCE (km)			TOTAL DISTANCE (km)	INCIDENT-FREE IMPACT, PERSON-REM PER UNIT SHIPMENT			
	RURAL	SUBURBAN	URBAN		DOSE TO CREW	PUBLIC OFF-LINK DOSE	PUBLIC ON-LINK DOSE	STOP
Hanford, WA	2,324	224	36	2,584	$7.8x10^{-2}$	$2.0x10^{-3}$	$1.4x10^{-2}$	0.22
NTS, NV	945	68	25	1,038	$3.2x10^{-2}$	$2.0x10^{-3}$	$1.2x10^{-2}$	$8.6x10^{-2}$
SRS, SC	2,051	455	41	2,548	$8.0x10^{-2}$	$3.0x10^{-3}$	$1.5x10^{-2}$	0.22
Clive, UT	1,533	156	33	1,722	$5.2x10^{-2}$	$1.4x10^{-3}$	$1.0x10^{-2}$	0.14

Source: DOE 1996h
km: kilometer
NTS: Nevada Test Site
rem: Roentgen equivalent, man
SNL/NM: Sandia National Laboratories/New Mexico
SRS: Savannah River Site
Notes: 1) On-link means occupants of vehicles that share the transportation corridor with the radioactive shipment.
2) Off-link means people by the side of the transportation corridor.
3) Stop means people in the vicinity of the shipment when it stopped.

G.3.4.3 Hazardous Waste

In 1996, the total number of hazardous waste shipments was 91; the ER Project was responsible for 27 of those shipments. Only normal operations-related shipments (64) were considered routine. Table G.3–3 presents the expected number of shipments by alternative. SNL/NM uses multiple hazardous waste disposal facilities located throughout the U.S. The longest route for hazardous waste was selected for the SWEIS bounding analysis: Albuquerque, New Mexico, to Clive, Utah, a distance of approximately 1,722 km (Table G.3–2). The projected numbers of hazardous waste shipments would be: No Action Alternative–84, Expanded Operations Alternative–112, and Reduced Operations Alternative–58.

G.3.4.4 Solid Waste

Solid waste is generally picked up once a week. In 1997, 51 shipments were made from SNL/NM to the Rio Rancho Sanitary Landfill. The bounding calculation assumed that the disposal of solid waste would be located within 50 km for the SWEIS analysis. These shipments would not be expected to vary over the time frame of the SWEIS. Table G.3–3 shows the number of shipments would be constant at 51 for each of the alternatives. In addition, should the Kirtland Air Force Base (KAFB) landfill close, construction and demolition debris shipments (599 per year) would likely go to the Rio Rancho Sanitary Landfill or the Cerro Colorado Landfill. Landscaping waste, also handled at the KAFB landfill, would be required to be shipped offsite (142 per year).

G.3.4.5 Recycled Hazardous Material

In 1997, two recycled hazardous material shipments were made to Anaheim, California. Six shipments were made to a local facility in Albuquerque, New Mexico (see Tables G.3–2 and G.3–3).

G.3.4.6 Transuranic and Mixed Transuranic Wastes

During normal operations, minimal quantities of TRU and mixed transuranic (MTRU) wastes are generated at SNL/NM. As TRU and MTRU wastes are generated, they are collected and stored until sufficient quantities are accumulated for shipment. The existing TRU/MTRU wastes stored onsite, as well as all future TRU/MTRU wastes, would be transferred to Los Alamos National Laboratory (LANL) for certification, as indicated in the *Waste Management Programmatic Impact Statement* [PEIS] *for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997i) Record of Decision (ROD) (DOE 1998n), prior to disposal at the Waste Isolation Pilot Plant (WIPP).

G.3.4.7 Special Projects Waste

The wastes in storage (legacy wastes) and the wastes generated during special projects, such as ER Project wastes, were included in the analysis as total shipments over a 5-year period. These waste shipments are presented in Table G.3–5.

For the transportation impact evaluation, the representative distances traveled for the receipt and shipment of SNL/NM special projects material and waste are summarized in Table G.3–2.

Table G.3–5. Summary of Total Shipments for Transportation Impacts Under Special Projects Over 5 Years

MATERIAL TYPE	TOTAL NUMBER OF SHIPMENTS (OVER 5 YEARS)
Legacy LLW[a]	56
Legacy LLMW[a]	8
Legacy TRU/MTRU[a]	2
LLW[a] *(ER)*	136
LLMW[a] *(ER)*	5
TSCA Hazardous Waste[b] *(ER)*	113
Nonhazardous Solid Waste[b] *(ER)*	9

Source: SNL/NM 1998a
ER: Environmental Restoration
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
TSCA: *Toxic Substances Control Act*
TRU: transuranic
[a] Storage operation
[b] ER Project operation

G.4 ANALYSIS OF RADIOLOGICAL IMPACTS OF TRANSPORTATION: *RADTRAN 4* METHODOLOGY

Radiological transportation risk was modeled using *RADTRAN 4,* a computer modeling program developed at SNL/NM (SNL 1992a). Although the most current version of *RADTRAN is RADTRAN 5, RADTRAN 4,* which is fully documented, was used in the analysis.

G.4.1 Incident-Free Transportation

RADTRAN 4 models incident-free transportation as a separate module from transportation accidents. When radioactive materials are transported, there is some external radiation dose from the transported cargo. The external dose rate (mrem/hour) measured at 1 m from the external surface of the transported package is called the transport index (TI) and is limited by regulation (10 CFR Part 71). *RADTRAN 4* models the TI as the point source for radiological risks of incident-free transportation. The measured and recorded TI is used in RADTRAN 4 when it is available. When the actual TI is not known, the regulatory limit for each type of shipment is modeled, although experience indicates that the external dose rate is well below the regulatory limit in many shipments. In this analysis, as in most, only external gamma radiation is considered, because external neutrons are absorbed by air before reaching a receptor. Figure G.4–1 illustrates the *RADTRAN 4* incident-free model.

At the distances of interest, the dose rate at the receptor is inversely proportional to the square of the receptor distance from the radiation source. The total (integrated) radiation dose to the receptor is inversely proportional to the distance of the receptor from the radiation source. Dose is also inversely proportional to vehicle velocity and directly proportional to distance traveled and to the number of shipments. Population radiation dose is the dose to the total number of receptors exposed. Incident-free dose is independent of the isotopic content or radioactivity of the material being shipped and depends only on the external dose rates.

Radiation doses are calculated separately for the truck crew (crew dose), people residing along the transportation corridor (off-link dose), occupants of vehicles that share the transportation corridor with the radioactive shipment (on-link dose), and people in the vicinity of the shipment when it stopped (stop dose). For the *RADTRAN 4* analyses in this study, each route was divided into rural, suburban, and urban links. Highway routes are modeled using the *HIGHWAY* routing code (Johnson et al 1993), which provides distances and population densities for rural, suburban, and urban segments, or links, of the route. Actual 1990 census population data (for populations within a half-mile of the route) and actual distances were used in *RADTRAN 4* for each route. The rural-suburban-urban classification provided national average vehicle densities, vehicle speeds, accident rates, and similar parameter values.

Doses from incident-free transportation include the crew dose and the combined off-link, on-link, and stop doses to the public. The crew and population dose from more than one shipment can be calculated by multiplying the crew and population dose for one shipment (Table G.4–1) by the number of shipments of a given material.

G.4.2 Accident Radiation Dose Risks

The radioactive materials being shipped, and their activities, become important in the transportation accident module. *RADTRAN 4* models accident risk as the risk from emission of fractions of the radioactive cargo into the air. This risk combines the probability that an accident will occur, the probability of a particular size breach of containment, and the fraction of each isotope

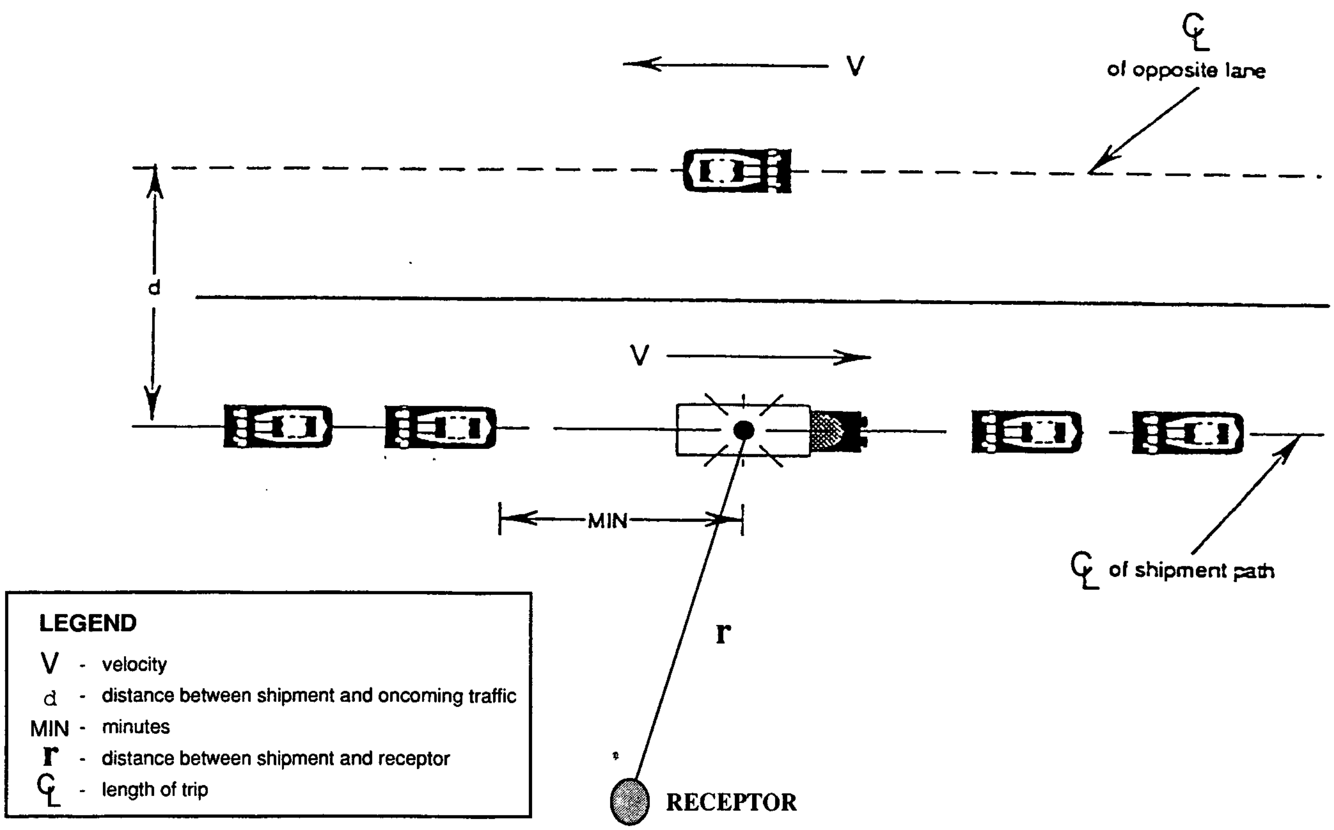


Figure G.4–1. The *RADTRAN 4* Incident-Free Model
Examples of SNL/NM radioactive material shipments were used during SWEIS analysis of potential impacts.

that would be leaked, aerosolized, and inhaled under a particular accident scenario. Groundshine (whole-body radiation dose from aerosols deposited on the ground) and cloudshine (whole-body radiation dose from reflected radiation) is also part of this risk. Dose to the receptor is calculated from the dose conversion factors in (SNL 1993b, Johnson et al. 1993, DOE 1988b).

In the model, the set of all possible accidents is divided into subsets called "accident severity categories." There are eight severity categories in the present study, each with a particular probability of occurrence and varying degrees of cargo damage that result in aerosolized and respirable release fractions. The accident severity categories always include a category for no release and no loss of shielding (by far the most probable case) and a category for loss of shielding only (no actual release of material). A detailed description of the accident severity category approach is contained in NUREG-0170 (NRC 1977b). The severity categories capture the universe of accidents.

The probability of occurrence of an accident depends on truck accident frequency (accidents per vehicle-mile) and indirectly on population density (for example, a larger fraction of accidents in urban areas are minor). The overall (conditional) probability of an accident of a particular severity is estimated by multiplying the probability of the severity category by the frequency of truck accidents along the route. For example, if Severity Category VIII had an occurrence probability of 1.3×10^{-4}, and the probability of any accident happening in an urban area is 1.6×10^{-5}, the likelihood of an accident in Severity Category VIII occurring on a 5-km

Table G.4–1. Radiological Doses to Crew and Public and Accident Risks to Public (Person-Rem) Per Unit Shipment

MATERIAL TYPE	ROUTE DESTINATION	CREW	INCIDENT-FREE PUBLIC			ACCIDENT IMPACTS PUBLIC	TOTAL	
			OFF-LINK	ON-LINK	STOPS		CREW	PUBLIC
Radioactive Material[a]	Mountain Top, PA	3.2×10^{-2}	2.4×10^{-3}	2.5×10^{-2}	2.4×10^{-1}	7.6×10^{-3}	3.2×10^{-2}	2.7×10^{-1}
LLW	Clive, UT	5.2×10^{-2}	1.4×10^{-3}	1.0×10^{-2}	1.4×10^{-1}	5.8×10^{-4}	5.2×10^{-2}	1.5×10^{-1}
LLMW[b]	SRS	1.6×10^{-4}	1.3×10^{-5}	1.2×10^{-4}	1.5×10^{-3}	4.6×10^{-11}	1.6×10^{-4}	1.6×10^{-3}
LLMW[b]	SNL/NM[a]	1.1×10^{-4}	8.9×10^{-6}	8.4×10^{-5}	1.5×10^{-3}	3.2×10^{-11}	1.1×10^{-4}	1.6×10^{-3}
TRU/MTRU[c]	LANL	1.6×10^{-3}	1.5×10^{-4}	1.4×10^{-3}	7.3×10^{-3}	2.4×10^{-8}	1.6×10^{-3}	8.8×10^{-3}

Sources: DOE 1996h, SNL 1992a
kg: kilograms
LANL: Los Alamos National Laboratory
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
SNL/NM: Sandia National Laboratories/New Mexico
SNL/CA: Sandia National Laboratories/California
SRS: Savannah River Site
TRU: transuranic
[a] Shipment consists of 100 kg of depleted uranium. The composition is given in Table G.4–2.
[b] 1996 shipment of 7.2×10^{-6} curies of sodium-24; Transport Index = 0.1.
[c] 1997 shipment of americium-241, europium-152, cesium-137, Transport Index = 1.0.

urban part of a route would be:

$$(1.3\times10^{-4})\times(1.6 \text{ accidents}/10^{5} \text{ km})\times(5 \text{urban km}) = 1.04\times10^{-7}$$

Eq. G.4.1

G.4.3 Calculation of Radiological Health Risks

Health risks from incident-free population doses are calculated by multiplying any occupational dose by 0.0004 LCF per person-rem and any dose to the public by 0.0005 LCF per person-rem (ICRP 1991). Inhalation and immersion population dose risks are calculated in *RADTRAN 4* using established dose conversion factors (DOE 1988b). Population dose risks can then be expressed as LCFs, using the public dose conversion factor of 0.0005 LCF per person-rem. Radiation doses are reported as committed effective dose equivalent (CEDE), a quantity that considers the type of radiation (gamma, in this case) and its distribution throughout the body as well as the absorbed dose itself, and integrates the combination of these over 50 years (ICRP 1991).

G.4.4 The Modeled "Bounding Case" Shipment

The analysis considered a representative shipment of radiological material of 100 kg of depleted uranium (DU), as shown in Table G.4–2. Five 1-m packages were identified that could contain the shipment. Although the TI associated with such packages is approximate, the maximum regulatory TI would be 16, so TI=16 was modeled. Neither this shipment nor any shipment with attributes close to its parameters appears in unclassified shipment databases for 1995, 1996, or 1997. The TI and release fractions postulated for this shipment result in very conservatively estimated radiological risks.

The radiation doses from modeled accidents are reported as dose risks rather than doses because incident-free transportation has essentially a probability of 1 (or 100 percent) of occurring, because most transportation is incident-free. The probabilities of a transportation accident and of a resulting release of radioactive material are orders of magnitude less than one, and are incorporated into the reported accident population dose. Radiological health risk is the product of probability and consequence; radiation dose risks are the products of the

Table G.4–2. Radionuclide Content of Depleted Uranium per Shipment

ISOTOPE	CURIES PER SHIPMENT	GRAMS PER SHIPMENT
Uranium-232	8.8×10^{-2}	4.11×10^{-3}
Uranium-234	2.2×10^{-2}	3.56
Uranium-235	4.2×10^{-4}	196
Uranium-238	3.3×10^{-2}	96,100

Source: DOE 1996i

probability of an accident happening, times the probability of release of radioactive material if that accident happens, times the respirable fraction of released material, times the radiation dose per inhaled unit of radioactive material. Therefore, rather than reporting population radiation *doses*, as for incident-free transportation, this analysis reported radiation *dose risks* for potential accident scenarios. The unit of dose risk is person-rem, as is the unit of population radiation dose.

Releases and aerosol fractions depend on the physical and chemical nature of the isotope (for example, volatility and particle size), as well as the severity of the accident. Such fractions have been incorporated into the *RADTRAN 4* model (SNL 1992). For this study, all material released was assumed to be aerosolized and respirable. The dispersion of airborne gases and particulate matter is modeled using a Gaussian dispersion model, as discussed in Chapter 5 and Appendix D. The two factors that independently affect the modeled dose to the population under the plume footprint are the downwind distance to which the dispersion is modeled, and the concentration of dispersed material within the isopleth pattern. The concentration of airborne breathable material decreases very sharply as one moves away from the source.

G.4.5 Accident Fatalities Risk

As with the incident-free risk analysis, the dose to the public due to accidental release was calculated for a single shipment of each material type to determine a bounding transportation impact. The unit shipment doses are presented in Table G.4–1. Table G.4–3 presents the annual doses to population from a radiological release due to a potential transportation accident supporting normal operations under each alternative. Table G.4–4 presents the doses to population from a radiological release due to a hypothetical transportation accident during special project shipments.

G.4.6 Traffic Fatalities Risk

Traffic fatalities were estimated using unit-risk factors (risk per kilometer traveled) developed from national statistics for highway accident-related deaths (SNL 1986). These nonradiological unit-risk factors are presented in Table G.4–5. The traffic fatalities per unit shipment are presented in Tables G.4–6 and G.4–7 for normal operations shipments and total special project shipments, respectively. The calculated lifetime traffic fatalities resulting from normal operations shipments for each alternative are presented in Table G.4–8. The calculated total traffic fatalities associated with special project shipments are presented in Table G.4–9.

G.4.7 Vehicle Emissions Fatalities Risk

Nonradiological LCFs due to truck emissions (air pollutants) were evaluated based on unit-risk factors developed by SNL/NM (SNL/NM 1982). These nonradiological unit-risk factors are presented in Table G.4–5. Table G.4–10 presents the annual incident-free exposures due to truck emissions that could result in LCFs due to normal operations shipments. Table G.4–11 presents the estimated incident-free exposures due to truck emissions that could result in LCFs due to special project shipments.

G.4.8 Bounding Accident Scenario

The bounding transportation accident involves an explosion of a tractor-trailer containing 40,000 ft^3 of hydrogen. Appendix F provides detailed information regarding this bounding transportation accident. Additionally, Sections 5.3.8, 5.4.8, and 5.5.8 discuss radiological and chemical facility accidents.

Table G.4.3. Dose Risk to Population for Radiological Release Due to Transportation Accident During Normal Operations Shipments

MATERIAL TYPE	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
ANNUAL DOSE RISK TO POPULATION (person-rem)					
Radioactive [b]	2.3	4.3	4.5	13.5	1.1
LLW	2.3×10^{-3}	7.5×10^{-3}	7.5×10^{-3}	1.2×10^{-2}	4.6×10^{-3}
LLW (D&D)	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}
LLMW [c]	4.6×10^{-11}	1.7×10^{-10}	1.7×10^{-10}	1.7×10^{-10}	1.7×10^{-10}
Medical Isotopes Production	NA	1.5×10^{-2}	1.5×10^{-2}	5.2×10^{-2}	1.9×10^{-3}
ANNUAL LCFs					
Radioactive [b]	1.2×10^{-3}	2.2×10^{-3}	2.3×10^{-3}	6.0×10^{-3}	5.5×10^{-4}
LLW	1.2×10^{-6}	3.8×10^{-6}	3.8×10^{-6}	6.0×10^{-6}	2.3×10^{-6}
LLW (D&D)	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}
LLMW [c]	2.3×10^{-14}	8.5×10^{-14}	8.5×10^{-14}	8.5×10^{-14}	8.5×10^{-14}
Medical Isotopes Production	NA	7.5×10^{-6}	7.5×10^{-6}	3.0×10^{-5}	9.6×10^{-7}
TOTAL RISK[d]	**1.2×10^{-3}**	**2.2×10^{-3}**	**2.3×10^{-3}**	**6.8×10^{-3}**	**5.5×10^{-4}**

Sources: DOE 1996h, SNL 1992a; SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
NA: not applicable
rem: Roentgen equivalent, man

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100kg of depleted uranium.
[c] 1996 shipment of 7.2 x 10-6 curies of sodium -24: Transport Index = 0.1.
[d] Lifetime estimated LCFs due to potential radiological accident
Note: Calculations using *RADTRAN 4* (SNL 1992a)

Table G.4–4. Doses Risk to Population from Radiological Release Due to Transportation Accident During Normal Operations Shipments

MATERIAL TYPE	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
ANNUAL DOSE RISK, GENERAL POPULATION (person-rem)					
TRU/MTRU [a]	0	2.4×10^{-8}	7.2×10^{-8}	9.6×10^{-8}	4.8×10^{-8}
TRU/MTRU (Legacy) [a]	0	0	4.8×10^{-8}	4.8×10^{-8}	4.8×10^{-8}
LLW (Legacy + ER)	0	0	0.11	0.11	0.11
LLMW (Legacy + ER) [b]	0	0	4.4×10^{-4}	4.4×10^{-4}	4.4×10^{-4}
ANNUAL LCFs					
TRU/MTRU [a]	0	1.2×10^{-11}	3.6×10^{-11}	4.8×10^{-11}	2.4×10^{-11}
TRU/MTRU (Legacy) [a]	0	0	2.4×10^{-11}	2.4×10^{-11}	2.4×10^{-11}
LLW (Legacy + ER)	0	0	5.5×10^{-5}	5.5×10^{-5}	5.5×10^{-5}
LLMW (Legacy + ER) [b]	0	0	3.0×10^{-13}	3.0×10^{-13}	3.0×10^{-13}
TOTAL [c]		**1.2×10^{-11}**	**5.5×10^{-5}**	**5.5×10^{-5}**	**5.5×10^{-5}**

Sources: DOE 1996h, SNL 1992a, SNL/NM 1998a
ER: Environmental Restoration
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
rem: Roentgen equivalent, man
TRU: Transuranic
[a] 1997 shipment of americium -241, europium -152, cesium -137; Transport Index= 1.0.
[b] 1996 shipment of 7.2×10^{-6} curies of sodium -24; Transport Index= 0.1.
[c] Lifetime estimated LCFs from total special project shipments
Note: Calculations using *RADTRAN 4* (SNL 1992)

Table G.4–5. Nonradiological Unit-Risk Factors for Truck Transport

NORMAL	RURAL	SUBURBAN	URBAN
Nonoccupational Latent Cancers/km	-	-	1.0×10^{-7}
Nonoccupational Fatalities/km	5.3×10^{-8}	1.3×10^{-8}	7.5×10^{-9}
Occupational Fatalities/km	1.5×10^{-8}	3.7×10^{-9}	2.1×10^{-9}

Sources: SNL 1986, SNL/NM 1982
km: kilometer

Table G.4–6. Transportation Traffic Fatalities Per Unit Shipment from Normal Operations Shipment by Alternative

MATERIAL TYPE	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
TRAFFIC FATALITIES, CREW AND GENERAL PUBLIC, PER SHIPMENT (ROUND TRIP)					
Radioactive	3.5×10^{-4}	3.5×10^{-4}	3.5×10^{-4}	3.5×10^{-4}	3.5×10^{-4}
Chemical	2.1×10^{-6}	2.1×10^{-6}	2.1×10^{-6}	2.1×10^{-6}	2.1×10^{-6}
Explosive	2.9×10^{-4}	2.9×10^{-4}	2.9×10^{-4}	2.9×10^{-4}	2.9×10^{-4}
LLW	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
LLMW (Receipt)	2.1×10^{-4}	2.1×10^{-4}	2.1×10^{-4}	2.1×10^{-4}	2.1×10^{-4}
LLMW (Shipment)	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
Hazardous Waste	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
Recyclable Hazardous Waste (California)	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}
Recyclable Hazardous Waste (Local)	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}
Solid Waste	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}
D&D Hazardous Waste TSCA-PCBs	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
D&D Hazardous Waste TSCA-Asbestos	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}
Biohazardous Waste	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}
Recyclable D&D Hazardous Waste	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}
Recyclable Nonhazardous Solid Waste	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-4}
Nonhazardous Landscaping Waste	NA	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}
Construction and Demolition Solid Waste	NA	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}
RCRA Hazardous Waste (Receipt)	6.7×10^{-7}	6.7×10^{-7}	6.7×10^{-7}	6.7×10^{-7}	6.7×10^{-7}
LLW (D&D)	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}

Sources: SNL 1986, 1992a; SNL/NM 1982
D&D: decontamination and decommissioning
LLMW: low-level mixed waste
LLW: low-level waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Table G.4–7. Transportation Traffic Fatalities Per Unit Shipment from Total Special Project Shipments

MATERIAL TYPE	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
TRU/MTRU	0	1.9×10^{-5}	1.9×10^{-5}	1.9×10^{-5}	1.9×10^{-5}
TRU/MTRU (Legacy)	0	0	1.9×10^{-5}	1.9×10^{-5}	1.9×10^{-5}
LLW (Legacy)	0	0	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
LLMW (Legacy)	0	0	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
LLW (ER)	0	0	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
LLMW (ER)	0	0	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
Hazardous Waste (ER)	0	0	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
Nonhazardous Solid Waste (ER)	0	0	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}

Sources: SNL 1986, 1992a; SNL/NM 1982
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic

Table G.4–8. Transportation Traffic Lifetime Fatalities for Normal Operations from Annual Shipments by Alternative

MATERIAL TYPE	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
TRAFFIC FATALITIES, CREW AND GENERAL PUBLIC, PER SHIPMENT (ROUND TRIP)					
Radioactive	0.11	0.20	0.21	0.62	$4.9x10^{-2}$
Explosive	$8.8x10^{-2}$	0.16	0.17	0.51	$4.0x10^{-2}$
Chemical	$5.8x10^{-3}$	$5.8x10^{-3}$	$5.8x10^{-3}$	$5.8x10^{-3}$	$5.8x10^{-3}$
Medical Isotopes Production	NA	$6.0x10^{-3}$	$6.0x10^{-3}$	$2.1x10^{-2}$	$7.7x10^{-4}$
LLW	$8.8x10^{-4}$	$2.9x10^{-3}$	$2.9x10^{-3}$	$4.6x10^{-3}$	$1.8x10^{-3}$
LLMW (Receipt)	0	$2.1x10^{-4}$	$2.1x10^{-4}$	$2.1x10^{-4}$	$2.1x10^{-4}$
LLMW (Shipment)	$3.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$
Hazardous Waste	$1.4x10^{-2}$	$1.8x10^{-2}$	$1.9x10^{-2}$	$2.5x10^{-2}$	$1.3x10^{-2}$
Recyclable Hazardous Waste (California)	$3.0x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$	$6.0x10^{-4}$	$3.0x10^{-4}$
Recyclable Hazardous Waste (Local)	$9.6x10^{-6}$	$1.3x10^{-5}$	$1.3x10^{-5}$	$1.8x10^{-5}$	$9.6x10^{-6}$
Solid Waste	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
D&D Hazardous Waste TSCA-Asbestos	$3.1x10^{-4}$	$3.1x10^{-4}$	$3.1x10^{-4}$	$3.1x10^{-4}$	$3.1x10^{-4}$
Biohazardous Waste	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$
Recyclable D&D Hazardous Waste	$3.5x10^{-5}$	$3.5x10^{-5}$	$3.5x10^{-5}$	$3.5x10^{-5}$	$3.5x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.2x10^{-4}$	$1.2x10^{-4}$	$1.2x10^{-4}$	$1.2x10^{-4}$	$1.2x10^{-4}$
Nonhazardous Landscaping Waste	NA	$3.7x10^{-4}$	$3.7x10^{-4}$	$3.7x10^{-4}$	$3.7x10^{-4}$
Construction and Demolition Solid Waste	NA	$1.6x10^{-3}$	$1.6x10^{-3}$	$1.6x10^{-3}$	$1.6x10^{-3}$
RCRA Hazardous Waste (Receipt)	$8.0x10^{-6}$	$1.7x10^{-5}$	$1.7x10^{-5}$	$1.7x10^{-5}$	$1.7x10^{-5}$
LLW (D&D)	$8.8x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$
TOTAL[b]	**0.22**	**0.40**	**0.42**	**1.2**	**0.11**

Sources: DOE 1997i, SNL 1986, 1992a; SNL/NM 1997b, 1997d, 1982, 1998a
D&D: decontamination and decommissioning
LLMW: low-level mixed waste
LLW: low-level waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
rem: Roentgen equivalent, man
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Lifetime estimated fatalities from annual shipments
Note: Calculations were completed using *RADTRAN 4* (SNL 1992b)

Table G.4–9. Transportation Traffic Fatalities from Total Special Project Shipments

MATERIAL TYPE	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
TRU/MTRU	0	$1.9x10^{-5}$	$5.7x10^{-5}$	$7.6x10^{-5}$	$3.8x10^{-5}$
TRU/MTRU (Legacy)	0	0	$3.8x10^{-5}$	$3.8x10^{-5}$	$3.8x10^{-5}$
LLW (Legacy)	0	0	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$
LLMW (Legacy)	0	0	$2.4x10^{-3}$	$2.4x10^{-3}$	$2.4x10^{-3}$
LLW (ER)	0	0	$3.0x10^{-2}$	$3.0x10^{-2}$	$3.0x10^{-2}$
LLMW (ER)	0	0	$1.5x10^{-3}$	$1.5x10^{-3}$	$1.5x10^{-3}$
Hazardous Waste (ER)	0	0	$2.5x10^{-2}$	$2.5x10^{-2}$	$2.5x10^{-2}$
Solid Waste (ER)	0	0	$2.3x10^{-5}$	$2.3x10^{-5}$	$2.3x10^{-5}$
TOTAL[a]			**$7.1x10^{-2}$**	**$7.1x10^{-2}$**	**$7.1x10^{-2}$**

Sources: SNL 1986, 1992a; SNL/NM 1982, 1998a
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] Lifetime estimated fatalities from annual shipments
Note: Calculations were completed using *RADTRAN 4* (SNL 1992b)

Table G.4–10. Annual Incident-Free Exposures Due to Truck Emissions from Normal Operations Shipments

MATERIAL TYPE	UNIT RISK [a] FACTOR PER URBAN KILOMETER	TRUCK DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER SHIPMENT FOR ROUND TRIP	TOTAL LCFs FOR BASE YEAR SHIPMENTS (TYPICALLY 1996)	TOTAL LCFs FOR NO ACTION ALTERNATIVE		TOTAL LCFs FOR EXPANDED OPERATIONS ALTERNATIVE	TOTAL LCFs FOR REDUCED OPERATIONS ALTERNATIVE
					2003	2008		
Radioactive	1.0×10^{-7}	73	1.5×10^{-5}	4.6×10^{-3}	8.4×10^{-3}	9.0×10^{-3}	2.8×10^{-2}	2.1×10^{-3}
Chemical	1.0×10^{-7}	8.0	1.6×10^{-6}	4.4×10^{-3}	4.4×10^{-3}	4.4×10^{-3}	4.4×10^{-3}	4.4×10^{-3}
Explosive	1.0×10^{-7}	48.0	9.6×10^{-6}	2.9×10^{-3}	5.3×10^{-3}	5.7×10^{-3}	1.7×10^{-2}	1.3×10^{-3}
LLW	1.0×10^{-7}	33.0	6.6×10^{-6}	2.6×10^{-5}	8.6×10^{-5}	8.6×10^{-5}	1.4×10^{-4}	5.3×10^{-5}
LLMW (Receipt)	1.0×10^{-7}	35.6	7.1×10^{-6}	0	7.1×10^{-6}	7.1×10^{-6}	7.1×10^{-6}	7.1×10^{-6}
LLMW (Shipment)	1.0×10^{-7}	40.6	8.1×10^{-6}	8.1×10^{-6}	2.4×10^{-5}	2.4×10^{-5}	2.4×10^{-5}	2.4×10^{-5}
Medical Isotopes Production	-	-	-	NA	2.0×10^{-3}	2.0×10^{-3}	1.0×10^{-2}	3.5×10^{-4}
Hazardous Waste	1.0×10^{-7}	33.0	6.6×10^{-6}	4.2×10^{-4}	5.3×10^{-4}	5.5×10^{-4}	7.4×10^{-4}	3.8×10^{-4}
Recyclable Hazardous Waste (California)	1.0×10^{-7}	23.0	4.6×10^{-6}	9.2×10^{-6}	1.4×10^{-5}	1.4×10^{-5}	1.8×10^{-5}	9.2×10^{-6}
Recyclable Hazardous Waste (Local)	1.0×10^{-7}	6.4	1.3×10^{-6}	7.8×10^{-6}	1.0×10^{-5}	1.0×10^{-5}	4.4×10^{-5}	7.8×10^{-6}
Solid Waste	1.0×10^{-7}	10.0	2.0×10^{-6}	1.0×10^{-4}	1.0×10^{-4}	1.0×10^{-4}	1.0×10^{-4}	1.0×10^{-4}
D&D hazardous waste TSCA-PCBs	1.0×10^{-7}	33.0	6.6×10^{-6}	6.6×10^{-6}	6.6×10^{-6}	6.6×10^{-6}	6.6×10^{-6}	6.6×10^{-6}
D&D Hazardous Waste TSCA-Asbestos	1.0×10^{-7}	10.0	2.0×10^{-6}	2.8×10^{-5}	2.8×10^{-5}	2.8×10^{-5}	2.8×10^{-5}	2.8×10^{-5}
Biohazardous Waste	1.0×10^{-7}	24.0	4.8×10^{-6}	4.8×10^{-6}	4.8×10^{-6}	4.8×10^{-6}	4.8×10^{-6}	4.8×10^{-6}
Recyclable D&D Hazardous Waste	1.0×10^{-7}	6.4	1.3×10^{-6}	2.9×10^{-5}	2.9×10^{-5}	2.9×10^{-5}	2.9×10^{-5}	2.9×10^{-5}

Table G.4–10. Annual Incident-Free Exposures Due to Truck Emissions from Normal Operations Shipments (concluded)

MATERIAL TYPE	UNIT RISK [a] FACTOR PER URBAN KILOMETER	TRUCK DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER SHIPMENT FOR ROUND TRIP	TOTAL LCFs FOR BASE YEAR SHIPMENTS (TYPICALLY 1996)	TOTAL LCFs FOR NO ACTION ALTERNATIVE		TOTAL LCFs FOR EXPANDED OPERATIONS ALTERNATIVE	TOTAL LCFs FOR REDUCED OPERATIONS ALTERNATIVE
					2003	2008		
Recyclable Nonhazardous Solid Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
Nonhazardous Landscaping Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$
Construction and Demolition Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	$1.2x10^{-3}$	$1.2x10^{-3}$	$1.2x10^{-3}$	$1.2x10^{-3}$
RCRA Hazardous Waste (Receipt)	$1.0x10^{-7}$	3	$6.0x10^{-7}$	$7.2x10^{-6}$	$1.5x10^{-5}$	$1.5x10^{-5}$	$1.5x10^{-5}$	$1.5x10^{-5}$
LLW (D&D)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$
TOTAL [b]				**$1.33x10^{-2}$**	**$2.3x10^{-2}$**	**$2.4x10^{-2}$**	**$6.2x10^{-2}$**	**$1.1x10^{-2}$**

Sources: SNL 1992a; SNL/NM 1982, 1998a
D&D: decontamination and decommissioning
km: kilometer
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substance Control Act*
[a] LCFs per km of urban travel
[b] Lifetime estimated total LCFs from annual shipments

Table G.4–11. Total Incident-Free Exposures Due to Truck Emissions from Special Project Shipments

MATERIAL TYPE	UNIT RISK FACTOR[a] PER URBAN KILOMETER	TRUCK DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER SHIPMENT FOR ROUND TRIP	TOTAL LCFs FOR BASE YEAR SHIPMENTS (TYPICALLY 1996)	TOTAL LCFs FOR NO ACTION ALTERNATIVE		TOTAL LCFs FOR EXPANDED OPERATIONS ALTERNATIVE	TOTAL LCFs FOR REDUCED OPERATIONS ALTERNATIVE
					2003	2008		
TRU/MTRU	1.0×10^{-7}	8.4	1.7×10^{-6}	0	1.7×10^{-6}	5.1×10^{-6}	6.8×10^{-6}	3.4×10^{-6}
TRU/MTRU (Legacy)	1.0×10^{-7}	8.4	1.7×10^{-6}	0	0	3.4×10^{-6}	3.4×10^{-6}	3.4×10^{-6}
LLW (Legacy)	1.0×10^{-7}	33	6.6×10^{-6}	0	0	3.7×10^{-4}	3.7×10^{-4}	3.7×10^{-4}
LLMW (Legacy)	1.0×10^{-7}	40.6	8.1×10^{-6}	0	0	6.5×10^{-5}	6.5×10^{-5}	6.5×10^{-5}
LLW (ER)	1.0×10^{-7}	33	6.6×10^{-6}	0	0	9.0×10^{-4}	9.0×10^{-4}	9.0×10^{-4}
LLMW (ER)	1.0×10^{-7}	40.6	8.1×10^{-6}	0	0	4.1×10^{-5}	4.1×10^{-5}	4.1×10^{-5}
Hazardous Waste (ER)	1.0×10^{-7}	33	6.6×10^{-6}	0	0	7.5×10^{-4}	7.5×10^{-4}	7.5×10^{-4}
Nonhazardous Solid Waste (ER)	1.0×10^{-7}	10	2.0×10^{-6}	0	0	1.8×10^{-5}	1.8×10^{-5}	1.8×10^{-5}
TOTAL[b]					**1.7×10^{-6}**	**2.1×10^{-3}**	**2.1×10^{-3}**	**2.1×10^{-3}**

Sources: SNL 1992a; SNL/NM 1982, 1998a
ER: Environmental Restoration
km: kilometer
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] LCFs per km of urban travel
[b] Lifetime estimated LCFs from total special project shipments.

G.5 SUMMARY OF TRANSPORTATION RISK CALCULATIONS

Table G.5–1 presents a summary of overall transportation impacts evaluated in terms of fatalities due to annual shipments for the SNL/NM operations for the base year and under each alternative. The major contributor to the overall impact would be highway traffic fatalities. Table G.5–2 presents the total transportation impacts evaluated in terms of fatalities due to total special project shipments. These impacts, when combined with annual normal operations shipments, would have minimal effect on overall transportation impacts. The impacts of annual shipments supporting normal operations would be much higher than those of special project shipments.

G.6 TRANSPORTATION ROUTE SCREENING AND INCIDENT-FREE IMPACTS ANALYSIS

G.6.1 Transportation Route Screening

SNL/NM operations rely on the transportation of material and wastes throughout much of the U.S. The estimated quantities of material and wastes were projected based on the levels of activities presented in the SNL/NM facility source documents (SNL/NM 1998a). Appendix A contains the information regarding SNL/NM material inventories. Waste generation projections and wastes currently in storage are presented in Appendix H.

Table G.5–1. Summary of Overall Lifetime Estimated Transportation Impacts Due to Normal Operations (Fatalities per Annual Shipments)

TYPE OF IMPACT	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Radiological Incident-Free	$4.6x10^{-2}$	$9.9x10^{-2}$	0.1	0.31	$2.4x10^{-2}$
Radiological Accident	$1.2x10^{-3}$	$2.2x10^{-3}$	$2.3x10^{-3}$	$6.8x10^{-3}$	$5.5x10^{-4}$
Traffic Fatalities	0.22	0.40	0.42	1.2	0.11
LCFs Due to Truck Emissions	$1.3x10^{-2}$	$2.3x10^{-2}$	$2.4x10^{-2}$	$6.2x10^{-2}$	$1.1x10^{-2}$

Sources: SNL 1986, 1992a; SNL/NM 1982, 1998a
LCFs: latent cancer fatalities
Note: Calculations using *RADTRAN 4* (SNL 1992a)

Table G.5–2. Overall Lifetime Estimated Transportation Impacts Due to Special Project Operations (Fatalities per Annual Shipments)

TYPE OF IMPACT	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Radiological Incident-Free	0	$5.0x10^{-6}$	$1.8x10^{-2}$	$1.8x10^{-2}$	$1.8x10^{-2}$
Radiological Accident	0	$1.2x10^{-11}$	$5.5x10^{-5}$	$5.5x10^{-5}$	$5.5x10^{-5}$
Traffic Fatalities	0	0	$7.1x10^{-2}$	$7.1x10^{-2}$	$7.1x10^{-2}$
LCFs Due to Truck Emissions	0	$1.7x10^{-6}$	$2.1x10^{-3}$	$2.1x10^{-3}$	$2.1x10^{-3}$

Sources: SNL 1986, 1992a; SNL/NM 1982, 1998a
LCFs: latent cancer fatalities
Note: Calculations using *RADTRAN 4* (SNL 1992a)

The transportation impacts associated with material and wastes have been calculated. Due to uncertainties in the number of projected shipments, receipts, and possible transportation routes, a bounding analysis was completed using representative routes for each material and waste. To select a representative route, a screening was performed that included reviewing SNL/NM transportation records for each material type and waste category. Table G.6–1 presents the sites and corresponding parameters considered in selecting representative routes. The selection was made based on the location with the largest number of shipments/ receipts, the longest transportation route, and the highest population distribution along the route.

G.6.2 Incident-Free Impacts Analysis

The incident-free impacts associated with radioactive material and wastes have been calculated. Due to uncertainties in the quantities and radioactivity of projected shipments and receipts, a bounding analysis was completed using the maximum TI value allowed by regulation. The *RADTRAN 4* model limits TI-related calculations based on package size. A package 1-m in size carries a TI value of 16, while a 5-m-size package carries a TI value of 13. The SNL/NM SWEIS evaluated a 1-m-size package, 1 package per shipment, a TI value of 16 per shipment, and a stop time of 0.011 hr/km. Further, the data presented in Table G.6–1 for radioactive materials and radioactive wastes were used in the *RADTRAN 4* modeling.

Calculations using TI values of 5, 8, and 13 were completed to illustrate the bounding affect of the 16-TI value. Table G.6–2 compares the incident-free impact calculation for a radioactive material shipment to Mountaintop, Pennsylvania, with variations in TI. The table shows that the doses to the crew and the public (off-link, on-link, and stop) are linearly proportional to the TI value and decrease as the TI value decreases.

The 16-TI value is conservative. The incident-free impacts for the transport of radioactive materials would be much lower than the highway traffic fatalities (see Section G.4).

Table G.6–1. SNL/NM Shipping Locations, Material Type, Route Characteristics, and Total Distance

SHIPMENT FROM SNL/NM TO LOCATION (MATERIAL TYPE)	ROUTE CHARACTERISTICS			TOTAL DISTANCE (km)
	RURAL	SUBURBAN	URBAN	
MOUNTAINTOP, PA (RADIOACTIVE MATERIALS)				
Population Density, people/square km	11.3	297.2	2,408.1	
Distance, km	2,408.8	539.5	73	3,022.3
Percent in Each Classification	79.7	17.9	2.4	
OAKRIDGE, TN (RADIOACTIVE MATERIALS)				
Population Density, people/square km	7.9	317.3	2,132	
Distance, km	1,915.3	272.4	31.3	2,219.2
Percent in Each Classification	86.3	12.3	1.4	
BUFFALO, NY (RADIOACTIVE MATERIALS)				
Population Density, people/square km	10.5	291.1	2,343.1	
Distance, km	2,245.2	545	60.6	2,851.7
Percent in Each Classification	78.7	19.1	2.1	
ST. LOUIS, MO (RADIOACTIVE MATERIALS)				
Population Density, people/square km	7.3	321	2,467.9	
Distance, km	1,430.1	197.3	35.9	1,664
Percent in Each Classification	85.9	11.9	2.2	
LARGO, FL (RADIOACTIVE MATERIALS)				
Population Density, people/square km	9	353.5	2,036.7	
Distance, km	2,277.4	465.3	49	2,792.1
Percent in Each Classification	81.6	16.7	1.8	
CHARLESTON, SC (RADIOACTIVE MATERIALS)				
Population Density, people/square km	9.7	337.2	2,139.9	
Distance, km	2,244.7	467.5	37.1	2,750.3
Percent in Each Classification	81.6	17	1.4	
SAVANNAH RIVER SITE, SC (RADIOACTIVE MATERIALS)				
Population Density, people/square km	9.3	345.4	2,109	
Distance, km	2,051.1	455.3	40.6	2,548
Percent in Each Classification	80.5	17.9	1.6	
ALBUQUERQUE (CHEMICALS)				
Population Density, people/square km	NA	NA	NA	
Distance, km	8	24	8	40
Percent in Each Classification	20	60	20	

Table G.6–1. SNL/NM Shipping Locations, Material Type, Route Characteristics, and Total Distance (continued)

SHIPMENT FROM SNL/NM TO LOCATION (MATERIAL TYPE)	ROUTE CHARACTERISTICS			TOTAL DISTANCE (km)
	RURAL	SUBURBAN	URBAN	
SILVERDALE, WA (EXPLOSIVES)				
Population Density, people/square km	NA	NA	NA	
Distance, km	2,069.1	288.8	48.1	2,406
Percent in Each Classification	86	12	2	
ALBUQUERQUE AREA (RECYCLABLE WASTES)				
Population Density, people/square km	NA	NA	NA	
Distance, km	10	30	10	50
Percent in Each Classification	20	60	20	
ALBUQUERQUE CITY (RECYCLABLE WASTES)				
Population Density, people/square km	NA	NA	NA	
Distance, km	6.4	19.2	6.4	32
Percent in Each Classification	20	60	20	
RICHLAND, WA (LLW)				
Population Density, people/square km	3.7	377.4	2,140.3	
Distance, km	2,324	224	36	2,584
Percent in Each Classification	89.9	8.7	1.4	
NEVADA TEST SITE, NV (LLW)				
Population Density, people/square km	3.3	486.4	2,357.5	
Distance, km	945	68	25	1,038
Percent in Each Classification	91	7	2	
SAVANNAH RIVER SITE, SC (LLMW)				
Population Density, people/square km	9.3	345.4	2,109	
Distance, km	2,051.1	455.3	40.6	2,548
Percent in Each Classification	80.5	17.9	1.6	
CLIVE, UT (LLW, HAZARDOUS)				
Population Density, people/square km	NR	NR	NR	
Distance, km	1,533	156	33	1,722
Percent in Each Classification	89	9	2	
LOS ALAMOS, NM (TRU/MTRU)				
Population Density, people/square km	8.6	431.0	2,125.0	
Distance, km	132.1	27	8.3	167.4

Table G.6–1. SNL/NM Shipping Locations, Material Type, Route Characteristics, and Total Distance (concluded)

SHIPMENT FROM SNL/NM TO LOCATION (MATERIAL TYPE)	ROUTE CHARACTERISTICS			TOTAL DISTANCE (km)
	RURAL	SUBURBAN	URBAN	
Percent in Each Classification	78.9	16.1	5	
ARAGONITE, UT (BIOHAZARDOUS WASTE)				
Population Density, people/square km	NA	NA	NA	
Distance, km	984.8	105.8	24.4	1,114
Percent in Each Classification	88.4	9.5	2.2	

Sources: DOE 1996h, SNL 1992a
km: kilometer
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: Not applicable
NR: not reported
TRU: transuranic
Note: Only radioactive material and waste require population density information for the *RADTRAN 4* model.

Table G.6–2. Comparison of Incident-Free Impacts with Variations in Transport Index Values[a]

TRANSPORT INDEX	CREW DOSE (person-rem)	DOSE TO PUBLIC (person-rem)		
		OFF-LINK	ON-LINK	STOP
13	1.12×10^{-1}	1.7×10^{-2}	7.1×10^{-2}	6.02×10^{-1}
8	5.6×10^{-2}	1.1×10^{-2}	4.4×10^{-2}	3.71×10^{-1}
5	3.5×10^{-2}	6.7×10^{-3}	2.7×10^{-2}	2.32×10^{-1}

Sources: Original, SNL 1992a
hr: hour
km: kilometer
m: meter
rem: Roentgen equivalent, man
[a] Shipment to Mountaintop, Pennsylvania; 5.2-m package; stop time of 0.011 hr/km

G.7 ONSITE TRANSPORTATION IMPACTS

Onsite transportation impacts due to the movement of various materials and waste within SNL/NM and the KAFB site boundary would be small compared to the offsite transportation impacts. This is due to the shorter travel distance, smaller quantities, and lower population density. This assumption was supported by quantifying the impacts for the Expanded Operations Alternative onsite shipments/transfers. Table G.7–1 presents the projected number of onsite transfers of various materials and wastes, along with expected travel distances. These distances were assumed to be suburban type. Transportation impacts would include incident-free radiological doses and nonradiological traffic fatalities. The impacts calculated for each of these are presented in Table G.7–2 for the Expanded Operations Alternative. The onsite impacts would be much smaller than the offsite transportation impacts summarized in Table G.5–1. Therefore, onsite impacts were not evaluated in detail for all alternatives.

Table G.7–1. Summary of Annual Onsite Transfers

MATERIAL TYPE	MAXIMUM ROUND TRIP DISTANCE (km)	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
			2003	2008		
Radioactive	19	10	1,158[b]	1,160[b]	1,198[b]	1,145[b]
Explosives	32	1,453	2,675	2,844	8,490	665
LLW	16	761	772	772	775	770
LLMW	16	35	24	24	20	28
TRU/MTRU	16	4	4	4	5	2
Hazardous (RCRA)	16	800	800	800	800	800
Municipal Solid Waste	80	896[c]	155	155	155	155
ER RCRA	16	NA	1,407	NA	1,407	1,407

Sources: SNL 1996a, SNL/NM 1998a, SNL/NM 1997b
ER: Environmental Restoration
KAFB: Kirtland Air Force Base
km: kilometer
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: Not applicable
NR: Not reported
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Increase in transfers due to medical isotope production
[c] Includes waste managed at the KAFB landfill

Table G.7–2. Onsite Transportation Impacts

TYPE OF IMPACT	EXPANDED OPERATIONS ALTERNATIVE (NUMBER OF FATALITIES)
Radiological Incident-Free	1.7×10^{-4}
Traffic Fatalities	5.7×10^{-3}

Source: DOE 1996h, SNL 1986

G.8 HAZARDOUS MATERIALS AND AIR CARGO, NATIONALLY AND AT THE ALBUQUERQUE INTERNATIONAL SUNPORT

The U.S. Department of Transportation (DOT), Office of Hazardous Material Safety, estimates approximately 800,000 U.S. hazardous material cargos are shipped each day by water, air, rail, truck, and pipeline (DOT 1998a). Of these, about 500,000 shipments involve chemical and associated products, about 300,000 involve petroleum products, and at least 10,000 other shipments involve other hazardous materials including medical wastes and hazardous wastes.

Truck transport accounts for only about 43 percent of hazardous materials tonnage, but about 94 percent of the individual shipments. The air mode, while almost negligible in terms of tonnage (about 1 percent), has a share of individual shipments that greatly exceeds its percent tonnage (about 5 percent). In contrast, enormous amounts of hazardous materials tonnage are carried by rail, pipeline, and water modes, but the number of shipments is less than 1 percent (see Table G.8–1).

Hazardous materials air tonnage amounts to only 0.1 percent of hazardous materials truck tonnage. The SWEIS transportation analysis focuses on the dominant mode of transportation (trucks) and does not directly analyze air transportation. The DOE feels that it is reasonable to believe that very little tonnage of SNL/NM hazardous materials shipments and receipts are managed through the Albuquerque International Sunport.

Complete facts on Albuquerque International Sunport air cargo, including hazardous materials, were not available. The following information has been compiled to provide some context, based on reasonable assumptions. Further, the following information and its underlying analysis are an attempt to quantify the levels of hazardous materials air cargo shipments at the Sunport and quantities possibly related to SNL/NM. Virtually all figures in both the text and tables are estimates that can be rounded to the nearest tens, hundreds, thousands, millions, etc. Where precise figures are used, the intent is not to convey a false sense of precision, but rather to facilitate tracking the data and methodology used.

In 1997, approximately 62 M tons of all types of cargo were shipped by air domestically. In 1998, approximately 65,000 tons of cargo moved through the Albuquerque International Sunport freight center. According to the Federal Aviation Administration (FAA) and the DOT, 312,000 tons were landed at the Sunport (includes KAFB). The FAA and the DOT rank the Sunport the 45th largest of the 102 qualifying air cargo airports in the U.S.

Assuming the Sunport handles 0.5 percent of national shipments (312,000/62 M), it would handle approximately 20 tons of hazardous materials per day (0.5 times 4,049). This is small compared to the 312,000 tons of all cargo the Sunport handles. To estimate SNL/NM's portion of this 20 of tons hazardous materials at the Sunport, the analysis can use the SNL/NM's portion of placarded truck traffic in the region of influence (ROI). Within the ROI, SNL/NM material and waste transportation represents only 0.96 percent (14.5/ 1,514) of the total 24-hour placarded material and waste truck traffic (see Table 5.3.9–3) along Interstate (I)-25 and I-40. A reasonable assumption is that, on a daily basis, only 400 lb (or 1 percent of 20 tons/day), which would be 10 or 20 packages, of the hazardous material that lands at the Sunport, are related to SNL/NM. This is small in comparison to the approximately 25,000 nonbulk chemical packages (approximately 540 tons) shipped by truck each year to and from SNL/NM. In the base year, another 370 tons (340,317 kg) of total chemical waste were shipped by truck for disposal (see Table 3.6–2). The percentage of SNL/NM material shipped by air is further reduced when hazardous materials truck shipments include bulk chemicals (130 tons), bulk gases (argon, carbon dioxide, and oxygen), explosives, radioactive materials, and radioactive wastes (another 50 tons; see Table 5.3.10–1 [49,414 kg] in the base year). SNL/NM also receives 475 M ft^3, or 45,000 tons, of natural gas (at 60 pounds per square inch) through a pipeline each year.

In conclusion, while air cargo tonnage is increasing both nationally and internationally, the transportation of hazardous materials is dominated by transportation modes other than air. SNL/NM shipments and receipts are dominated by truck transport, and the DOE has focused the analysis accordingly.

Table G.8–1. Hazardous Material Shipments and Tons by Mode

MODE	SHIPMENTS	%	TONS SHIPPED	%
Truck	768,907	93.98	3,709,180	42.94
Rail	4,315	0.53	378,916	4.39
Pipeline	873	0.11	3,273,750	37.90
Water	335	0.04	1,272,925	14.73
Air	43,750	5.35	4,049	0.05
Daily Totals	818,180	100	8,638,820	100
Annual Totals	298,635,700		3,153,169,300	

Source: DOT 1998a

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APPENDIX H – WASTE GENERATION

H.1 INTRODUCTION

This appendix contains information supporting the waste generation impacts analysis. It details Sandia National Laboratories/New Mexico's (SNL/NM's) current and anticipated future waste generation and disposal activities under the three alternatives proposed in this Site-Wide Environmental Impact Statement (SWEIS): No Action, Expanded Operations, and Reduced Operations. The information used in this analysis was taken from available baseline data, projected operational levels, projected material consumption, and actual waste generation quantities given in the following documents:

- SNL/NM facility source documents (SNL/NM 1998a);
- *SNL/NM Environmental Information Document* (SNL/NM 1997a);
- *Facilities and Safety Information Document* (SNL/NM 1997b, SNL/NM 1998ee);
- *Environmental Assessment* of *the Environmental Restoration Project at Sandia National Laboratories/New Mexico,* DOE/EA-1140 (DOE 1996c);
- *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement,* DOE/EIS-0249F (DOE 1996b); and
- *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997i).

For detailed discussions of these waste types and waste management impacts, see Sections 4.11, 5.3.10, 5.4.10, and 5.5.10. Additional information on transportation associated with waste activities is presented in Sections 4.10, 5.3.9, 5.4.9, 5.5.9, and Appendix G.

H.2 SCOPE OF THE ANALYSIS

Multipliers were calculated to analyze waste generation impacts and to project the quantities of waste expected to be generated under each alternative in this SWEIS. These multipliers were derived from base year (typically 1996 or 1997) material inventories (see Appendix A, Material Inventory, for details on multiplier calculations) and from projections presented in the SNL/NM facility source documents (SNL/NM 1998a) for the 10-year time frame of this SWEIS (1998 to 2008).

This analysis focuses on waste types, volumes, onsite storage capacities, and offsite disposal. To further refine projections for the three alternatives, waste generation was further identified by the following four sources:

- Selected facilities (10 selected facilities under the SWEIS as having the most potential for impact)—existing operations (see Chapter 3 for a discussion on the selection of facilities). The waste projections for selected facilities are the maximum quantities generated for any 1-year period. Existing operations-derived wastes are considered to be those generated from mission-related work (see Chapter 2 for definitions of mission lines).
- Selected facilities—new operations. New facilities or new operations were addressed separately from existing operations to show the changes from the base year, without large increases from the new programs inflating the results.
- Balance of operations—existing operations. This source includes wastes generated during the base year from the balance of SNL/NM operations not covered under selected facilities or special projects.
- Special Projects. Due to the nature of SNL/NM operations, irregular or one-time waste generation activities from special projects that are not existing operations-related are possible. These projects include the Environmental Restoration (ER) Project, Decontamination and Decommissioning (D&D) Program, and Legacy Waste Work-off Project.

Special wastes were treated as a separate category in this analysis, even though special wastes could include all waste categories identified below, because of the potentially large volumes of these wastes, their special treatment and storage, and the specific time frames of their generation, storage, and disposal (Section H.3.3).

H.3 WASTE CATEGORIES

The various waste categories that would potentially be generated by SNL/NM include

- radioactive, including low-level wastes (LLW), low-level mixed wastes (LLMW), transuranic (TRU) wastes, and mixed transuranic (MTRU) wastes (Section H.3.1);
- hazardous, including chemical wastes (*Resource Conservation and Recovery Act* [RCRA]-listed, *Toxic Substances Control Act* [TSCA]-listed), and biohazardous (medical) wastes (Section H.3.2);

- nonhazardous, including solid wastes deposited in local landfills (trash and debris) and sewage (process wastewater) (Section H.3.3); and
- recyclable material, including such things as lead, ignitable liquids, solvents, oils, scrap metal, paper, and plastics (Section H.3.4).

Each of these waste categories was evaluated for waste generation impacts, including the amount of each waste category generated for the base year and for each of the alternatives. For spent fuel inventory projections, see Appendix A.

H.3.1 Assumptions

Several assumptions were made that had impacts across the various waste streams. The most important assumption was waste density, which was also the basis for other calculations. Waste density was calculated using the following equation:

$$\frac{\text{weight of waste}}{\text{volume of waste}} = \text{density of waste for a specific volume}$$

(Eq. H.3-1)

For water, the density is approximately equal to 1.0 kg/L and 1 L=0.001 m^3. Therefore:

$$\frac{1{,}000\,\text{L}}{1\,\text{m}^3} \times \frac{1.0\,\text{kg}}{1\,\text{L}} = 1{,}000\,\text{kg/m}^3$$

(Eq. H.3-2)

One 55-gal drum of waste has approximately 7.35 ft^3 of volume. For normal operations, the drum is left with some void space at the top, usually 5 percent, leaving a full drum of waste with 7 ft^3 of usable volume. There are 35.3 ft^3 in every cubic meter. Therefore:

$$\frac{7\,\text{ft}^3}{1\,\text{drum}} \times \frac{1\,\text{m}^3}{35.3\,\text{ft}^3} = 0.2\,\text{m}^3/\text{drum}$$

(Eq. H.3-3)

Densities of waste generated from the representative selected facilities are shown in Table H.3–1. Waste projections were based on these numbers when actual densities were unavailable, so that the information could be presented in standard units.

Table H.3–1. Densities Used to Calculate Waste Quantities[a]

WASTE	DENSITY[b] (kg/m^3)
Low-Level Waste	500
Low-Level Mixed Waste	550
Transuranic	310
Mixed Transuranic	76
Hazardous	1,000
Solid	310

Sources: SNL/NM 1998a, t
kg/m^3: kilograms per cubic meter
[a] Densities are listed; however, actual quantities are used whenever possible.
[b] Rounded to two significant digits

H.3.2 Radioactive Wastes

Table H.3–2 lists radioactive waste volumes, by radioactive waste type, selected facilities (existing operations), new facilities (new operations), and balance of operations (existing operations) for the base year and each of the three alternatives.

H.3.2.1 Low-Level Waste

It is expected that the disposal of LLW will continue at the U.S. Department of Energy (DOE)-approved facilities. Pending the final decision for the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997i), facilities including, but not limited to, the Nevada Test Site (NTS) or a commercial facility such as the Envirocare facility located outside of Clive, Utah, will be used. Disposal at these facilities is dependent on the waste meeting their waste acceptance criteria. Projected waste volumes are shown in Table H.3–2. Current waste storage levels and waste capacities are shown in Table H.3–3. Table H.3–4 shows medical isotopes production waste volumes.

H.3.2.2 Low-Level Mixed Waste

It is expected that the treatment and/or disposal of LLMW would occur at DOE-approved facilities pending the final decision for the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Wastes* (DOE 1997i). Examples of these facilities include: the CIF Incinerator at the Savannah River Site, South Carolina; the WERF Incinerator at

Table H.3–2. Radioactive Waste Generation by Alternative

FACILITY	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
LLW, SELECTED FACILITIES, NORMAL OPERATIONS (ft³)					
Microelectronics Development Laboratory	4	5	7	8[b]	3
Explosive Components Facility	95	190	190	190	190
Neutron Generator Facility	211	282	282	282	282
Radioactive and Mixed Waste Management Facility[b]	119	154	154	196	59
Sandia Accelerator & Beam Research Experiment	4	4.8	4.8	8.4	0
High-Energy Radiation Megavolt Electron Source III	0.25	0.48	0.48	1.38	0.04
Z-Machine	44	20	20	28	12
Gamma Irradiation Facility	56	0	0	126	56
Sandia Pulsed Reactor	31	31	31	63.4	31
Radiographic Integrated Test Stand	2.1	4.2	6.3	8.5	1.1
Subtotal	**566**	**692**	**696**	**911**[b]	**634**
LLW, NEW FACILITIES (OPERATIONS)					
Hot Cell Facility	100	2,200	2,200	5,000	270
Annular Core Research Reactor (medical isotopes production configuration)	56	370	370	1,090	56
Annular Core Research Reactor (DP configuration)	0	0	35	170	0
New Gamma Irradiation Facility	0	92	92	126	56
Subtotal	**156**	**2,662**	**2,697**	**6,386**	**382**
LLW, BALANCE OF OPERATIONS, NORMAL OPERATIONS (ft³)					
Balance of Operations	2,600	2,600	2,600	2,600	2,600
TOTAL LLW	**3,322**	**5,954**	**5,993**	**9,897**[b]	**3,616**
LLMW, SELECTED FACLITIES, NORMAL OPERATIONS (kg)					
Neutron Generator Facility	150	300	300	300	300
Radioactive and Mixed Waste Management Facility[c]	842	1,095	1,095	1,390	421
Sandia Pulsed Reactor	143	143	143	500	143
Aerial Cable Facility	0	0	0	0	0

Table H.3–2. Radioactive Waste Generation by Alternative (continued)

FACILITY	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Sled Track Facility	0	0	0	0	0
Lurance Canyon Burn Site	0	0	0	0	0
Explosive Components Facility	1,000	1,000	1,000	1,000	1,000
Subtotal	**2,135**	**2,538**	**2,538**	**3,190**	**1,864**
LLMW, NEW FACILITIES (OPERATIONS) (kg)					
Hot Cell Facility	250	607	607	1,429	179
Annular Core Research Reactor (DP configuration)	0	0	0	179	0
Subtotal	**250**	**607**	**607**	**1,607**	**179**
LLMW, BALANCE OF OPERATIONS, NORMAL OPERATIONS (kg)					
Balance of Operations	157	157	157	157	157
TOTAL LLMW	**2,542**	**3,302**	**3,302**	**4,954**	**2,200**
TRU WASTE, SELECTED FACILITIES, NORMAL OPERATIONS (ft^3)					
Z-Machine	0	8	8	16	0
Sandia Pulsed Reactor	0	2	2	5	0
Subtotal	**0**	**10**	**10**	**21**	**0**
TRU WASTE, NEW FACILITIES (OPERATIONS) (ft^3)					
Annular Core Research Reactor (DP configuration)	0	0	0	5	0
Subtotal	**0**	**0**	**0**	**5**	**0**
TRU WASTE, BALANCE OF OPERATIONS, NORMAL OPERATIONS (ft^3)					
Balance of Operations	0	0	0	0	0
TOTAL TRU	**0**	**10**	**10**	**26**	**0**
MTRU WASTE, SELECTED FACILITIES, NORMAL OPERATIONS (ft^3)					
Sandia Pulsed Reactor	0	2	2	5	0
Radioactive and Mixed Waste Management Facility[c]	0	2	2	5	0
Subtotal	**16**	**23**	**23**	**32**	**8**
MTRU WASTE, NEW FACILITIES (OPERATIONS) (ft^3)					
Annular Core Research Reactor (DP configuration)	0	0	0	5	0

Table H.3–2. Radioactive Waste Generation by Alternative (concluded)

FACILITY	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Subtotal	**0**	**0**	**0**	**5**	**0**
Balance of Operations	0	0	0	0	0
TOTAL MTRU	**1**	**23**	**23**	**37**	**8**

Sources: SNL/NM 1998a, 1997b
DP: Defense Programs
ft³: cubic feet
kg: kilograms
m³: cubic meter
LLMW: low-level mixed waste
LLW: low-level waste
MESA: Microsystems and Engineering Sciences Applications
MTRU: mixed transuranic
RMWMF: Radioactive and Mixed Waste Management Facility
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] If implemented, the MESA Complex configuration would increase the quantity by 0.1 ft³ of LLW annually.
[c] RMWMF MTRU waste should be considered to be inventory based on projected facility operations.
Note: 1) Numbers are rounded and may differ from calculated values.
2) LLW and LLMW managed by the RMWMF may require repackaging and generation of a secondary waste. Waste generated for these operations was assumed to be less than 1 percent of the total in storage and was considered the bounding case.

Table H.3–3. Low-Level Waste in Storage and Facility Storage Capacity[a]

FACILITY	LLW IN STORAGE		FACILITY CAPACITY	
	WEIGHT (kg)	VOLUME (m^3)	WEIGHT[b] (M kg)	VOLUME (m^3)
High Bay (6596) in TA-I	0	0	2.268	1,800
ISS in TA-III	0	0	0.643	510
Manzano Bunker 37118[c]	0	0	0.352	279
Manzano Bunker 37045[c]	0	0	0.222	176
Manzano Bunker 37078[c]	0	0	0.352	279
Manzano Bunker 37063[c]	255	0.62	0.296	235
Manzano Bunker 37034[c]	4,450	6.71	0.296	235
Manzano Bunker 37055[c]	1,732	3.48	0.222	176
Manzano Bunker 37057[c]	6.4	0.82	0.222	176
RMWMF in TA-III	69,811	325	10.08	8,000
TOTAL LLW IN STORAGE	**76,255**	**336**		
TOTAL FACILITY CAPACITY			**14.95**	**11,874**

Source: SNL/NM 1998a
ACRR: Annular Core Research Reactor
ISS: Interim Storage Site
kg: kilograms
LLW: low-level waste
m³: cubic meters
M kg: million kilograms
RMWMF: Radioactive and Mixed Waste Management Facility
TA: technical area
[a] LLW generated from the ACRR, while operating in the medical isotopes production configuration, will be managed at the ACRR facility prior to offsite disposal.
[b] Facility weight capacity is based on a maximum weight of 250 kg per drum (actual), using all available storage.
[c] See Figure 4.4–12 for the approximate locations of these waste storage facilities.
Note: Numbers are rounded and may differ from calculated values.

Table H.3–4. Medical Isotopes Production Project, Low-Level Waste Projections (kg)

FACILITY	BASE YEAR [a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Hot Cell Facility	1,686	37,086	37,086	84,286	4,551
ACRR (medical isotopes production configuration)	944	6,237	6,237	18,374	944
TOTAL	**2,630**	**43,323**	**43,323**	**102,660**	**5,495**

Sources: SNL/NM 1998a, SNL/NM 1997b
ACRR: Annular Core Research Reactor
kg: kilograms
LLW: low-level waste

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Note: Waste generated by the Medical Isotopes Production Project represents approximately 32 to 84 percent of the selected facility total LLW at SNL/NM projected under the three alternatives.

INEEL, Idaho; the TSCA Incinerator at Oak Ridge, Tennessee; Environcare facilities in Clive, Utah; Waste Control Specialist in Texas; DSSI, Oak Ridge, Tennessee, for treatment; Hanford, Washington, for disposal; and the NTS, Nevada, for disposal. Disposal at these facilities is dependent on meeting waste acceptance criteria. Projected waste volumes are shown in Table H.3–2. Current stored quantities of these wastes and capacities of storage facilities are shown in Table H.3–5. Table H.3–6 lists medical isotopes production waste volumes.

H.3.2.3 Transuranic and Mixed Transuranic Waste

The existing TRU and MTRU wastes stored onsite, as well as all future TRU and MTRU wastes, are to be transferred to Los Alamos National Laboratory (LANL) for certification, as indicated in the January 20, 1998, Record of Decision (ROD) for DOE's *Waste Management Program: Treatment and Storage of Transuranic Waste* (DOE 1998n). Projected waste volumes are shown in Table H.3–2. Current stored quantities of these wastes and facility storage capacities are shown in Table H.3–7. Neither TRU nor MTRU wastes would be generated at the ACRR during medical isotopes production.

H.3.3 Hazardous Waste

Table H.3–8 lists hazardous waste volumes by selected facilities (existing operations), new facilities (new operations), and balance of operations (existing operations) for the base year and each of the three alternatives.

SNL/NM uses multiple hazardous waste disposal facilities located throughout the U.S. Table H.3–9 shows these facilities. Wastes shipped in 1997 are shown in Table H.3–10. Hazardous waste storage facility capacities are shown in Table H.3–11. The August 5, 1998, *Record of Decision for the Department of Energy's Waste Management Program: Treatment of Non-Wastewater Hazardous Waste* discusses the decision to continue to use commercially available facilities for hazardous waste disposal (DOE 1998m).

H.3.3.1 Biohazardous (Medical) Waste

The total volume of medical waste would remain generally a function of the total number of full-time employees and subcontractors located at SNL/NM. A total of 2,463 kg of biohazardous waste was disposed of in 1997. No large increase is anticipated based on the information provided.

Table H.3–5. Low-Level Mixed Waste Currently in Storage and Facility Storage Capacity[a]

FACILITY	LLMW IN STORAGE		FACILITY CAPACITY	
	WEIGHT (kg)	VOLUME (m^3)	WEIGHT[b] (M kg)	VOLUME (m^3)
High Bay (6596) in TA-I	60,261	101	2.269	1,800
ISS in TA-III	0	0	0.643	510
Manzano Bunker 37118[c]	0	0	0.352	279
Manzano Bunker 37045[c]	0	0	0.222	176
Manzano Bunker 37078[c]	0	0	0.352	279
Manzano Bunker 37063[c]	0	0	0.296	235
Manzano Bunker 37034[c]	6,568	9.8	0.296	235
Manzano Bunker 37055[c]	163.3	1.7	0.222	176
Manzano Bunker 37057[c]	0	0	0.222	176
RMWMF in TA-III	17,065	39	10.08	8,000
TOTAL LLMW IN STORAGE	**84,057**	**152**		
TOTAL FACILITY CAPACITY			**14.95**	**11,874**

Source: SNL/NM 1998a
ACRR: Annular Core Research Reactor
ISS: Interim Storage Site
kg: kilograms
LLMW: low-level mixed waste
m^3: cubic meters
M kg: million kilograms
RMWMF: Radioactive and Mixed Waste Management Facility
TA: technical area
[a] LLMW generated from the ACRR, while operating in the medical isotopes production configuration, will be managed at the ACRR facility prior to offsite disposal.
[b] Faclity weight capacity is based on a maximum weight of 250 kg per drum (actual), using all available storage.
[c] See Figure 4.4–12 for the approximate locations of these waste storage facilities.
Note: Numbers are rounded and may differ from calculated values.

Table H.3–6. Medical Isotopes Production Project, Low-Level Mixed Waste Projections (kg)

FACILITY	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Hot Cell Facility	250	607	607	1,429	179
ACRR (medical isotopes production configuration)	0	0	0	179	0
TOTAL	**250**	**607**	**607**	**1,607**	**179**

Sources: SNL/NM 1998a, SNL/NM 1997b
ACRR: Annular Core Research Reactor
kg: kilograms
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Notes: 1) Waste generated by the Medical Isotopes Production Project represents approximately 32 to 84 percent of the selected facility total LLMW at SNL/NM projected under the three alternatives
2) Numbers are rounded and may differ from calculated values.

Table H.3–7. Transuranic and Mixed Transuranic Waste in Storage and Facility Storage Capacity[a]

FACILITY	TRU WASTE		MTRU WASTE		CAPACITY	
	WEIGHT (kg)	VOLUME (m^3)	WEIGHT (kg)	VOLUME (m^3)	WEIGHT[b] (M kg)	VOLUME (m^3)
High Bay (6596)	0	0	0.5	0.03	2.268	1,800
ISS	0	0	0	0	0.643	510
Manzano Bunker 37118[c]	0	0	0	0	0.352	279
Manzano Bunker 37045[c]	0	0	0	0	0.222	176
Manzano Bunker 37078[c]	0	0	0	0	0.352	279
Manzano Bunker 37063[c]	1,719	4.84	0	0	0.296	235
Manzano Bunker 37034[c]	0	0	0	0	0.296	235
Manzano Bunker 37055[c]	0	0	0	0	0.222	176
Manzano Bunker 37057[c]	0	0	0	0	0.222	176
RMWMF	134	1.22	34	0.42	10.08	8,000
TOTAL TRU and MTRU IN STORAGE	**1,853**	**6.1**	**34.5**	**0.45**		
TOTAL FACILITY CAPACITY					**14.95**	**11,874**

Source: SNL/NM 1998a
ACRR: Annular Core Research Reactor
ISS: Interim Storage Site
kg: kilograms
m^3: cubic meters
MTRU: mixed transuranic
RMWMF: Radioactive and Mixed Waste Management Facility
TA: technical area
TRU: transuranic

[a] TRU and MTRU waste generated from the ACRR, while operating in the medical isotopes production configuration, will be managed at the ACRR facility prior to offsite disposal.
[b] Facility weight capacity is based on a maximum weight of 250 kg per drum (actual), using all available storage.
[c] See Figure 4.4–12 for the approximate locations of these waste storage facilities.
Note: Numbers are rounded and may differ from calculated values.

Table H.3–8. Hazardous Waste Generation by Alternative

FACILITY NA E	BASE YEAR [a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
HAZARDOUS WASTE, NORMAL OPERATIONS (kg)					
Microelectronics Development Laboratory MESA Complex configuration[b]	2,520	3,150	4,410	4,738 (5,938)	1,688
Advanced Manufacturing Processes Laboratory	4,732	5,915	5,915	6,625	4,732
Explosive Components Facility	360	500	500	500	500
Integrated Materials Research Laboratory	2,400	2,100	1,850	2,000	2,000
Neutron Generator Facility	2,760	3,680	3,680	3,680	3,680
Hazardous Waste Management Facility	800	750	770	860	690
Thermal Treatment Facility	0	76	76	272	0
High-Energy Radiation Megavolt Electron Source	167	316	316	915	25
SATURN	167	501	501	1,286	100
Short-Pulse High Intensity Nanosecond X-Radiator	21	45	45	107	3.6
Sandia Accelerator and Beam Research Experiment	63	76	76	132	0
Z-Machine	750	1,000	1,000	1,250	400
Advanced Pulsed Power Research Module	50	100	100	200	5
Gamma Irradiation Facility	199	0	0	398	199
Repetitive High Energy Pulsed Power Unit I	0	1	1	1	0
Repetitive High Energy Pulsed Power Unit I	0	5	5	10	0
Sandia Pulsed Reactor	199	398	398	852	199
Radiographic Integrated Test Stand	68	136	204	272	34
Containment Technology Test Facility-West	0.1	0.1	0	0.1	0.1
Sled Track Complex	15	15	15	50	3
Centrifuge Complex	10	12	12	15	12

Table H.3–8. Hazardous Waste Generation by Alternative (concluded)

FACILITY NA E	BASE YEAR [a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Aerial Cable Facility	5	5	5	9	5
Lurance Canyon Burn Site	900	900	900	900	900
Drop/Impact Complex	0	0	0	0	0
Explosives Application Laboratory	1.0	1	1	2	0.5
Terminal Ballistics Complex	0.3	0.5	0.5	0.8	0
Subtotal MESA Complex configuration[b]	**16,187**	**19,682**	**20,780**	**25,074 (26,274)**	**15,176**
HAZARDOUS WASTE, NEW FACILITIES (OPERATIONS) (kg)					
Hot Cell Facility	199	398	398	625	199
Annular Core Research Reactor (Medical Isotopes Production Configuration)	199	398	398	852	199
Annular Core Research Reactor (DP Configuration)	0	0	57	398	0
Tera-Electron Volt Energy Superconducting Linear Accelerator	0	50	50	65	2
New Gamma Irradiation Facility	0	398	398	398	199
Subtotal	**398**	**1,243**	**1,300**	**2,337**	**598**
Selected Facilities Total MESA Complex configuration[b]	**16,585**	**20,925**	**22,080**	**27,411 (28,611)**	**15,774**
Hazardous Waste Derived Multiplier MESA Complex configuration[b]	**1.00**	**1.26**	**1.33**	**1.65 (1.73)**	**0.95**
HAZARDOUS WASTE, BALANCE OF OPERATIONS, EXISTING OPERATIONS (kg)					
Balance of Operations	39,267	49,544	52,278	64,902	37,349
TOTAL HAZARDOUS WASTE MESA Complex configuration[b]	**55,852**	**70,469**	**74,358**	**92,314 (93,514)**	**53,132**

Sources: SNL/NM 1998a, SNL/NM 1997b
DP: Defense Programs
kg: kilograms
MESA: Microsystems and Engineering Sciences Applications
MDL: Microelectronics Development Laboratory

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] If implemented, the MESA Complex configuration under the Expanded Operations Alternative would increase hazardous waste generation by 1,200 kg per year.
Note: Numbers are rounded and may differ from calculated values.

Table H.3–9. 1997 Waste Disposal and Recyclable Quantities and Sites Used[a]

FACILITY NAME	WASTE/MATERIAL TYPE [b]	RCRA WASTE (kg)	NON-RCRA WASTE (kg)
Ensco Environmental Services	Hazardous	34,709	22,907
Keers Environmental	Asbestos	0	148,793
Kinsbursky Bros.	Batteries (recycle)	0	7,715
Kirtland Air Force Base	Explosives	125	0
Laidlaw, NY	Pyrophoric materials, nonflammable gas	218	99
Laidlaw - APTUS, UT	Hazardous, biohazardous (medical), PCBs	10,791	10,455
Laidlaw, UT	PCBs	0	198
Laidlaw, UT	Chromium-contaminated water, contaminated soil, PCBs, asbestos	346,393	32,445
Laidlaw, OK	Hazardous	1,167	0
NSSI	Cylinder	500	0
Safety-Kleen	Used oil (recycle)	0	36,243
Salesco Systems	PCBs, fluorescent lights, nonregulated	419	18,871
SNL/NM	Explosives, hazardous	1,330	490
Tab Manufacturing	Lead (recycle)	0	16,647
Transformer Disposal Specialists, Inc.	PCBs	0	23,459

Source: Rinchem 1998a
HWMF: Hazardous Waste Management Facility
kg: kilogram
NSSI: National Sources & Services, Inc.
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
[a] Represents only material handled through the HWMF
[b] Includes recyclable waste

Table H.3–10. Hazardous Waste Management Facility (HWMF) 1997 Waste and Recycle Quantities Shipped

WASTE/MATERIAL TYPE	TOTAL SHIPPED (kg)
Asbestos	155,951
ER Project	338,635
Explosives	130
Lead (Recyclable)	16,647
Non-RCRA	69,321
PCBs	28,591
RCRA	55,852
Recyclable (Other)	7,879
Subtitle D [a]	4,728
Used Oil (Recyclable)	36,242
TOTAL	**713,976**

Source: Rinchem 1998a
ER: Environmental Restoration
kg: kilogram
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
[a] Subtitle D refers to RCRA Subtitle D as defined in 40 CFR Parts 257 and 258.
Note: Recyclable materials are considered to have economic value and are not included as waste for calculations.

Table H.3–11. Hazardous Waste Management Facility Operations Storage Capacities

FACILITY	CAPACITY	
	(m^3)	(kg)
Waste Packaging Building 959	21.65	21,715
Waste Storage Building 958	226.95	227,587
Modular Storage Buildings	37.89	38,001
TOTAL	**286.50**	**287,303**

Source: SNL/NM 1998a
kg: kilograms
m^3: cubic meters

H.3.4 Special Projects Wastes

H.3.4.1 Environmental Restoration Project

Overall projections indicate the ER Project, a special project beyond the scope of normal operations, will be the single largest waste generator at SNL/NM in 1998. In 1997, SNL/NM shipped approximately 0.58 M kg of hazardous (RCRA and TSCA) waste for offsite disposal. The ER Project was responsible for 338,635 kg of that total. The ER Project will produce and dispose of various waste types, primarily contaminated soil and debris, by the conclusion of the project in 2004. The environmental consequences associated with the project are discussed separately in the ER Project Environmental Assessment (DOE 1996c). However, the ER Project waste volumes are included in this analysis and are listed in Table H.3–12.

H.3.4.2 SNL/NM Facility

A second special project beyond the scope of normal operations, to renovate and refurbish outdated metal, temporary office, and trailer structures, is currently planned for the next 10 years. The projections directly affect the quantity of TSCA hazardous waste requiring disposal. Under these projections, SNL/NM would continue to generate TSCA hazardous waste, primarily asbestos removed from older buildings and PCBs from old transformers, at the rate of approximately 122,000 kg per year. A total of 184,542 kg of TSCA waste, generated through special projects, was shipped offsite for disposal in 1997.

No projections are made for this program beyond the year 2007. The wastes generated under this special project are related indirectly to the decrease in gross square feet of facilities presented in Table H.3–13.

H.3.4.3 Legacy Waste Work-Off Project

Legacy waste is considered to be waste material currently in storage pending disposal. For the most part, legacy waste is either radioactive or classified. SNL/NM is in the process of disposing of this waste as treatment and disposal capacity becomes available. The projected time frame for removal of this waste is discussed in Appendix G.

Table H.3–12. Analysis of Environmental Restoration Project-Generated Waste Volumes[a]

YEAR	WASTE TYPE	VOLU E (m^3)	WEIGHT[ab] (kg)
1996[bc]	RCRA Hazardous	274.7	314,981
	LLW	374.2	429,046
	LLMW	66.5	76,232
	TSCA Hazardous	3.8	4,384
	Nonhazardous	43.6	49,975
	Subtotal	**762.8**	**874,626**
1997[bc]	RCRA Hazardous	34.8	39,957
	LLW	255.3	292,727
	LLMW	99.6	114,240
	TSCA Hazardous	5.4	6,137
	Nonhazardous	74.9	85,921
	Subtotal	**470**	**538,883**
1998	RCRA Hazardous	20,066.1	23,007,630
	LLW	2,216.8	2,541,780
	LLMW	53.2	61,022
	TSCA Hazardous	901.5	1,033,686
	Nonhazardous	109.1	125,112
	Subtotal	**23,346.8**	**26,769,230**
1999	RCRA Hazardous	694.6	796,402
	LLW	15.5	17,762
	LLMW	1.8	2,017
	TSCA Hazardous	878.6	1,007,384
	Nonhazardous	38.2	43,837
	Subtotal	**1,628.7**	**1,867,403**
2000	RCRA Hazardous	1,529.3	1,753,497
	LLW	-	-
	LLMW	-	-
	TSCA Hazardous	-	-
	Nonhazardous	-	-
	Subtotal	**1,529.3**	**1,753,497**
TOTAL		**27,737.5**	**31,803,638**

Source: SNL/NM 1998m
LLMW: low-level mixed waste
LLW: low-level waste
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] Actual cleanup is expected to be completed between fiscal year (FY) 2003 and FY2005, with environmental restoration waste disposed of prior to the end of the project.
[b] Conversion based on 1997 average waste density of 1,146.6 kg/m^3
[c] Actual quantities

Table H.3–13. SNL/NM Facility Square Footage Changes

YEAR	NUMBER OF BUILDINGS	GROSS SQUARE FEET
Current Levels	674	5,020,014
FY 1998 through 1999 Decreases	-138	-179,204
FY 2000 through 2002 Decreases	-49	-108,937
FY 2003 through 2007 Decreases	-29	-84,132
FY 1998 through 2007 Increases	+7	+240,000
TOTALS THROUGH 2007	**465**	**4,887,741**

Source: SNL 1997a
CSRL: Compound Semiconductor Research Laboratories
FY: fiscal year
MESA: Microsystems and Engineering Sciences Applications
Note: Table does not include leased space, MESA Complex, and CSRL.

H.3.5 Nonhazardous Waste

H.3.5.1 Solid Waste

Municipal solid waste is usually transported once a week from SNL/NM. In 1997, 51 shipments were made from SNL/NM Solid Waste Transfer Facility to the Rio Rancho Sanitary Landfill. For the SWEIS analysis, the bounding calculation assumed the disposal of solid waste would be located within 50 km. These volumes are not expected to vary significantly over the time frame of the SWEIS. Solid waste projections are shown in Table H.3–14. Quantities of building debris generated from construction and demolition (C&D) activities are currently disposed of onsite at the KAFB Landfill and are shown in Table 5.3.10–3.

If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration under the Expanded Operations Alternative would result in the following estimated quantities of decontamination, decommissioning, and demolition wastes: 1 ton of asbestos–TSCA, 0.5 ton of PCB–TSCA ballasts, 0.5 ton of hazardous waste, 0.1 ton of nonhazardous waste, and 2,000 tons of demolition debris. The analysis assumed that 1 ton is equal to approximately 2.5 yd^3 and that demolition wastes would occur after the MESA Complex becomes operational in fiscal year (FY) 2003.

H.3.5.2 Wastewater

Wastewater is discussed in detail in Sections 4.4, 5.3.2, 5.4.2, and 5.5.2 of the SWEIS. Projections of wastewater volumes are shown in Table H.3–15.

H.3.6 Recyclable Materials

SNL/NM routinely recycles solid waste materials such as scrap metal, paper, cardboard, and plastics. SNL/NM also recycles hazardous materials such as lead, waste oil, solvents, and other chemicals whenever possible. Recyclable materials are considered to have economic value and are, therefore, not included as waste for calculations. See Section 4.12 for a detailed discussion.

Table H.3–14. Solid Waste Quantities from Existing Facilities and New Facilities (Operations)

SOLID WASTE	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Site-Wide Municipal Solid Waste (m^3)	2,022	2,006	1,955	2,022[b]	1,955
Change From Base Year (%)	0	-0.8	-3.3	0	-3.3

Sources: SNL/NM 1998a, c, y
CSRL: Compound Semiconductor Research Laboratories
FY: fiscal year
m^3: cubic meters
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Not expected to change in the MESA Complex configuration under the Expanded Operations Alternative.
Note: See Table 5.3.10–3 for construction and demolition wastes, including 2,000 tons for demolition of CSRL after FY 2003.

Table H.3–15. Analysis of Process Wastewater Generation from All Existing Facilities and New Facilities (Operations)

WASTEWATER	BASE YEAR [a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Existing Operations Wastewater (M gal)	49	62	84	86[b]	51
New Operations Wastewater (M gal)	0	4	4	5	3
TOTAL OPERATIONS WASTEWATER (M gal)	49	66	88	91[b]	54
Site-Wide Water Use (M gal)	440	454	463	495[b]	416
Site-Wide Wastewater[c] (M gal)	280	290	304	322[b]	268

Sources: SNL/NM 1997b, 1998a, c
M gal: million gallons
MESA: Microsystems and Engineering Sciences Applications
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] If implemented, the MESA Complex configuration under the Expanded Operations Alternative would increase the quantity by 3.8 M gal per year.
[c] Wastewater includes process water and sanitary water

H.4 SUMMARY

Table H.4–1 is a summary of total waste volumes for the waste categories addressed above, by base year, under each of the three alternatives. Percentage increases or decreases from base year are also shown.

Table H.4–1. Summary of Waste Volumes and Percent Increases/Decreases by Alternative for All Operations

SU ARY OF ALL WASTES	UNITS	BASE YEAR [a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
			5-YEAR	10-YEAR		
Radioactive Waste	m^3	98.9	174.9	176	289.4[b]	106.4
RCRA Hazardous Waste [c]	kg	55,852	70,469	74,358	92,314[b]	53,123
Solid Waste	m^3	2,022	2,006	1,955	2,022	1,955
Process Wastewater	M gallons	280	273	265	322[b]	270
Radioactive Waste	% Change	0	76.9	78	192.7	7.6
RCRA Hazardous Waste	% Change	0	24.4	31.3	74.3	-8.8
Solid Waste	% Change	0	-0.8	-3.3	0	-3.3
Process Wastewater	% Change	0	2.2	-5.4	15.0	-3.6

Sources: SNL/NM 1997b, 1998a, c, m, y;
D&D: decontamination and decommissioning
DOE: U.S. Department of Energy
ft^3: cubic feet
gal: gallons
kg: kilograms
M: million
m^3: cubic meters
MESA: Microsystems and Engineering Sciences Applications
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] If implemented, the MESA Complex configuration under the Expanded Operations Alternative would contribute an additional 1,200 kg of hazardous waste, 0.1 ft^3 of low-level waste, and 3.8 M gal of wastewater annually. The MESA Complex configuration is not expected to increase the overall quantities of solid waste because the DOE would not increase the workforce, a key parameter in solid waste generation.
[c] SNL/NM operations are projected to generate approximately 122,000 kg of TSCA hazardous waste annually, primarily from D&D operations.

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APPENDIXES

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