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Cover Sheet, Table of Contents, List of Figures,
List of Tables, Acronyms, Units of Measure,
Metric Conversion Chart, Metric Prefixes

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*.

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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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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	$\mu g/m^3$
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

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

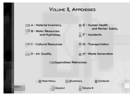
Metric Conversion Chart

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



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A

Material Inventory

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 5-YEAR	NO ACTION ALTERNATIVE 10-YEAR	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
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[c]	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 5-YEAR	NO ACTION ALTERNATIVE 10-YEAR	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
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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B

Water Resources and Hydrology

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).

- Vapor phase transport by way of diffusion is the only mechanism by which the TCE could have reached the water table in the relatively short time period between TCE disposal and appearance of contamination at the water table (DOE 1992d).

Organic liquid phase transport, movement of the organic liquid TCE toward the water table under its driving head at disposal, would not have reached the water. Water phase transport, movement of TCE dissolved in natural recharge (from precipitation), would not have reached the water table either (DOE 1992d). The rate of vertical transport of natural recharge may be determined by four different methods: chloride mass balance, stable oxygen isotope, bomb-pulse tritium, and bomb-pulse chlorine-36 from aboveground remote atmospheric testing. Using these methods, it was determined that it would likely take recharging precipitation approximately 9,000 years to reach the water table at the CWL. A lower-bound water phase transport time, based on the tritium method, which is known to be affected by downward vapor fluxes, is 1,250 years (SNL/NM 1995d).

B.1.1.3 Modeling

The unsaturated zone thickness beneath the CWL is approximately 480 ft. The saturated zone (aquifer) at this location consists of interbedded, low permeability, silty clay layers that confine sand layers of relatively high conductivity. The uppermost water-bearing unit in the saturated zone consists of 39 ft of silty clay. Three sand layers are present within the upper 135 ft of the aquifer. The horizontal velocity in the silty clay layer is small, the pore velocity being 0.07 ft per year. Vertical flow through this layer to the sandy layer, at a pore velocity of 0.03 ft per year, would occur prior to meaningful horizontal flow. The dominant flow direction in this layer is vertical to the sandy layer. Because this is neither a recharge nor discharge area, flow through the sand layers is assumed to be primarily horizontal, away from the CWL.

TCE advective transport away from the CWL would be in the sandy layers underlying the silty clay layer to which the TCE is being released. Modeling has shown that it may take hundreds of years for transport through porous material from the silty clay layer to the sandy layer. However, TCE has been found in the sandy layer. It is thought that this might be from discontinuities in monitoring well grout seals or in joints and cracks in the polyvinyl chloride (PVC) casing of the well. Nevertheless, a natural preferential pathway has not been ruled out (SNL/NM 1995d). Even if there was a natural preferential pathway, the release rate of TCE to the sandy layer would be attenuated. For the purposes of projecting TCE concentrations in the sandy layer, it was conservatively assumed that the TCE released to the silty clay layer would be instantaneously transported to the sandy layer without attenuation.

Downgradient concentrations resulting from subsequent transport away from the CWL through the sandy layer were estimated using the *Multimedia Environmental Pollutant Assessment System* (*MEPAS*) model (PNL 1989). The *MEPAS* model integrates standard calculation methodologies for source term, environmental transport, and exposure. The groundwater module of *MEPAS* simulates vertical transport (one-dimensional advection–one-dimensional dispersion) through the unsaturated soil and horizontal transport (one-dimensional advection–three-dimensional dispersion) through a single saturated zone.

The *MEPAS* model accounts for the major mechanisms of constituent mobility (adsorption/desorption), persistence (degradation or decay), advection, and dispersion. Mobility is described by a distribution coefficient that assumes instantaneous adsorption/desorption between the soil matrix and pore water. Persistence is described by a first-order degradation/decay coefficient. Advection is described by constant, unidirectional flow in the vertical direction in the unsaturated zone and in the horizontal direction in the saturated zone. Dispersion is described in one dimension (vertical) in the unsaturated zone and in all three dimensions in the saturated zone. Although three-dimensional dispersion is likely in the unsaturated zone, the assumption of one-dimensional dispersion results in the highest concentration at the water table and reflects current data showing TCE contamination directly under the CWL. The model was applied to both the aqueous phase transport of chromium and the TCE vapor release to the saturated zone.

The site conditions used in *MEPAS* to calculate downgradient contaminant concentrations are shown in Table B.1–3 (taken from SNL/NM 1995d unless otherwise indicated). The unsaturated zone parameters represent the site directly beneath the CWL. The saturated zone parameters represent the site along the projected contaminant plume trajectory, from the CWL to the nearby municipal well field (Ridgecrest), located approximately 7 mi north of the CWL. The trajectories and saturated groundwater velocities of contaminants released from the CWL were obtained from a simulation using the *MODPATH* model in conjunction with a three-dimensional simulation of flow of groundwater beneath Kirtland Air Force Base (KAFB) using the *MODFLOW*

Table B.1–3. Chemical Waste Landfill Transport Analysis Parameters

PARAMETER	VALUE
UNSATURATED ZONE PROPERTIES	
Chromium source to water table depth, ft	410
TCE distribution coefficient, mL/g	0.012
Chromium (as chromic acid) distribution coefficient, mL/g	0[a]
Dry bulk density, g/cm^3	1.8
Total porosity	0.34
SATURATED ZONE PROPERTIES	
Aquifer thickness, ft	100[b]
Pore velocity, CWL to TA-III boundary ft/yr	430[b]
Pore velocity, TA-III boundary to Ridgecrest-5, ft/yr	991[b]
Aquifer porosity	0.2
Longitudinal dispersivity, ft	100
Lateral dispersivity, ft	3
Vertical dispersivity, ft	0.114[c]
TCE distribution coefficient, mL/g	0.012
Chromium (as chromic acid) distribution coefficient, mL/g	0[a]
Dry bulk density, g/cm^3	1.8

Sources: [a] DOE 1992d, [b] DOE 1997a, [c] PNL 1995, SNL/NM 1995d
ft: feet
ft/yr: feet per year
g/cm^3: grams per cubic centimeter
g/yr: grams per year
m: meters
mg/L: milligrams per liter
mL/g: milliliters per gram
TCE: trichloroethylene

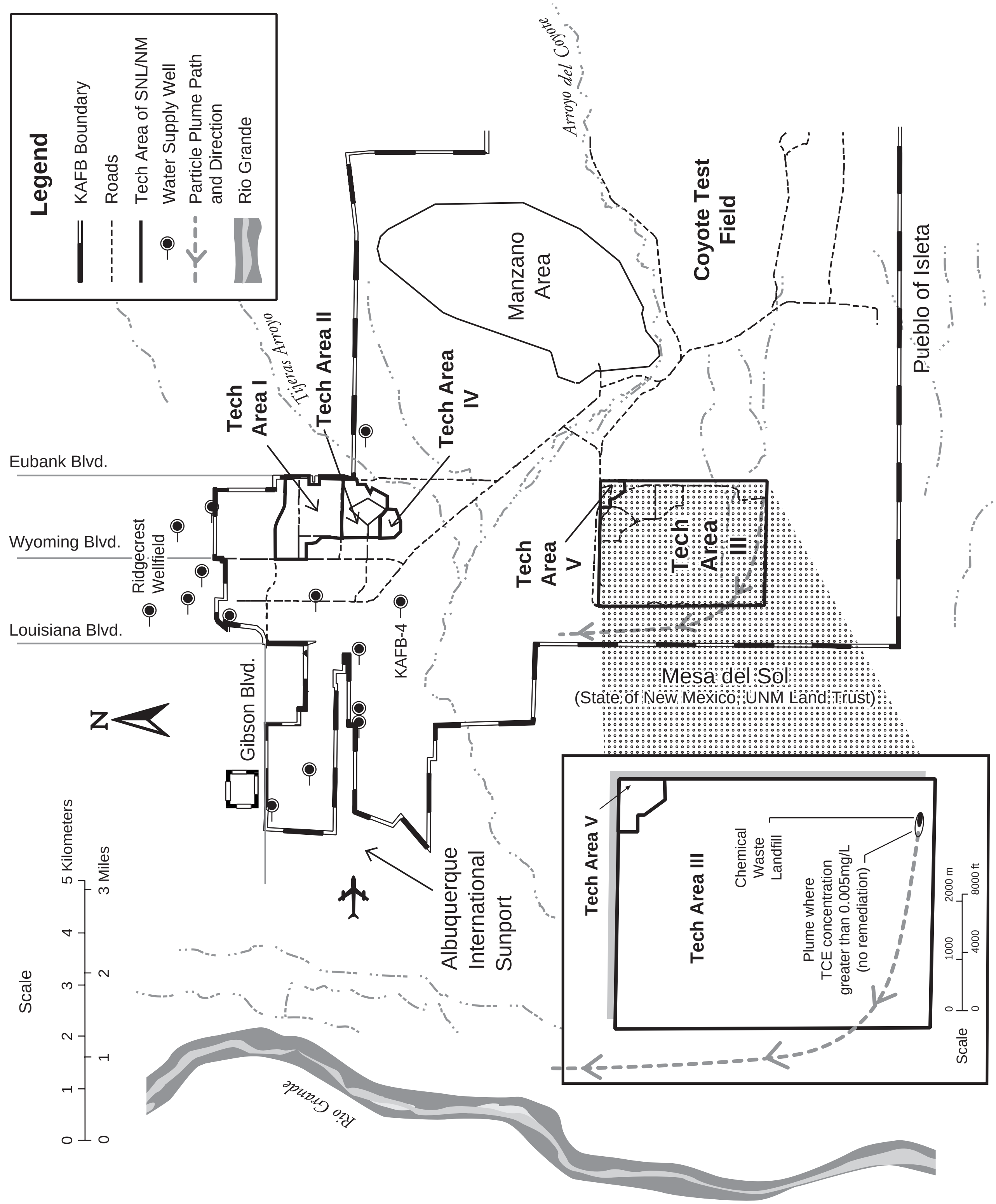
model (DOE 1997a). The aquifer thickness was conservatively chosen to include only the most conductive sandy zone, the ancestral Rio Grande lithofacies. The nearest drinking water supply well to the CWL is KAFB-4. This well, which lies along the projected plume trajectory, is located approximately 4 mi north of the landfill (SNL/NM 1995d). Although recent measurements indicate that TCE is degrading at the source (Ardito 1998), no degradation of the vapor phase TCE was assumed. This is intended to account for uncertainty of the degradation rate and the short travel time of this phase. Degradation products have not been detected in the TCE plume in the aquifer.

A previous modeling analysis (SNL/NM 1995d) of the vapor phase transport in the vadose zone from the source to the water table indicated that, in the absence of significant advection (such as, in the upper silty clay unit), nearly circular isopleths would result because diffusion is the dominant transport mechanism. The analysis showed that concentrations from 0.036 to 0.050 mg/L (in groundwater) could be expected within a nearly circular region, 349 ft in diameter. The source conditions used in the present analysis assumed an equivalent source area and a conservative concentration of 0.050 mg/L (the maximum concentration measured in 1996, as shown in Table B.1–1, was 0.026 mg/L). The release rate of TCE to the aquifer that duplicated these assumed conditions was 33.3 g per year; this release rate was used for subsequent calculations.

Because the vapor has already reached the aquifer, the release rate of 33.3 g per year is not likely to decrease immediately after source remediation. Consequently, that rate was used for the 10-year period from when TCE was first found in the aquifer (May 1990) until remediation, allowing for the 1-year period following a 1991 pump test in which no TCE was detected in the groundwater. The model results indicate that the maximum concentrations in the sandy aquifer (through which the contaminants are transported from the landfill and from which the drinking water wells draw their water) will always be less than the drinking water standard 410 ft downgradient from the source (covering an area of 1.7 ac), and will be an order of magnitude less than this standard at the Technical Area (TA)-III boundary (Figure B.1–1). 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.

B.1.1.4 Remediation Efficiency

A sensitivity study was performed for the Site-Wide Environmental Impact Statement (SWEIS) that considers the ultimate fate of the TCE for remediation of 50, 90, and 95 percent of the source. After remediation, downgradient concentrations due to the vapor phase source would be expected to quickly decline. Concentrations at the maximum unremediated downgradient extent of the MCL would decrease below this value about 10 years after introduction into the sandy layer. The maximum downgradient distance within which the MCL would be exceeded would decrease to 190 ft after 50 percent remediation and to



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 assumed to be reached linearly over the 10-year period. In addition, a population growth factor of 1.5 percent

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

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 Alternative (SNL/NM 1998c). This projection was subtracted from the KAFB withdrawals prior to

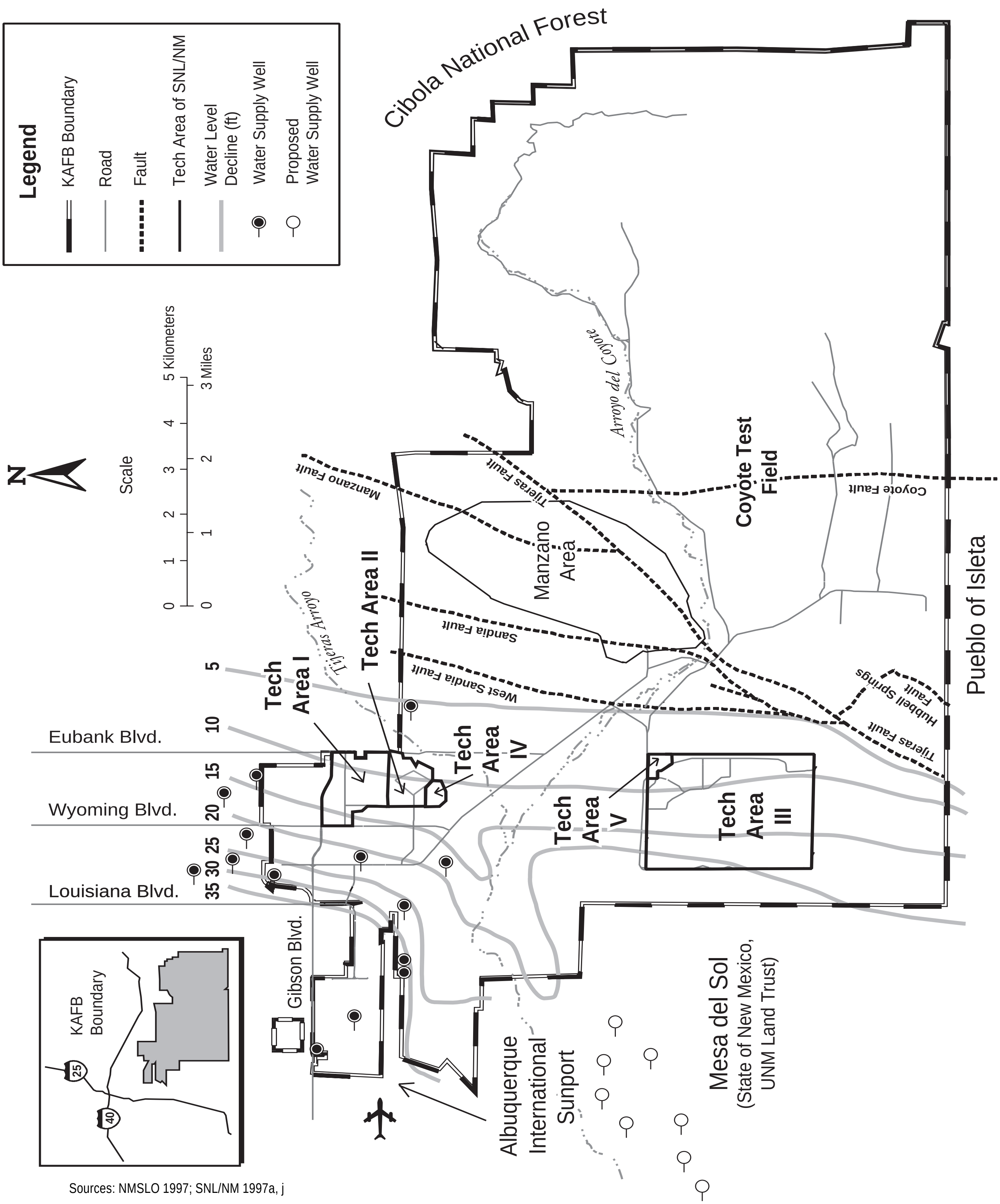


Figure B.2–1. Albuquerque-Belen Basin Groundwater Level Declines, 1985 through 1996

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

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 this projection, it was assumed that 20,000 persons (of the eventual 97,500 total) will be resident in 2007,

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

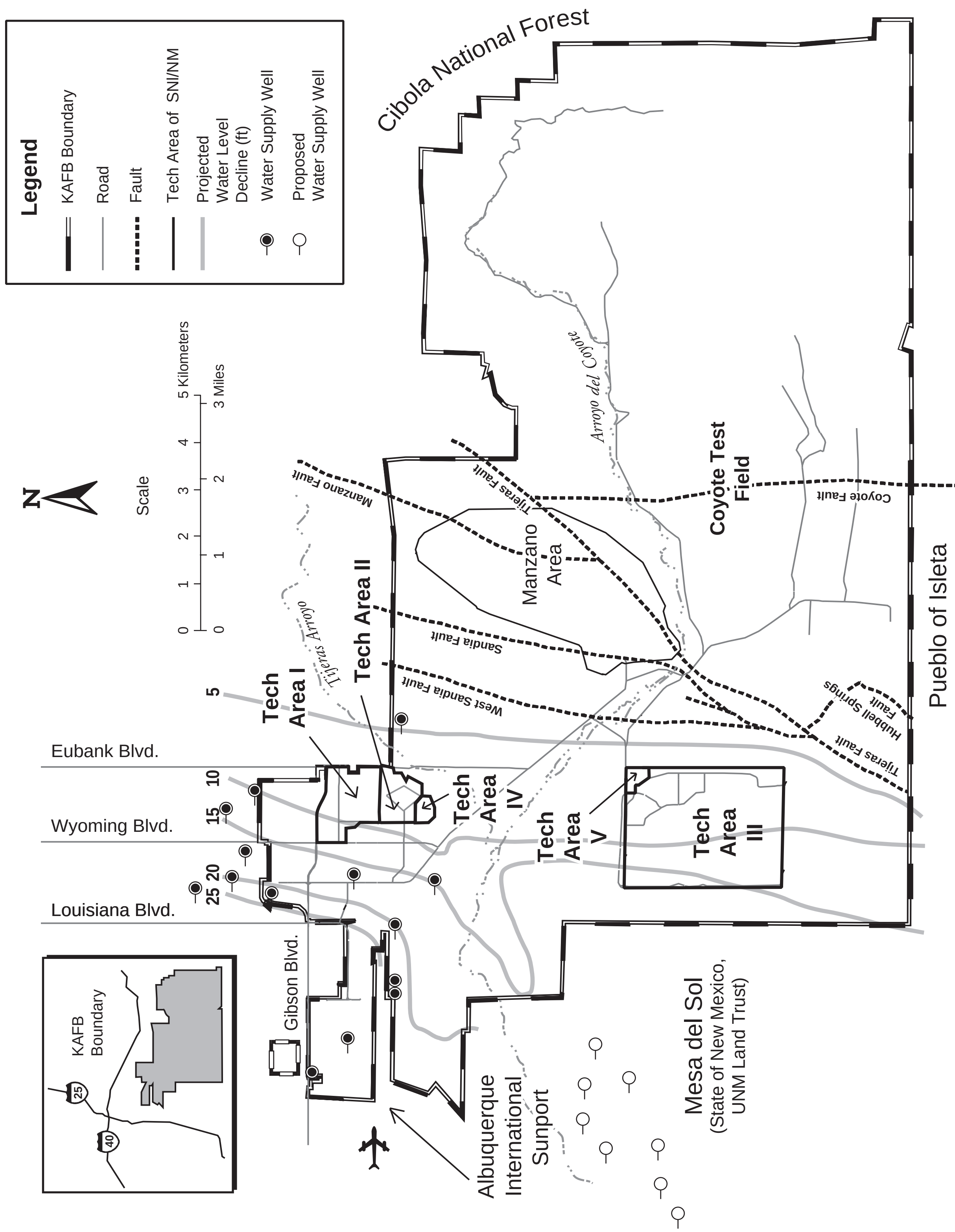
Source: Original
ft^3: cubic feet
KAFB: Kirtland Air Force Base
SNL/NM: Sandia National Laboratories/New Mexico

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	$1.84x10^6$	97,520	$5.97x10^{10}$	0.00016
1994	$13.1x10^6$	694,300	$5.41x10^{10}$	0.0013
1995	$6.5x10^6$	344,500	$6.78x10^{10}$	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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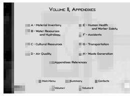

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C

Cultural Resources

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 home-steaders 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)

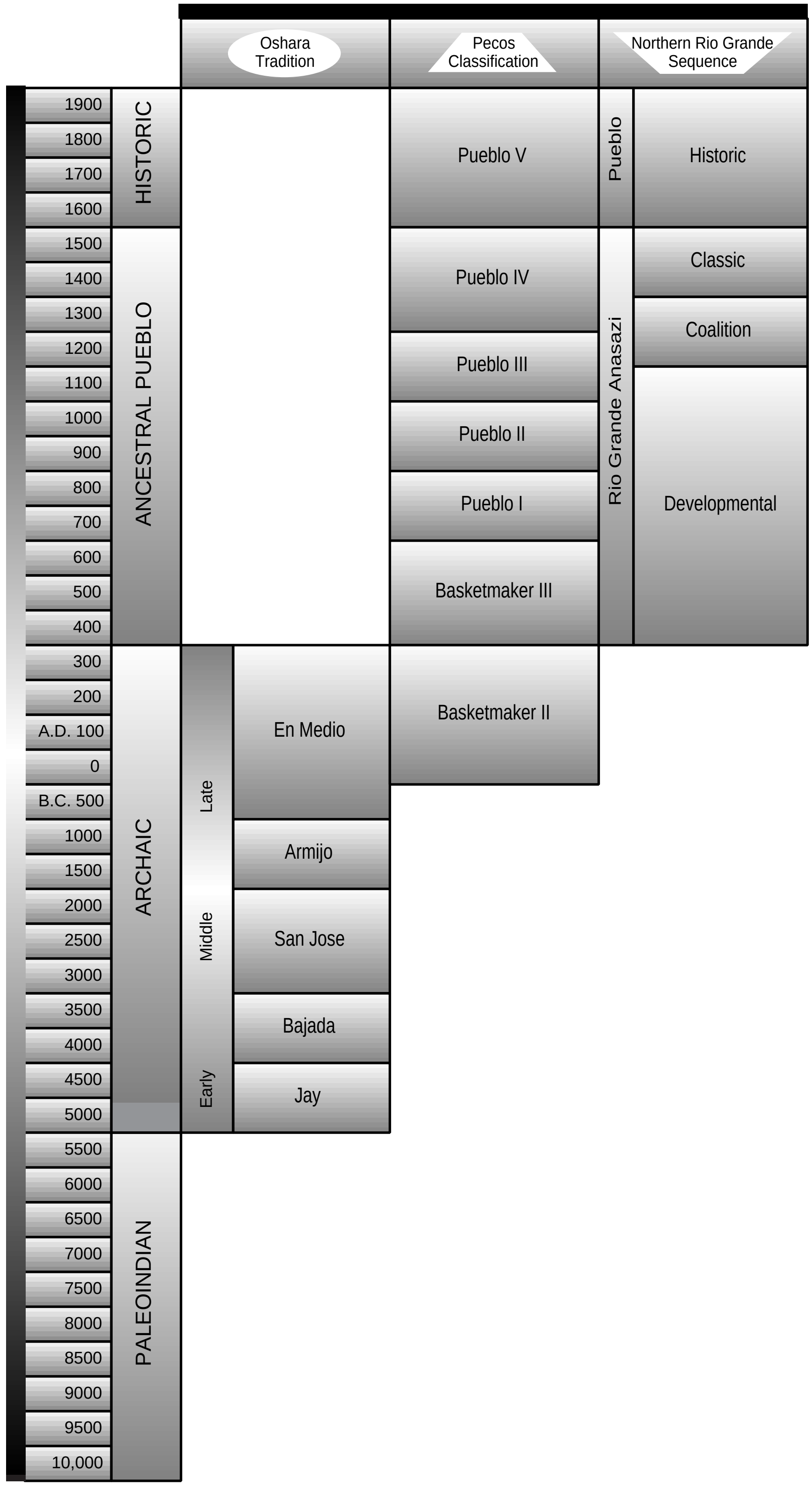
The beginning of the Archaic Stage coincides with a major climatic change and the extinction of the megafauna. The cooler, wetter climate shifted to drier, warmer conditions more common today. The lifestyle of the people changed during this stage. Big game hunting was slowly replaced by a reliance on 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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D

Air Quality

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.

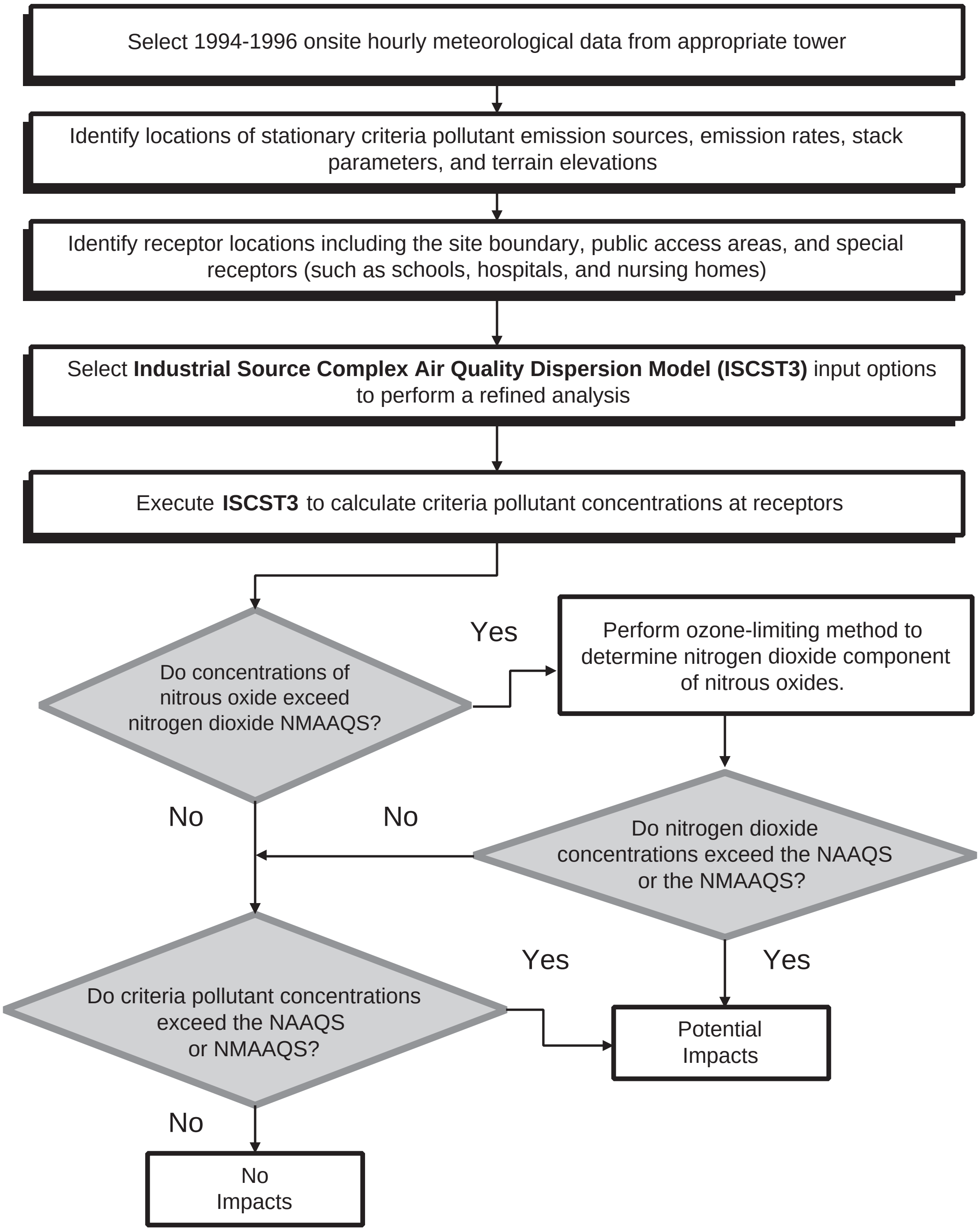
D.1.2 Criteria Pollutants

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.

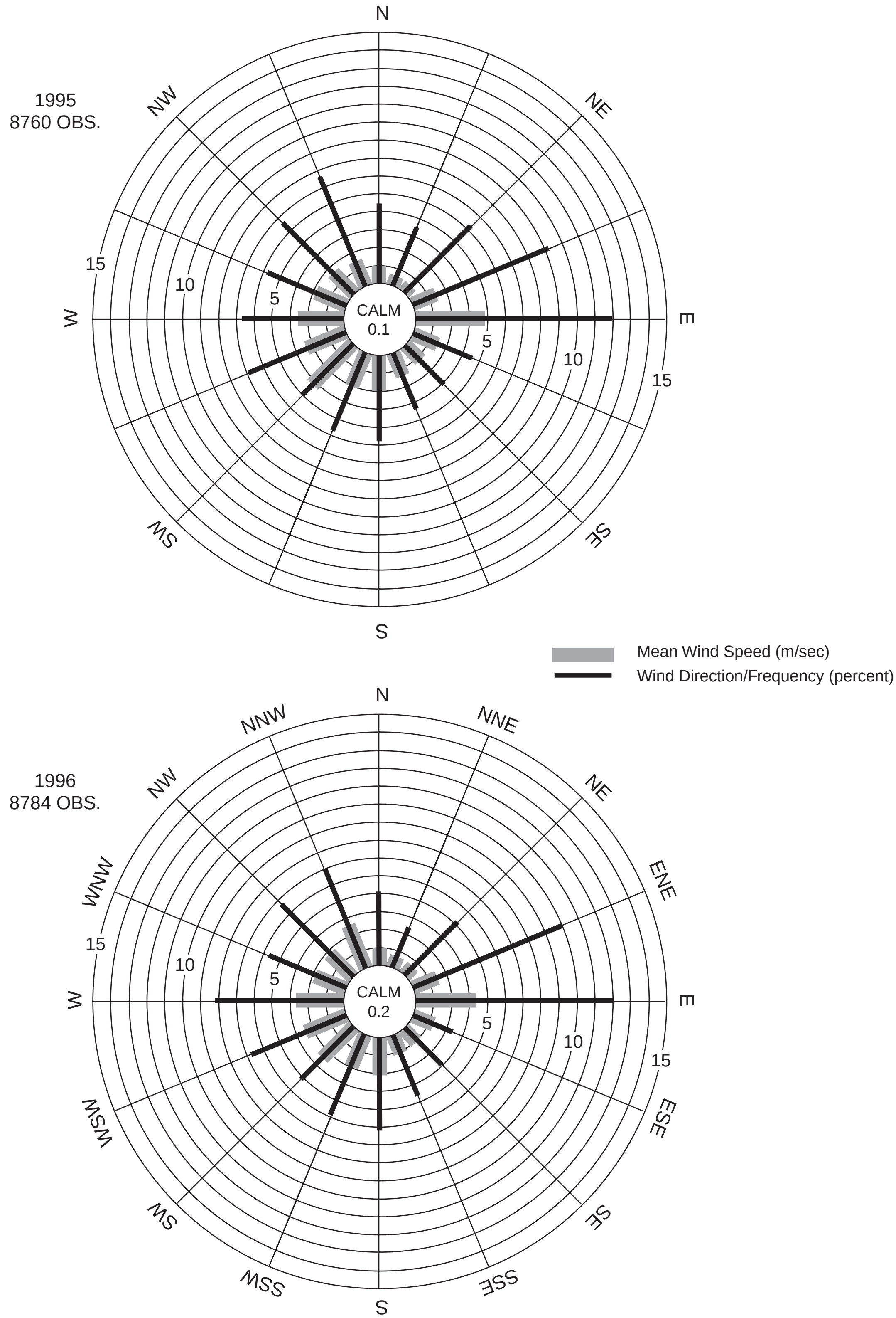
Other assumptions include

- 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.

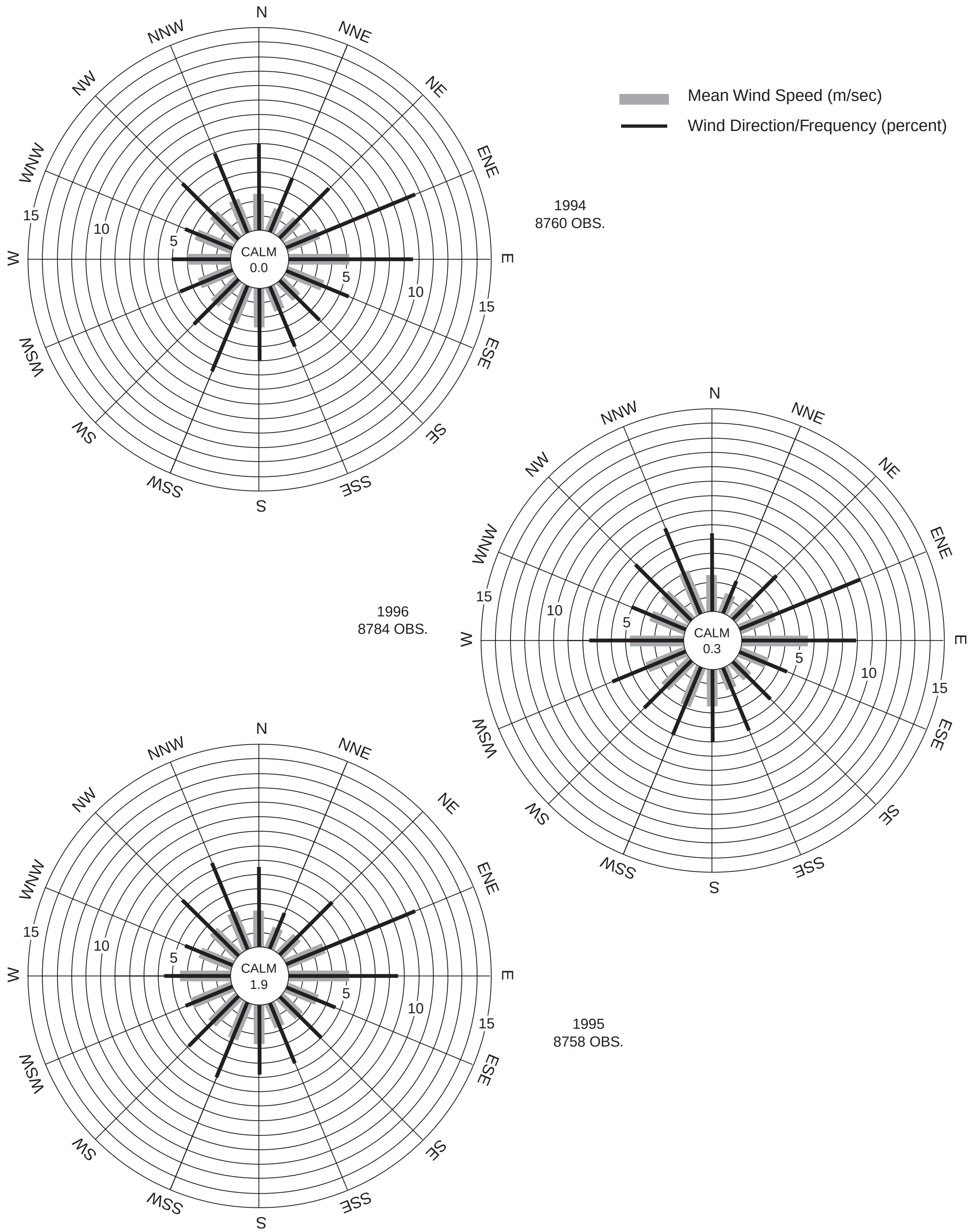
Modeling results for nitrogen oxides, using *ISCST3* for the 24-hour and annual averaging periods, are 0.19 ppm (300 $\mu g/m^3$) and 0.02 ppm (28 $\mu g/m^3$), respectively. The NMAAQS standards for nitrogen dioxide for the 24-hour and annual averaging periods are 0.10 ppm



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/m^3) and 0.05 ppm (78 μg/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 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.

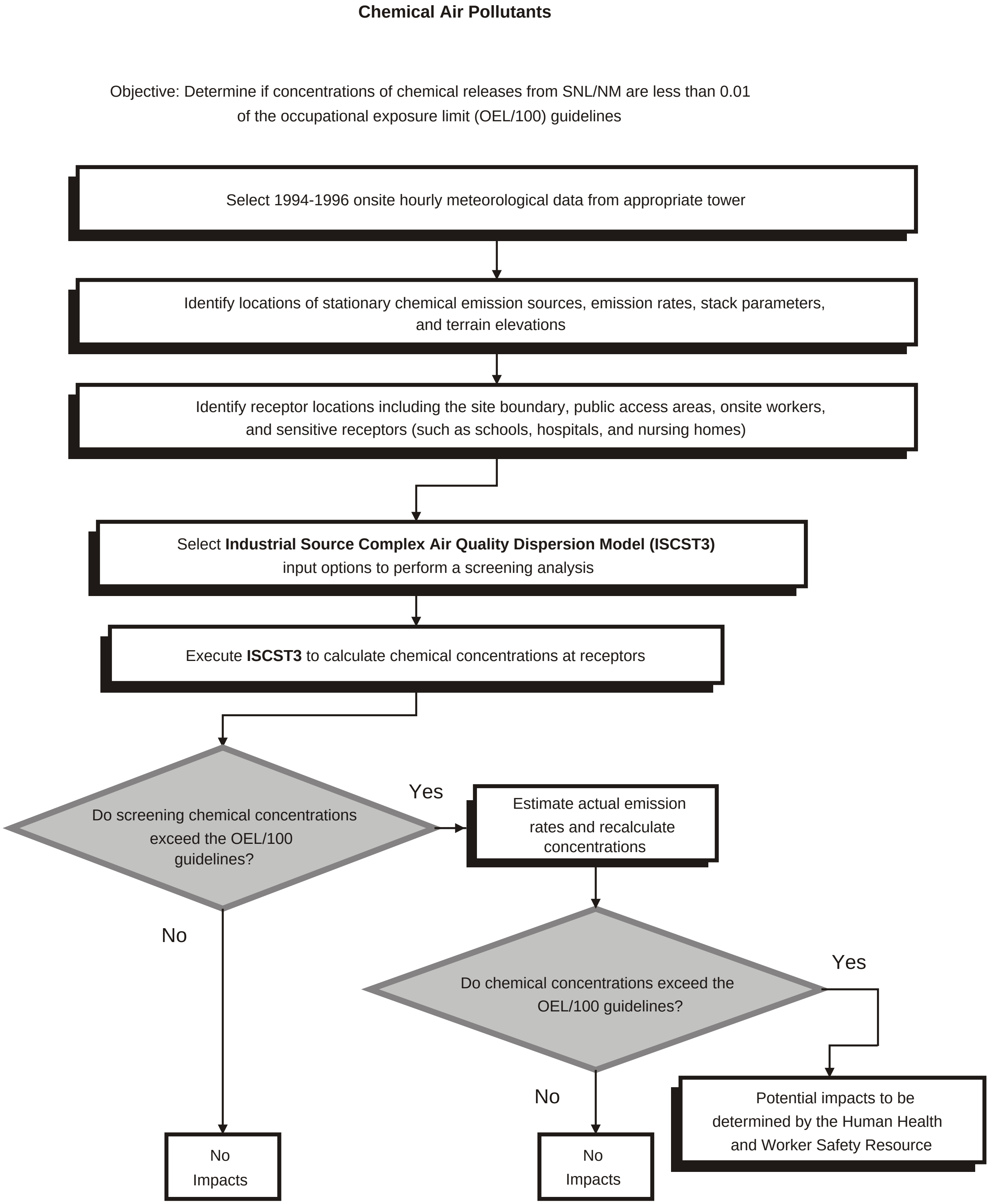
The second chemical screening level after identifying those noncarcinogenic chemicals contained within SNL/NM databases was to calculate the maximum offsite chemical concentration using an emission rate of 1 g per second in the center of 5 major emitters in TA-I. The maximum 8-hour concentration was 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
$\mu g/m^3$: 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/m³	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/m^3	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 $\mu g/m^3$	TEV g/sec	RESULT
897	123-31-9	Hydroquinone	$6.84x10^{2}$	$9.50x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	7439-92-1	Lead	5.00	$6.94x10^{-7}$	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
897	7647-01-0	Hydrogen chloride	$3.19x10^{3}$	$4.44x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
897	7664-39-3	Hydrogen fluoride	$1.64x10^{3}$	$2.27x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
905	67-56-1	Methanol	$5.12x10^{3}$	$7.11x10^{-4}$	$2.60x10^{3}$	3.07	FALSE
905	75-05-8	Acetonitrile	$1.26x10^{4}$	$1.75x10^{-3}$	$3.40x10^{2}$	$4.01x10^{-1}$	FALSE
905	108-88-3	Toluene	$6.92x10^{2}$	$9.61x10^{-5}$	$1.88x10^{3}$	2.22	FALSE
981	67-56-1	Methanol	$6.06x10^{3}$	$8.41x10^{-4}$	$2.60x10^{3}$	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	$1.89x10^{3}$	$2.63x10^{-4}$	$2.60x10^{3}$	3.07	FALSE
6580	7647-01-0	Hydrogen chloride	$2.19x10^{3}$	$3.04x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
858	67-56-1	Methanol	$1.47x10^{5}$	$2.04x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
858	78-93-3	Methyl ethyl ketone (2-butanone)	$1.41x10^{3}$	$1.96x10^{-4}$	$5.90x10^{3}$	6.97	FALSE
858	110-54-3	n-Hexane	$2.45x10^{3}$	$3.40x10^{-4}$	$1.76x10^{3}$	2.08	FALSE
858	7647-01-0	Hydrogen chloride	$1.15x10^{5}$	$1.6x10^{-2}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
858	7664-39-3	Hydrogen fluoride	$9.92x10^{4}$	$1.38x10^{-2}$	$2.00x10^{1}$	$2.36x10^{-2}$	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	$8.77x10^{4}$	$1.22x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
878	68-12-2	N,N-Dimethylformamide	$4.90x10^{1}$	$6.81x10^{-6}$	$3.00x10^{2}$	$3.54x10^{-1}$	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/m³	TEV g/sec	RESULT
878	7647-01-0	Hydrogen chloride	$5.43x10^{3}$	$7.54x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
878	7664-39-3	Hydrogen fluoride	$1.26x10^{4}$	$1.76x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	7782-49-2	Selenium hexafluoride as selenium	$6.80x10^{1}$	$9.45x10^{-6}$	1.60	$1.89x10^{-3}$	FALSE
878	7784-42-1	Arsine	$5.49x10^{3}$	$7.62x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
878	7803-51-2	Phosphine	$5.49x10^{3}$	$7.62x10^{-4}$	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
897	123-31-9	Hydroquinone	$6.84x10^{2}$	$9.50x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	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	1.89×10^{3}	2.63×10^{-4}	2.60×10^{3}	3.07	FALSE
6580	7647-01-0	Hydrogen chloride	6.57×10^{3}	9.12×10^{-4}	7.00×10^{1}	8.26×10^{-2}	FALSE
858	67-56-1	Methanol	1.57×10^{5}	2.18×10^{-2}	2.60×10^{3}	3.07	FALSE
858	78-93-3	Methyl ethyl ketone (2-butanone)	1.51×10^{3}	2.10×10^{-4}	5.90×10^{3}	6.97	FALSE
858	110-54-3	n-Hexane	2.62×10^{3}	3.65×10^{-4}	1.76×10^{3}	2.08	FALSE
858	7647-01-0	Hydrogen chloride	1.23×10^{5}	1.71×10^{-2}	7.00×10^{1}	8.26×10^{-2}	FALSE
858	7664-39-3	Hydrogen fluoride	1.06×10^{5}	1.48×10^{-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	1.17×10^{5}	1.62×10^{-2}	2.60×10^{3}	3.07	FALSE
878	68-12-2	N,N-Dimethylformamide	6.54×10^{1}	9.08×10^{-6}	3.00×10^{2}	3.54×10^{-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/m^{3}	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	$7.23x10^{3}$	$1.00x10^{-3}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
878	7664-39-3	Hydrogen fluoride	$1.69x10^{4}$	$2.34x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	7782-49-2	Selenium hexafluoride as selenium	$9.07x10^{1}$	$1.26x10^{-5}$	1.60	$1.89x10^{-3}$	FALSE
878	7784-42-1	Arsine	$7.32x10^{3}$	$1.02x10^{-3}$	1.60	$1.89x10^{-3}$	FALSE
878	7803-51-2	Phosphine	$7.32x10^{3}$	$1.02x10^{-3}$	1.40	$1.65x10^{-3}$	FALSE
893	67-56-1	Methanol[a]	$2.28x10^{5}$	$3.17x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
893	107-21-1	Ethylene glycol[a]	$9.80x10^{4}$	$1.36x10^{-2}$	$2.60x10^{2}$	$3.07x10^{-1}$	FALSE
893	108-88-3	Toluene[a]	$1.96x10^{4}$	$2.72x10^{-3}$	$1.88x10^{3}$	2.22	FALSE
893	7647-01-0	Hydrogen chloride[a]	$4.98x10^{4}$	$6.91x10^{-3}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
893	7664-39-3	Hydrogen fluoride[a]	$6.58x10^{4}$	$9.14x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
MESA	84-74-2	Dibutyl_phthalate[b]	$9.48x10^{3}$	$1.32x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
MESA	107-06-2	Ethylene dichloride[b]	$6.27x10^{2}$	$8.71 x10^{-5}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
MESA	107-21-1	Ethylene glycol[b]	$6.03x10^{4}$	$8.37x10^{-3}$	$2.60x10^{2}$	$3.07x10^{-1}$	FALSE
MESA	7647-01-0	Hydrogen chloride[b]	$3.75x10^{4}$	$5.21x10^{-3}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
MESA	7664-39-4	Hydrogen fluoride[b]	$8.48x10^{3}$	$1.18x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
MESA	67-56-1	Methanol[b]	$2.72x10^{5}$	$3.78x10^{-2}$	$2.60x10^{3}$	3.07	FALSE
MESA	110-54-3	N-Hexane[b]	$1.45x10^{3}$	$2.02x10^{-4}$	$1.76x10^{3}$	2.08	FALSE
MESA	7803-51-2	Phosphine[b]	$5.12x10^{4}$	$7.11x10^{-3}$	1.40	$1\ 65x10^{-3}$	TRUE
MESA	108-88-3	Toluene[b]	$6.96x10^{3}$	$9.67x10^{-4}$	$1.88x10^{3}$	2.22	FALSE
MESA	1330-20-7	Xylene[b]	$2.00x10^{2}$	$2.78x10^{-5}$	$4.34x10^{3}$	5.12	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

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/m^{3}	TEV g/sec	RESULT
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
897	123-31-9	Hydroquinone	$6.84x10^{2}$	$9.50x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
897	7439-92-1	Lead	5.00	$6.94x10^{-7}$	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
897	7647-01-0	Hydrogen chloride	$3.19x10^{3}$	$4.44x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
897	7664-39-3	Hydrogen fluoride	$1.64x10^{3}$	$2.27x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
905	67-56-1	Methanol	$1.02x10^{4}$	$1.42x10^{-3}$	$2.60x10^{3}$	3.07	FALSE
905	75-05-8	Acetonitrile	$2.52x10^{4}$	$3.49x10^{-3}$	$3.40x10^{2}$	$4.01x10^{-1}$	FALSE
905	108-88-3	Toluene	$1.38x10^{3}$	$1.92x10^{-4}$	$1.88x10^{3}$	2.22	FALSE
981	67-56-1	Methanol	$4.66x10^{4}$	$6.48x10^{-3}$	$2.60x10^{3}$	3.07	FALSE

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[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/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	$5.62x10^{4}$	$7.80x10^{-3}$	$2.60x10^{3}$	3.07	FALSE
858	78-93-3	Methyl ethyl ketone (2-butanone)	$5.39x10^{2}$	$7.49x10^{-5}$	$5.90x10^{3}$	6.97	FALSE
858	110-54-3	n-Hexane	$9.38x10^{2}$	$1.30x10^{-4}$	$1.76x10^{3}$	2.08	FALSE
858	7647-01-0	Hydrogen chloride	$4.41x10^{4}$	$6.12x10^{-3}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
858	7664-39-3	Hydrogen fluoride	$3.80x10^{4}$	$5.27x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	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	$6.84x10^{4}$	$9.50x10^{-3}$	$8.20x10^{2}$	$9.68x10^{-1}$	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	$7.98x10^{5}$	$1.11x10^{-1}$	$1.50x10^{-1}$	$1.77x10^{-4}$	FALSE
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.1–7. 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/m^3	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/m^3	TEV g/sec	RESULT
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	$2.35x10^{2}$	$3.26x10^{-5}$	$7.60x10^{1}$	$8.97x10^{-2}$	FALSE
897	67-56-1	Methanol	$2.91x10^{4}$	$4.04x10^{-3}$	$2.60x10^{3}$	3.07	FALSE
897	71-55-6	1,1,1-Trichloroethane (methyl chloroform)	$1.11x10^{4}$	$1.54x10^{-3}$	$1.08x10^{4}$	$1.28x10^{1}$	FALSE
897	74-88-4	Methyl iodide	$4.60x10^{2}$	$6.39x10^{-5}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
897	75-05-8	Acetonitrile	$6.07x10^{3}$	$8.44x10^{-4}$	$3.40x10^{2}$	$4.01x10^{-1}$	FALSE
897	106-42-3	p-Xylene	$6.31x10^{3}$	$8.76x10^{-4}$	$4.34x10^{3}$	5.12	FALSE
897	107-21-1	Ethylene glycol	$4.05x10^{3}$	$5.62x10^{-4}$	$2.60x10^{2}$	$3.07x10^{-1}$	FALSE
897	108-10-1	Methyl isobutyl ketone (hexone)	$1.05x10^{1}$	$1.46x10^{-6}$	$8.20x10^{2}$	$9.68x10^{-1}$	FALSE
897	108-88-3	Toluene	$3.02x10^{3}$	$4.19x10^{-4}$	$1.88x10^{3}$	2.22	FALSE
897	108-95-2	Phenol	$9.20x10^{1}$	$1.28x10^{-5}$	$1.90x10^{2}$	$2.24x10^{-1}$	FALSE
897	110-54-3	n-Hexane	$1.30x10^{4}$	$1.80x10^{-3}$	$1.76x10^{3}$	2.08	FALSE
897	123-31-9	Hydroquinone	$6.29x10^{2}$	$8.74x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	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 $\mu g/m^3$	TEV g/sec	RESULT
897	7439-92-1	Lead	4.60	$6.39x10^{-7}$	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
897	7647-01-0	Hydrogen chloride	$2.94x10^{3}$	$4.08x10^{-4}$	$7.00x10^{1}$	$8.26x10^{-2}$	FALSE
897	7664-39-3	Hydrogen fluoride	$1.51x10^{3}$	$2.09x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
905	67-56-1	Methanol	$1.02x10^{3}$	$1.42x10^{-4}$	$2.60x10^{3}$	3.07	FALSE
905	75-05-8	Acetonitrile	$2.52x10^{3}$	$3.49x10^{-4}$	$3.40x10^{2}$	$4.01x10^{-1}$	FALSE
905	108-88-3	Toluene	$1.38x10^{2}$	$1.92x10^{-5}$	$1.88x10^{3}$	2.22	FALSE
981	67-56-1	Methanol	$4.24x10^{3}$	$5.89x10^{-4}$	$2.60x10^{3}$	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 $\mu g/m^3$	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	7.85×10^{4}	1.09×10^{-2}	4.90×10^{3}	5.79	FALSE
870	7429-90-5	Aluminum	2.00×10^{5}	2.77×10^{-2}	50	5.90×10^{-2}	FALSE
870	1344-28-1	Aluminum Oxide	9.98×10^{4}	1.39×10^{-2}	5.00×10^{1}	5.90×10^{-2}	FALSE
870	1336-21-6	Ammonium Hydroxide	4.54×10^{3}	6.30×10^{-4}	No OEL		
870	1113-50-1	Boric Acid	3.99×10^{4}	5.54×10^{-3}	No OEL		
870		Brulin Cleaner	0	0	0	0	FALSE
870	11-15-9	Cellosolve Acetate	1.81×10^{3}	2.52×10^{-4}	No OEL		
870		Cerric Ammonium Nitrate	5.99×10^{5}	8.32×10^{-2}	No OEL		
870		Citridet Cleaner	3.82×10^{5}	5.31×10^{-2}	1.21×10^{3}	1.43	FALSE
870	7440-50-8	Copper	2.00×10^{5}	2.77×10^{-2}	1.00	1.18×10^{-3}	TRUE
870	7440-50-8	Copper (0.10%)	1.81×10^{1}	2.52×10^{-6}	1.00	1.18×10^{-3}	FALSE
870		Carboxyl terminated acrylonitrile butadiene Epoxy Resin	9.98×10^{4}	1.39×10^{-2}	No OEL		
870		Curing Agent Z (37% methylene dianiline)	1.51×10^{5}	2.09×10^{-2}	No OEL		
870		2,6-diethylaniline curing agent	1.20×10^{5}	1.66×10^{-2}	No OEL		
870		Diala oil	1.67×10^{5}	2.32×10^{-2}	No OEL		
870	106-42-3	Di-p Xylene	2.73×10^{5}	3.79×10^{-2}	4.34×10^{3}	5.12	FALSE
870	7440-52-0	Erbium	4.99×10^{3}	6.93×10^{-4}	No OEL		
870		Fluorinert	1.87×10^{6}	2.59×10^{-1}	No OEL		
870		Glass microballoons filler	2.49×10^{4}	3.46×10^{-3}	No OEL		
870		Hexylene glycol	3.33×10^{5}	4.63×10^{-2}	1.21×10^{3}	1.43	FALSE
870	1309-37-1	Iron (53%)	1.04×10^{4}	1.45×10^{-3}	50	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/m^3	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/m^3	TEV g/sec	RESULT
878	1344-28-1	Aluminum oxide (fibrous forms)	$1.67x10^{6}$	$2.31x10^{-1}$	$5.00x10^{1}$	$5.90x10^{-2}$	TRUE
878	12125-02-9	Ammonium chloride	$9.99x10^{4}$	$1.39x10^{-2}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
878	1303-96-4	Borates, tetra, sodium salts (anhydrous)	$1.00x10^{4}$	$1.39x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	111-76-2	Butyl cellosolve (R)	$5.97x10^{3}$	$8.29x10^{-4}$	$2.40x10^{2}$	$2.83x10^{-1}$	FALSE
878	1305-62-0	Calcium hydroxide	$1.12x10^{4}$	$1.56x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	76-22-2	Camphor	$7.44x10^{1}$	$1.03x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	1333-86-4	Carbon black	$4.46x10^{2}$	$6.19x10^{-5}$	$3.50x10^{1}$	$4.13x10^{-2}$	FALSE
878	2921-88-2	Chlorpyrifos	2.27	$3.15x10^{-7}$	2.00	$2.36x10^{-3}$	FALSE
878	7440-50-8	Copper dusts and mists, as copper	$7.60x10^{4}$	$1.06x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	110-82-7	Cyclohexane	$3.40x10^{2}$	$4.73x10^{-5}$	$7.00x10^{3}$	8.26	FALSE
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	111-40-0	Diethylene triamine	$2.07x10^{3}$	$2.87x10^{-4}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
878	109-87-5	Dimethyoxymethane (methylal)	3.40	$4.72x10^{-7}$	$3.10x10^{4}$	$3.66x10^{1}$	FALSE
878	141-43-5	Ethanolamine	$1.53x10^{2}$	$2.12x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	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	64-18-6	Formic acid	$5.68x10^{3}$	$7.89x10^{-4}$	$9.00x10^{1}$	$1.06x10^{-1}$	FALSE
878	7722-84-1	Hydrogen peroxide (concentration > 52%)	$2.94x10^{4}$	$4.08x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
878	7783-06-4	Hydrogen sulfide	$3.66x10^{3}$	$5.08x10^{-4}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
878	61788-32-7	Hydrogenated terphenyls	$3.18x10^{3}$	$4.42x10^{-4}$	$4.90x10^{1}$	$5.79x10^{-2}$	FALSE
878	7440-74-6	Indium & compounds as indium	$8.80x10^{3}$	$1.22x10^{-3}$	1.00	$1.18x10^{-3}$	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	$7.00x10^{2}$	$9.72x10^{-5}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1309-37-1	Iron oxide fume (Fe_2O_3) as iron	$1.03x10^{4}$	$1.43x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7439-89-6	Iron salts, soluble, as iron	$8.03x10^{3}$	$1.12x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	26952-21-6	Isoacytl alcohol	6.80	$9.45x10^{-7}$	$2.66x10^{3}$	3.14	FALSE
878	110-19-0	Isobutyl acetate	$5.10x10^{1}$	$7.08x10^{-6}$	$7.00x10^{3}$	8.26	FALSE
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

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	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
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

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	1314-13-2	Zinc oxide	1.14×10^{2}	1.58×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
893	67-64-1	Acetone	4.68×10^{5}	6.50×10^{-2}	5.90×10^{3}	6.97	FALSE
893	7726-95-6	Bromine	1.55×10^{2}	2.16×10^{-5}	6.60	7.79×10^{-3}	FALSE
893	7722-84-1	Hydrogen peroxide (Conc.> 52%)	1.30×10^{4}	1.80×10^{-3}	1.40×10^{1}	1.65×10^{-2}	FALSE
893	67-63-0	Isopropyl alcohol	1.77×10^{5}	2.46×10^{-2}	4.90×10^{3}	5.79	FALSE
893	7697-37-2	Nitric acid	1.36×10^{4}	1.89×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
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	4.95×10^{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
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	7722-84-1	Hydrogen peroxide (concentration > 52%)	2.36×10^{3}	3.28×10^{-4}	1.40×10^{1}	1.65×10^{-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
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	681-84-5	Methyl silicate	2.24×10^{2}	3.12×10^{-5}	6.00×10^{1}	7.08×10^{-2}	FALSE
897	71-36-3	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	7697-37-2	Nitric acid	1.60×10^{1}	2.22×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE
897	144-62-7	Oxalic acid	3.92×10^{3}	5.44×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
897	109-66-0	Pentane	1.91×10^{3}	2.66×10^{-4}	3.50×10^{3}	4.13	FALSE
897	9003-53-6	Phenlylethylene (Styrene, monomer)	8.00×10^{-1}	1.11×10^{-7}	8.50×10^{2}	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-Trinitrophenol)	9.95	1.38×10^{-6}	1.00	1.18×10^{-3}	FALSE
897	1310-58-3	Potassium hydroxide	9.30×10^{3}	1.29×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	71-23-8	Propyl alcohol	2.98×10^{4}	4.14×10^{-3}	4.92×10^{3}	5.81	FALSE
897	7440-22-4	Silver Metal	1.68×10^{1}	2.33×10^{-6}	1.00×10^{-1}	1.18×10^{-4}	FALSE
897	1310-73-2	Sodium hydroxide	5.00×10^{2}	6.94×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	7664-93-9	Sulfuric acid	7.75×10^{3}	1.08×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
897	109-99-9	Tetrahydrofuran	1.17×10^{4}	1.62×10^{-3}	1.50×10^{3}	1.77	FALSE
897	7719-09-7	Thionyl chloride	4.89×10^{3}	6.80×10^{-4}	4.90×10^{1}	5.79×10^{-2}	FALSE
897	76-03-9	Trichloroacetic acid	5.00×10^{2}	6.94×10^{-5}	6.70×10^{1}	7.91×10^{-2}	FALSE
905	67-64-1	Acetone	1.40×10^{4}	1.95×10^{-3}	5.90×10^{3}	6.97	FALSE
905	67-63-0	Isopropyl alcohol	1.24×10^{4}	1.72×10^{-3}	4.90×10^{3}	5.79	FALSE
905	1309-48-4	Magnesium oxide	8.00×10^{2}	1.11×10^{-4}	6.00×10^{1}	7.08×10^{-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	$1.03x10^{2}$	$1.43x10^{-5}$	$3.00x10^{2}$	$3.54x10^{-1}$	FALSE
605	7664-93-9	Sulfuric acid	$8.25x10^{1}$	$1.15x10^{-5}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
6580	141-78-6	Ethyl acetate	$7.20x10^{3}$	$1.00x10^{-3}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
6580	7722-84-1	Hydrogen peroxide (concentration> 52%)	$4.99x10^{2}$	$6.94x10^{-5}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
6580	7697-37-2	Nitric acid	$1.57x10^{4}$	$2.19x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
6580	1310-73-2	Sodium hydroxide	$1.13x10^{4}$	$1.57x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
6580	7664-93-9	Sulfuric acid	$9.20x10^{3}$	$1.28x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
6920	7697-37-2	Nitric acid	$1.87x10^{2}$	$2.60x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
6920	1310-73-2	Sodium hydroxide	$4.54x10^{2}$	$6.30x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
6920	7440-66-6	Zinc	$1.00x10^{3}$	$1.39x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
858	64-19-7	Acetic acid	$5.64x10^{4}$	$7.83x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
858	67-64-1	Acetone	$3.04x10^{4}$	$4.22x10^{-3}$	$5.90x10^{3}$	6.97	FALSE
858	7722-84-1	Hydrogen peroxide (concentration> 52%)	$3.10x10^{6}$	$4.31x10^{-1}$	$1.40x10^{1}$	$1.65x10^{-2}$	TRUE
858	7697-37-2	Nitric acid	$3.99x10^{6}$	$5.54x10^{-1}$	$5.00x10^{1}$	$5.90x10^{-2}$	TRUE
858	7664-38-2	Phosphoric acid	$7.59x10^{4}$	$1.05x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
858	7803-62-5	Silane (silicon tetrahydride)	$1.78x10^{5}$	$2.47x10^{-2}$	$6.60x10^{1}$	$7.79x10^{-2}$	FALSE
858	1310-73-2	Sodium hydroxide	$6.12x10^{7}$	8.50	$2.00x10^{1}$	$2.36x10^{-2}$	TRUE
858	7664-93-9	Sulfuric acid	$5.78x10^{4}$	$8.02x10^{3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
870	64-19-7	Acetic Acid	$1.05x10^{5}$	$1.45x10^{-2}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
870	64-19-7	Acetic Acid, Glacial	$1.15x10^{5}$	$1.60x10^{-2}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
870	67-64-1	Acetone	$6.46x10^{6}$	$8.97x10^{-1}$	$5.90x10^{3}$	6.97	FALSE
870	71-36-3	Alcohol, Butyl	$1.21x10^{4}$	$1.69x10^{-3}$	$3.00x10^{3}$	3.54	FALSE
870	67-63-0	Alcohol, Isopropyl	$2.61x10^{5}$	$3.63x10^{-2}$	$4.90x10^{3}$	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/m^3	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	$9.07x10^{5}$	$1.26x10^{-1}$	$4.34x10^{3}$	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.1–9. 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
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/m^3	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/m³	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	2.10×10^{4}	2.92×10^{-3}	1.00×10^{-1}	1.18×10^{-4}	TRUE
878	7631-90-5	Sodium bisulfite	7.50×10^{2}	1.04×10^{-4}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	1310-73-2	Sodium hydroxide	7.31×10^{2}	1.01×10^{-4}	2.00×10^{1}	2.36×10^{-2}	FALSE
878	8052-41-3	Stoddard solvent	3.41×10^{2}	4.73×10^{-5}	3.50×10^{3}	4.13	FALSE
878	7664-93-9	Sulfuric acid	3.27×10^{2}	4.54×10^{-5}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	75-65-0	t-Butyl alcohol	5.10	7.09×10^{-7}	3.00×10^{3}	3.54	FALSE
878	7440-25-7	Tantalum	1.56×10^{3}	2.17×10^{-4}	5.00×10^{1}	5.90×10^{-2}	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	7722-88-5	Tetrasodium pyrophosphate	2.25	3.12×10^{-7}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7440-31-5	Tin metal	2.06×10^{4}	2.86×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
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	7440-33-7	Tungsten as Wolfram insoluble compounds	4.11×10^{4}	5.71×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	7440-62-2	Vanadium (fume or dust)	3.27×10^{4}	4.54×10^{-3}	5.00×10^{-1}	5.90×10^{-4}	TRUE
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
878	7440-66-6	Zinc	1.45×10^{1}	2.01×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	1314-13-2	Zinc oxide	1.71×10^{2}	2.37×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
893	67-64-1	Acetone	4.68×10^{5}	6.50×10^{-2}	5.90×10^{3}	6.97	FALSE
893	7726-95-6	Bromine	1.55×10^{2}	2.16×10^{-5}	6.60	7.79×10^{-3}	FALSE
893	7722-84-1	Hydrogen peroxide (concentration> 52%)	1.30×10^{4}	1.80×10^{-3}	1.40×10^{1}	1.65×10^{-2}	FALSE
893	67-63-0	Isopropyl alcohol	1.77×10^{5}	2.46×10^{-2}	4.90×10^{3}	5.79	FALSE
893	7697-37-2	Nitric acid	1.36×10^{4}	1.89×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
893	1310-58-3	Potassium hydroxide	2.04×10^{3}	2.84×10^{-4}	2.00×10^{1}	2.36×10^{-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/m^3	TEV g/sec	RESULT
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	4.95×10^{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
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	7722-84-1	Hydrogen peroxide (concentration> 52%)	2.36×10^{3}	3.28×10^{-4}	1.40×10^{1}	1.65×10^{-2}	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	681-84-5	Methyl silicate	2.24×10^{2}	3.12×10^{-5}	6.00×10^{1}	7.08×10^{-2}	FALSE
897	71-36-3	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	7697-37-2	Nitric acid	1.60×10^{1}	2.22×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE
897	144-62-7	Oxalic acid	3.92×10^{3}	5.44×10^{-4}	1.00×10^{1}	1.18×10^{-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/m^3	TEV g/sec	RESULT
897	109-66-0	Pentane	1.91×10^{3}	2.66×10^{-4}	3.50×10^{3}	4.13	FALSE
897	9003-53-6	Phenlylethylene (styrene, monomer)	8.00×10^{-1}	1.11×10^{-7}	8.50×10^{2}	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-trinitrophenol)	9.95	1.38×10^{-6}	1.00	1.18×10^{-3}	FALSE
897	1310-58-3	Potassium hydroxide	9.30×10^{3}	1.29×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	71-23-8	Propyl alcohol	2.98×10^{4}	4.14×10^{-3}	4.92×10^{3}	5.81	FALSE
897	7440-22-4	Silver metal	1.68×10^{1}	2.33×10^{-6}	1.00×10^{-1}	1.18×10^{-4}	FALSE
897	1310-73-2	Sodium hydroxide	5.00×10^{2}	6.94×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	7664-93-9	Sulfuric acid	7.75×10^{3}	1.08×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
897	109-99-9	Tetrahydrofuran	1.17×10^{4}	1.62×10^{-3}	1.50×10^{3}	1.77	FALSE
897	7719-09-7	Thionyl chloride	4.89×10^{3}	6.80×10^{-4}	4.90×10^{1}	5.79×10^{-2}	FALSE
897	76-03-9	Trichloroacetic acid	5.00×10^{2}	6.94×10^{-5}	6.70×10^{1}	7.91×10^{-2}	FALSE
905	67-64-1	Acetone	2.81×10^{4}	3.90×10^{-3}	5.90×10^{3}	6.97	FALSE
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	7.85×10^{2}	1.09×10^{-4}	4.90×10^{3}	5.79	FALSE
981	67-64-1	Acetone	8.97×10^{3}	1.25×10^{-3}	5.90×10^{3}	6.97	FALSE
981	7664-93-9	Sulfuric acid	1.41×10^{5}	1.95×10^{-2}	1.00×10^{1}	1.18×10^{-2}	TRUE
986	67-64-1	Acetone	1.50×10^{4}	2.08×10^{-3}	5.90×10^{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/m^3	TEV g/sec	RESULT
605	79-09-4	Propionic acid	$2.06x10^{2}$	$2.87x10^{-5}$	$3.00x10^{2}$	$3.54x10^{-1}$	FALSE
605	7664-93-9	Sulfuric acid	$1.65x10^{2}$	$2.29x10^{-5}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
6580	141-78-6	Ethyl acetate	$5.40x10^{3}$	$7.50x10^{-4}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
6580	7722-84-1	Hydrogen peroxide (concentration> 52%)	$1.33x10^{3}$	$1.85x10^{-4}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
6580	7697-37-2	Nitric acid	$4.20x10^{4}$	$5.83x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
6580	1310-73-2	Sodium hydroxide	$1.50x10^{4}$	$2.09x10^{-3}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
6580	7664-93-9	Sulfuric acid	$2.76x10^{4}$	$3.83x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
6920	7697-37-2	Nitric acid	$3.75x10^{2}$	$5.21x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
6920	1310-73-2	Sodium hydroxide	$9.07x10^{2}$	$1.26x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
6920	7440-66-6	Zinc	$2.00x10^{3}$	$2.78x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
858	64-19-7	Acetic acid	$6.04x10^{4}$	$8.39x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
858	67-64-1	Acetone	$3.26x10^{4}$	$4.53x10^{-3}$	$5.90x10^{3}$	6.97	FALSE
858	7722-84-1	Hydrogen peroxide (concentration> 52%)	$3.33x10^{6}$	$4.62x10^{-1}$	$1.40x10^{1}$	$1.65x10^{-2}$	TRUE
858	7697-37-2	Nitric acid	$4.27x10^{6}$	$5.93x10^{-1}$	$5.00x10^{1}$	$5.90x10^{-2}$	TRUE
858	7664-38-2	Phosphoric acid	$8.13x10^{4}$	$1.13x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
858	7803-62-5	Silane (silicon tetrahydride)	$1.90x10^{5}$	$2.65x10^{-2}$	$6.60x10^{1}$	$7.79x10^{-2}$	FALSE
858	1310-73-2	Sodium hydroxide	$6.56x10^{7}$	9.11	$2.00x10^{1}$	$2.36x10^{-2}$	TRUE
858	7664-93-9	Sulfuric acid	$6.19x10^{4}$	$8.60x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
870	64-19-7	Acetic Acid	$1.05x10^{5}$	$1.45x10^{-2}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
870	64-19-7	Acetic Acid, Glacial	$1.15x10^{5}$	$1.60x10^{-2}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
870	67-64-1	Acetone	$6.46x10^{6}$	$8.97x10^{-1}$	$5.90x10^{3}$	6.97	FALSE
870	71-36-3	Alcohol, Butyl	$1.21x10^{4}$	$1.69x10^{-3}$	$3.00x10^{3}$	3.54	FALSE
870	67-63-0	Alcohol, Isopropyl	$2.61x10^{5}$	$3.63x10^{-2}$	$4.90x10^{3}$	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	6.66×10^{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	2.48×10^{2}	3.45×10^{-5}	1.80×10^{1}	2.13×10^{-2}	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	109-86-4	2-Methoxyethanol	1.75×10^{2}	2.43×10^{-5}	3.00	3.54×10^{-3}	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	67-64-1	Acetone	7.83×10^{5}	1.09×10^{-1}	5.90×10^{3}	6.97	FALSE
878	7429-90-5	Aluminum (fume or dust)	2.14×10^{4}	2.97×10^{-3}	5.00×10^{1}	5.90×10^{-2}	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	3.33×10^{6}	4.63×10^{-1}	5.00×10^{1}	5.90×10^{-2}	TRUE
878	12125-02-9	Ammonium chloride	2.00×10^{5}	2.78×10^{-2}	1.00×10^{2}	1.18×10^{-1}	FALSE
878	1303-96-4	Borates, tetra, sodium salts (anhydrous)	2.00×10^{4}	2.78×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
878	111-76-2	Butyl cellosolve (R)	1.19×10^{4}	1.66×10^{-3}	2.40×10^{2}	2.83×10^{-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
878	1305-62-0	Calcium hydroxide	$2.24x10^{4}$	$3.12x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	76-22-2	Camphor	$1.49x10^{2}$	$2.07x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	1333-86-4	Carbon black	$8.91x10^{2}$	$1.24x10^{-4}$	$3.50x10^{1}$	$4.13x10^{-2}$	FALSE
878	2921-88-2	Chlorpyrifos	4.54	$6.30x10^{-7}$	2.00	$2.36x10^{-3}$	FALSE
878	7440-50-8	Copper dusts and mists, as copper	$1.52x10^{5}$	$2.11x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	TRUE
878	110-82-7	Cyclohexane	$6.81x10^{2}$	$9.46x10^{-5}$	$7.00x10^{3}$	8.26	FALSE
878	108-93-0	Cyclohexanol	$1.60x10^{1}$	$2.22x10^{-6}$	$2.00x10^{3}$	2.36	FALSE
878	108-91-8	Cyclohexylamine	$3.65x10^{4}$	$5.07x10^{-3}$	$4.00x10^{2}$	$4.72x10^{-1}$	FALSE
878	111-40-0	Diethylene triamine	$4.13x10^{3}$	$5.74x10^{-4}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
878	109-87-5	Dimethyoxymethane (methylal)	6.80	$9.45x10^{-7}$	$3.10x10^{4}$	$3.66x10^{1}$	FALSE
878	141-43-5	Ethanolamine	$3.05x10^{2}$	$4.24x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	141-78-6	Ethyl acetate	$9.75x10^{2}$	$1.35x10^{-4}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
878	78-10-4	Ethyl silicate	$9.57x10^{2}$	$1.33x10^{-4}$	$8.50x10^{2}$	1.00	FALSE
878	64-18-6	Formic acid	$1.14x10^{4}$	$1.58x10^{-3}$	$9.00x10^{1}$	$1.06x10^{-1}$	FALSE
878	7722-84-1	Hydrogen peroxide (concentration> 52%)	$5.88x10^{4}$	$8.16x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
878	7783-06-4	Hydrogen sulfide	$7.32x10^{3}$	$1.02x10^{-3}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
878	61788-32-7	Hydrogenated terphenyls	$6.36x10^{3}$	$8.83x10^{-4}$	$4.90x10^{1}$	$5.79x10^{-2}$	FALSE
878	7440-74-6	Indium & compounds as indium	$1.76x10^{4}$	$2.44x10^{-3}$	1.00	$1.18x10^{-3}$	TRUE
878	7553-56-2	Iodine	$1.40x10^{3}$	$1.94x10^{-4}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1309-37-1	Iron oxide fume (Fe_2O_3) as iron	$2.05x10^{4}$	$2.85x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7439-89-6	Iron salts, soluble, as iron	$1.61x10^{4}$	$2.23x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	26952-21-6	Isoacytl alcohol	$1.36x10^{1}$	$1.89x10^{-6}$	$2.66x10^{3}$	3.14	FALSE
878	110-19-0	Isobutyl acetate	$1.02x10^{2}$	$1.42x10^{-5}$	$7.00x10^{3}$	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	$2.78x10^{-7}$	$4.50x10^{-1}$	$5.31x10^{-4}$	FALSE
878	67-63-0	Isopropyl alcohol	$4.42x10^{5}$	$6.14x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
878	1309-48-4	Magnesium oxide	$2.35x10^{3}$	$3.27x10^{-4}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE
878	5124-30-1	Methylene bis(4-cyclohexylisocyanate)	$3.32x10^{2}$	$4.61x10^{-5}$	$5.40x10^{-1}$	$6.38x10^{-4}$	FALSE
878	7439-98-7	Molybdenum as molybdenum (insoluble compounds)	$3.15x10^{4}$	$4.37x10^{-3}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
878	628-63-7	n-Amyl acetate	$8.76x10^{2}$	$1.22x10^{-4}$	$2.60x10^{3}$	3.07	FALSE
878	123-86-4	n-Butyl acetate	$2.73x10^{3}$	$3.79x10^{-4}$	$7.10x10^{3}$	8.38	FALSE
878	71-36-3	n-Butyl alcohol	$1.35x10^{4}$	$1.87x10^{-3}$	$3.00x10^{3}$	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	$5.44x10^{2}$	$7.56x10^{-5}$	$1.33x10^{3}$	1.57	FALSE
878	142-82-5	n-Heptane	$1.21x10^{3}$	$1.67x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
878	7697-37-2	Nitric acid	$1.27x10^{5}$	$1.76x10^{-2}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	109-66-0	Pentane	$6.49x10^{2}$	$9.02x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	8002-05-9	Petroleum	$9.07x10^{2}$	$1.26x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	$2.10x10^{2}$	$2.92x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	7664-38-2	Phosphoric acid	$1.34x10^{4}$	$1.86x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	7440-06-4	Platinum metal	$2.03x10^{4}$	$2.83x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1310-58-3	Potassium hydroxide	$5.80x10^{3}$	$8.06x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	71-23-8	Propyl alcohol	$8.11x10^{3}$	$1.13x10^{-3}$	$4.92x10^{3}$	5.81	FALSE
878	8003-34-7	Pyrethrins	$4.72x10^{-1}$	$6.55x10^{-8}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	110-86-1	Pyridine	$3.87x10^{2}$	$5.38x10^{-5}$	$1.50x10^{2}$	$1.77x10^{-1}$	FALSE
878	14808-60-7	Quartz	$8.05x10^{3}$	$1.12x10^{-3}$	$5.00x10^{-1}$	$5.90x10^{-4}$	TRUE
878	78-92-2	sec-Butyl alcohol	$2.67x10^{3}$	$3.71x10^{-4}$	$3.00x10^{3}$	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/m^3	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/m^3	TEV g/sec	RESULT
893	1310-58-3	Potassium hydroxide[a]	$4.09x10^{3}$	$5.67x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
893	7664-93-9	Sulfuric acid[a]	$1.41x10^{5}$	$1.96x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	TRUE
893	8032-32-4	Varnish Makers and Painters (VM&P) naphtha[a]	$4.80x10^{3}$	$6.67x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
MESA	107-98-2	1-Methoxy-2-propanol[b]	$1.09x10^{2}$	$1.51x10^{-5}$	$3.75x10^{3}$	4.43	FALSE
MESA	872-50-4	1-Methyl-2-pyrrolidinone[b]	$8.21x10^{3}$	$1.14x10^{-3}$	$8.00x10^{2}$	$9.45x10^{-1}$	FALSE
MESA	111-15-9	2-Ethoxyethyl acetate[b]	$1.91x10^{3}$	$2.65x10^{-4}$	$2.70x10^{1}$	$3.19x10^{-2}$	FALSE
MESA	64-19-7	Acetic acid[b]	$1.06x10^{3}$	$1.47x10^{-4}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
MESA	67-64-1	Acetone[b]	$7.49x10^{5}$	$1.04x10^{-1}$	$5.90x10^{3}$	6.97	FALSE
MESA	21645-51-2	Aluminum hydroxide[b]	$5.00x10^{2}$	$6.95x10^{-5}$	$6.00x10^{1}$	$7.08x10^{-2}$	FALSE
MESA	1344-28-1	Aluminum oxide anhydrous[b]	$4.99x10^{1}$	$6.93x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
MESA	7664-41-7	Ammonia[b]	$4.54x10^{4}$	$6.30x10^{-3}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
MESA	7664-41-7	Ammonia anhydrous[b]	$1.92x10^{6}$	$2.67x10^{-1}$	$1.40x10^{2}$	$1.65x10^{-1}$	TRUE
MESA	7784-42-1	Arsine[b]	$1.34x10^{5}$	$1.86x10^{-2}$	1.60	$1.89x10^{-3}$	TRUE
MESA	7637-07-2	Boron trifluoride[b]	$3.49x10^{1}$	$4.85x10^{-6}$	$3.00x10^{1}$	$3.54x10^{-2}$	FALSE
MESA	7726-95-6	Bromine[b]	$1.53x10^{2}$	$2.13x10^{-5}$	6.60	$7.79x10^{-3}$	FALSE
MESA	110-82-7	Cyclohexane[b]	$9.42x10^{1}$	$1.31x10^{-5}$	$7.00x10^{3}$	8.26	FALSE
MESA	34590-94-8	Dipropylene glycol methyl ether[b]	$1.45x10^{2}$	$2.02x10^{-5}$	$3.00x10^{3}$	3.54	FALSE
MESA	64-17-5	Ethanol[b]	$2.83x10^{3}$	$3.92x10^{-4}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
MESA	78-10-4	Ethyl silicate[b]	$3.72x10^{3}$	$5.17x10^{-4}$	$8.50x10^{2}$	1.00	FALSE
MESA	56-81-5	Glycerin[b]	$6.30x10^{2}$	$8.75x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
MESA	7722-84-1	Hydrogen peroxide[b]	$2.73x10^{4}$	$3.79x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
MESA	67-63-1	Isopropyl alcohol[b]	$3.31x10^{5}$	$4.59x10^{-2}$	$4.90x10^{3}$	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 $\mu g/m^3$	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/m^3	TEV g/sec	RESULT
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	7722-84-1	Hydrogen peroxide (concentration> 52%)	2.36×10^{3}	3.28×10^{-4}	1.40×10^{1}	1.65×10^{-2}	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	681-84-5	Methyl silicate	2.24×10^{2}	3.12×10^{-5}	6.00×10^{1}	7.08×10^{-2}	FALSE
897	71-36-3	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	7697-37-2	Nitric acid	1.60×10^{1}	2.22×10^{-6}	5.00×10^{1}	5.90×10^{-2}	FALSE
897	144-62-7	Oxalic acid	3.92×10^{3}	5.44×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
897	109-66-0	Pentane	1.91×10^{3}	2.66×10^{-4}	3.50×10^{3}	4.13	FALSE
897	9003-53-6	Phenlylethylene (styrene, monomer)	8.00×10^{-1}	1.11×10^{-7}	8.50×10^{2}	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-trinitrophenol)	9.95	1.38×10^{-6}	1.00	1.18×10^{-3}	FALSE
897	1310-58-3	Potassium hydroxide	9.30×10^{3}	1.29×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	71-23-8	Propyl alcohol	2.98×10^{4}	4.14×10^{-3}	4.92×10^{3}	5.81	FALSE
897	7440-22-4	Silver metal	1.68×10^{1}	2.33×10^{-6}	1.00×10^{-1}	1.18×10^{-4}	FALSE
897	1310-73-2	Sodium hydroxide	5.00×10^{2}	6.94×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	7664-93-9	Sulfuric acid	7.75×10^{3}	1.08×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
897	109-99-9	Tetrahydrofuran	1.17×10^{4}	1.62×10^{-3}	1.50×10^{3}	1.77	FALSE
897	7719-09-7	Thionyl chloride	4.89×10^{3}	6.80×10^{-4}	4.90×10^{1}	5.79×10^{-2}	FALSE
897	76-03-9	Trichloroacetic acid	5.00×10^{2}	6.94×10^{-5}	6.70×10^{1}	7.91×10^{-2}	FALSE
905	67-64-1	Acetone	2.81×10^{4}	3.90×10^{-3}	5.90×10^{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 μg/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	$1.03x10^{2}$	$1.43x10^{-5}$	$3.00x10^{2}$	$3.54x10^{-1}$	FALSE
605	7664-93-9	Sulfuric acid	$8.25x10^{1}$	$1.15x10^{-5}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
6580	141-78-6	Ethyl acetate	$9.00x10^{2}$	$1.25x10^{-4}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
6580	7722-84-1	Hydrogen peroxide (concentration> 52%)	$1.66x10^{2}$	$2.31x10^{-5}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
6580	7697-37-2	Nitric acid	$5.25x10^{3}$	$7.29x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
6580	1310-73-2	Sodium hydroxide	$5.65x10^{3}$	$7.85x10^{-4}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
6580	7664-93-9	Sulfuric acid	$2.76x10^{3}$	$3.83x10^{-4}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
6920	7697-37-2	Nitric acid	$1.87x10^{2}$	$2.60x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
6920	1310-73-2	Sodium hydroxide	$4.54x10^{2}$	$6.30x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
6920	7440-66-6	Zinc	$1.00x10^{3}$	$1.39x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
858	64-19-7	Acetic acid	$2.16x10^{4}$	$3.00x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
858	67-64-1	Acetone	$1.16x10^{4}$	$1.62x10^{-3}$	$5.90x10^{3}$	6.97	FALSE
858	7722-84-1	Hydrogen peroxide (concentration> 52%)	$1.19x10^{6}$	$1.65x10^{-1}$	$1.40x10^{1}$	$1.65x10^{-2}$	TRUE
858	7697-37-2	Nitric acid	$1.53x10^{6}$	$2.12x10^{-1}$	$5.00x10^{1}$	$5.90x10^{-2}$	TRUE
858	7664-38-2	Phosphoric acid	$2.91x10^{4}$	$4.04x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
858	7803-62-5	Silane (silicon tetrahydride)	$6.81x10^{4}$	$9.45x10^{-3}$	$6.60x10^{1}$	$7.79x10^{-2}$	FALSE
858	1310-73-2	Sodium hydroxide	$2.34x10^{7}$	3.25	$2.00x10^{1}$	$2.36x10^{-2}$	TRUE
858	7664-93-9	Sulfuric acid	$2.21x10^{4}$	$3.07x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
870	64-19-7	Acetic Acid	$1.05x10^{5}$	$1.45x10^{-2}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
870	64-19-7	Acetic Acid, Glacial	$1.15x10^{5}$	$1.60x10^{-2}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
870	67-64-1	Acetone	$6.46x10^{6}$	$8.97x10^{-1}$	$5.90x10^{3}$	6.97	FALSE
870	71-36-3	Alcohol, Butyl	$1.21x10^{4}$	$1.69x10^{-3}$	$3.00x10^{3}$	3.54	FALSE
870	67-63-0	Alcohol, Isopropyl	$2.61x10^{5}$	$3.63x10^{-2}$	$4.90x10^{3}$	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/m^3	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/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	$1.24x10^{2}$	$1.73x10^{-5}$	$1.80x10^{1}$	$2.13x10^{-2}$	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
878	1344-28-1	Aluminum oxide (fibrous forms)	$1.67x10^{6}$	$2.31x10^{-1}$	$5.00x10^{1}$	$5.90x10^{-2}$	TRUE
878	12125-02-9	Ammonium chloride	$9.99x10^{4}$	$1.39x10^{-2}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
878	1303-96-4	Borates, tetra, sodium salts (anhydrous)	$1.00x10^{4}$	$1.39x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	111-76-2	Butyl cellosolve (R)	$5.97x10^{3}$	$8.29x10^{-4}$	$2.40x10^{2}$	$2.83x10^{-1}$	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 $\mu g/m^3$	TEV g/sec	RESULT
878	1305-62-0	Calcium hydroxide	$1.12x10^{4}$	$1.56x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	76-22-2	Camphor	$7.44x10^{1}$	$1.03x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	1333-86-4	Carbon black	$4.46x10^{2}$	$6.19x10^{-5}$	$3.50x10^{1}$	$4.13x10^{-2}$	FALSE
878	2921-88-2	Chlorpyrifos	2.27	$3.15x10^{-7}$	2.00	$2.36x10^{-3}$	FALSE
878	7440-50-8	Copper dusts and mists, as copper	$7.60x10^{4}$	$1.06x10^{-2}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	110-82-7	Cyclohexane	$3.40x10^{2}$	$4.73x10^{-5}$	$7.00x10^{3}$	8.26	FALSE
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	111-40-0	Diethylene triamine	$2.07x10^{3}$	$2.87x10^{-4}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
878	109-87-5	Dimethyoxymethane (methylal)	3.40	$4.72x10^{-7}$	$3.10x10^{4}$	$3.66x10^{1}$	FALSE
878	141-43-5	Ethanolamine	$1.53x10^{2}$	$2.12x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	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	64-18-6	Formic acid	$5.68x10^{3}$	$7.89x10^{-4}$	$9.00x10^{1}$	$1.06x10^{-1}$	FALSE
878	7722-84-1	Hydrogen peroxide (concentration> 52%)	$2.94x10^{4}$	$4.08x10^{-3}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
878	7783-06-4	Hydrogen sulfide	$3.66x10^{3}$	$5.08x10^{-4}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
878	61788-32-7	Hydrogenated terphenyls	$3.18x10^{3}$	$4.42x10^{-4}$	$4.90x10^{1}$	$5.79x10^{-2}$	FALSE
878	7440-74-6	Indium & compounds as indium	$8.80x10^{3}$	$1.22x10^{-3}$	1.00	$1.18x10^{-3}$	TRUE
878	7553-56-2	Iodine	$7.00x10^{2}$	$9.72x10^{-5}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1309-37-1	Iron oxide fume (Fe_2O_3) as iron	$1.03x10^{4}$	$1.43x10^{-3}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
878	7439-89-6	Iron salts, soluble, as iron	$8.03x10^{3}$	$1.12x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	26952-21-6	Isoacytl alcohol	6.80	$9.45x10^{-7}$	$2.66x10^{3}$	3.14	FALSE
878	110-19-0	Isobutyl acetate	$5.10x10^{1}$	$7.08x10^{-6}$	$7.00x10^{3}$	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/m^3	TEV g/sec	RESULT
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
878	1314-13-2	Zinc oxide	1.14×10^{2}	1.58×10^{-5}	5.00×10^{1}	5.90×10^{-2}	FALSE
893	67-64-1	Acetone	4.68×10^{5}	6.50×10^{-2}	5.90×10^{3}	6.97	FALSE
893	7726-95-6	Bromine	1.55×10^{2}	2.16×10^{-5}	6.60	7.79×10^{-3}	FALSE
893	7722-84-1	Hydrogen peroxide (concentration> 52%)	1.30×10^{4}	1.80×10^{-3}	1.40×10^{1}	1.65×10^{-2}	FALSE
893	67-63-0	Isopropyl alcohol	1.77×10^{5}	2.46×10^{-2}	4.90×10^{3}	5.79	FALSE
893	7697-37-2	Nitric acid	1.36×10^{4}	1.89×10^{-3}	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 (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	3.61×10^{3}	5.01×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
897	109-66-0	Pentane	1.76×10^{3}	2.44×10^{-4}	3.50×10^{3}	4.13	FALSE
897	9003-53-6	Phenlylethylene (styrene, monomer)	7.36×10^{-1}	1.02×10^{-7}	8.50×10^{2}	1.00	FALSE
897	88-89-1	Picric acid (2,4,6-trinitrophenol)	9.15	1.27×10^{-6}	1.00	1.18×10^{-3}	FALSE
897	1310-58-3	Potassium hydroxide	8.55×10^{3}	1.19×10^{-3}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	71-23-8	Propyl alcohol	2.74×10^{4}	3.81×10^{-3}	4.92×10^{3}	5.81	FALSE
897	7440-22-4	Silver metal	1.55×10^{1}	2.15×10^{-6}	1.00×10^{-1}	1.18×10^{-4}	FALSE
897	1310-73-2	Sodium hydroxide	4.60×10^{2}	6.39×10^{-5}	2.00×10^{1}	2.36×10^{-2}	FALSE
897	7664-93-9	Sulfuric acid	7.13×10^{3}	9.90×10^{-4}	1.00×10^{1}	1.18×10^{-2}	FALSE
897	109-99-9	Tetrahydrofuran	1.07×10^{4}	1.49×10^{-3}	1.50×10^{3}	1.77	FALSE
897	7719-09-7	Thionyl chloride	4.50×10^{3}	6.25×10^{-4}	4.90×10^{1}	5.79×10^{-2}	FALSE
897	76-03-9	Trichloroacetic acid	4.60×10^{2}	6.39×10^{-5}	6.70×10^{1}	7.91×10^{-2}	FALSE
905	67-64-1	Acetone	2.81×10^{3}	3.90×10^{-4}	5.90×10^{3}	6.97	FALSE
905	67-63-0	Isopropyl alcohol	2.47×10^{3}	3.44×10^{-4}	4.90×10^{3}	5.79	FALSE
905	1309-48-4	Magnesium oxide	1.60×10^{2}	2.22×10^{-5}	6.00×10^{1}	7.08×10^{-2}	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	1.57×10^{2}	2.18×10^{-5}	4.90×10^{3}	5.79	FALSE
981	67-64-1	Acetone	2.09×10^{3}	2.91×10^{-4}	5.90×10^{3}	6.97	FALSE
981	7664-93-9	Sulfuric acid	3.28×10^{4}	4.56×10^{-3}	1.00×10^{1}	1.18×10^{-2}	FALSE
986	67-64-1	Acetone	1.50×10^{3}	2.08×10^{-4}	5.90×10^{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	$1.11x10^{-6}$	$2.00x10^{3}$	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.1–12. 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	71-23-8	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	872-50-4	N-Methyl-2-pyrrolidone	$3.70x10^{4}$	$5.13x10^{-3}$	$8.00x10^{2}$	$9.45x10^{-1}$	FALSE
878	109-66-0	Pentane	$3.25x10^{2}$	$4.51x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	8002-05-9	Petroleum	$4.53x10^{2}$	$6.30x10^{-5}$	No OEL		
878	64742-47-8	Petroleum distillate	$1.73x10^{3}$	$2.40x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	$1.05x10^{2}$	$1.46x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	5.03	$6.99x10^{-7}$	No OEL		
878	74-98-6	Propane	$2.13x10^{3}$	$2.95x10^{-4}$	$1.80x10^{4}$	$2.13x10^{1}$	FALSE
878	71-23-8	Propyl alcohol	$4.06x10^{3}$	$5.63x10^{-4}$	$4.92x10^{3}$	5.81	FALSE
878	57-55-6	Propylene gylcol	$3.29x10^{2}$	$4.57x10^{-5}$	No OEL		
878	110-86-1	Pyridine	$1.94x10^{2}$	$2.69x10^{-5}$	$1.50x10^{2}$	$1.77x10^{-1}$	FALSE
878	78-92-2	sec-Butyl alcohol	$1.34x10^{3}$	$1.86x10^{-4}$	$3.00x10^{3}$	3.54	FALSE
878	8052-41-3	Stoddard solvent	$2.27x10^{2}$	$3.15x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	75-65-0	t-Butyl alcohol	3.40	$4.72x10^{-7}$	$3.00x10^{3}$	3.54	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	546-68-9	Titanium isopropoxides	$7.09x10^{1}$	$9.84x10^{-6}$	No OEL		
878	26471-62-5	Toluene diisocyanate	$2.95x10^{3}$	$4.10x10^{-4}$	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	$2.04x10^{1}$	$2.83x10^{-6}$	$7.00x10^{-1}$	$8.26x10^{-4}$	FALSE
878	102-71-6	Triethanolamine	$2.68x10^{1}$	$3.72x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	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/m^3	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	4.90×10^{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

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/m^3	TEV g/sec	RESULTS
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		
905	64-17-5	Ethanol	5.76×10^{3}	8.00×10^{-4}	1.88×10^{4}	2.22×10^{1}	FALSE
905	67-63-0	Isopropyl alcohol	1.24×10^{4}	1.72×10^{-3}	4.90×10^{3}	5.79	FALSE
905	109-99-9	Tetrahydrofuran	3.34×10^{3}	4.64×10^{-4}	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.1–13. 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	$4.54x10^2$	$6.30x10^{-5}$	$1.88x10^4$	$2.22x10^1$	FALSE
605	79-09-4	Propionic acid	$1.03x10^2$	$1.43x10^{-5}$	$3.00x10^2$	$3.54x10^{-1}$	FALSE
6580	64-17-5	Ethanol	$2.97x10^1$	$4.12x10^{-6}$	$1.88x10^4$	$2.22x10^1$	FALSE
6580	141-78-6	Ethyl acetate	$3.60x10^3$	$5.00x10^{-4}$	$1.40x10^4$	$1.65x10^1$	FALSE
858	64-19-7	Acetic acid	$5.64x10^4$	$7.83x10^{-3}$	$2.50x10^2$	$2.95x10^{-1}$	FALSE
858	107-83-5	Isohexanes	$2.45x10^3$	$3.40x10^{-4}$	$3.50x10^3$	4.13	FALSE
858	108-65-6	Methoxy acetate	$1.04x10^5$	$1.44x10^{-2}$	$2.75x10^3$	3.25	FALSE
870	872-50-4	1-Methyl-2-Pyrrolidinone	$1.54x10^4$	$2.14x10^{-3}$	$8.00x10^2$	$9.45x10^{-1}$	FALSE
870	100-51-6	Alcohol, Benzyl	$7.89x10^5$	$1.10x10^{-1}$	No OEL		
870	64-17-5	Alcohol, Ethyl	$3.08x10^7$	4.28	$1.88x10^4$	$2.22x10^1$	FALSE
878	110-71-4	1,2-Dimethoxyethane	$1.08x10^3$	$1.50x10^{-4}$	No OEL		
878	142-96-1	1-Butoxybutane, butyl ether	$9.80x10^2$	$1.36x10^{-4}$	No OEL		
878	90-72-2	2,4,6-Tri(dimethylaminomethyl) phenol	$4.04x10^3$	$5.61x10^{-4}$	No OEL		
878	112-34-5	2-Butyl oxyethanol dipropylene glycol	$5.90x10^4$	$8.20x10^{-3}$	$1.00x10^3$	1.18	FALSE
878	111-15-9	2-Ethoxyethyl acetate	$1.28x10^4$	$1.78x10^{-3}$	$2.70x10^1$	$3.19x10^{-2}$	FALSE
878	64-19-7	Acetic acid	$1.92x10^4$	$2.66x10^{-3}$	$2.50x10^2$	$2.95x10^{-1}$	FALSE
878	64742-89-8	Aliphatic petroleum distillates	$6.78x10^3$	$9.41x10^{-4}$	No OEL		
878	100-51-6	Benzyl alcohol	$1.88x10^4$	$2.60x10^{-3}$	No OEL		
878	111-76-2	Butyl cellosolve (R)	$8.95x10^3$	$1.24x10^{-3}$	$2.40x10^2$	$2.83x10^{-1}$	FALSE
878	76-22-2	Camphor	$1.12x10^2$	$1.55x10^{-5}$	$2.00x10^1$	$2.36x10^{-2}$	FALSE
878	76-12-0	Chlorofluorocarbon-112	$1.87x10^2$	$2.60x10^{-5}$	$1.69x10^4$	$2.00x10^1$	FALSE
878	110-82-7	Cyclohexane	$5.11x10^2$	$7.09x10^{-5}$	$7.00x10^3$	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	$1.20x10^{1}$	$1.67x10^{-6}$	$2.00x10^{3}$	2.36	FALSE
878	108-91-8	Cyclohexylamine	$2.74x10^{4}$	$3.81x10^{-3}$	$4.00x10^{2}$	$4.72x10^{-1}$	FALSE
878	124-18-5	Decane	$5.25x10^{2}$	$7.29x10^{-5}$	No OEL		
878	115-10-6	Dimethyl ether	$1.38x10^{3}$	$1.91x10^{-4}$	$1.91x10^{4}$	$2.26x10^{1}$	FALSE
878	67-68-5	Dimethylsulfoxide	$6.60x10^{3}$	$9.17x10^{-4}$	No OEL		
878	109-87-5	Dimethyoxymethane (methylal)	5.10	$7.09x10^{-7}$	$3.10x10^{4}$	$3.66x10^{1}$	FALSE
878	2807-30-9	Ektasolve ep	$3.40x10^{1}$	$4.72x10^{-6}$	$8.50x10^{2}$	1.00	FALSE
878	64-17-5	Ethanol	$1.33x10^{5}$	$1.84x10^{-2}$	$1.88x10^{4}$	$2.22x10^{1}$	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	74-85-1	Ethylene	$7.76x10^{4}$	$1.08x10^{-2}$	No OEL		
878	64-18-6	Formic acid	$8.52x10^{3}$	$1.18x10^{-3}$	$9.00x10^{1}$	$1.06x10^{-1}$	FALSE
878	75-28-5	Isobutane	$2.56x10^{3}$	$3.55x10^{-4}$	$1.90x10^{4}$	$2.24x10^{1}$	FALSE
878	110-19-0	Isobutyl acetate	$7.64x10^{1}$	$1.06x10^{-5}$	$7.00x10^{3}$	8.26	FALSE
878	67-63-0	Isopropyl alcohol	$3.32x10^{5}$	$4.61x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
878	64742-88-7	Medium aliphatic solvent naphtha	$3.91x10^{2}$	$5.43x10^{-5}$	No OEL		
878	108-65-6	Methoxy acetate	$7.96x10^{2}$	$1.11x10^{-4}$	$2.75x10^{3}$	3.25	FALSE
878	4253-34-3	Methyltriacetoxy silane	$1.09x10^{2}$	$1.51x10^{-5}$	No OEL		
878	1185-55-3	Methyltrimethoysilane	$1.30x10^{2}$	$1.81x10^{-5}$	No OEL		
878	628-63-7	n-Amyl acetate	$6.57x10^{2}$	$9.12x10^{-5}$	$2.60x10^{3}$	3.07	FALSE
878	106-97-8	n-Butane	$2.87x10^{2}$	$3.99x10^{-5}$	$1.90x10^{4}$	$2.24x10^{1}$	FALSE
878	123-86-4	n-Butyl acetate	$2.05x10^{3}$	$2.84x10^{-4}$	$7.10x10^{3}$	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/m³	TEV g/sec	RESULTS
878	71-23-8	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	872-50-4	N-Methyl-2-pyrrolidone	$5.54x10^{4}$	$7.70x10^{-3}$	$8.00x10^{2}$	$9.45x10^{-1}$	FALSE
878	109-66-0	Pentane	$4.87x10^{2}$	$6.76x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	8002-05-9	Petroleum	$6.80x10^{2}$	$9.44x10^{-5}$	No OEL		
878	64742-47-8	Petroleum distillate	$2.60x10^{3}$	$3.61x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	$1.57x10^{2}$	$2.19x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	7.54	$1.05x10^{-6}$	No OEL		
878	74-98-6	Propane	$3.19x10^{3}$	$4.43x10^{-4}$	$1.80x10^{4}$	$2.13x10^{1}$	FALSE
878	71-23-8	Propyl alcohol	$6.08x10^{3}$	$8.45x10^{-4}$	$4.92x10^{3}$	5.81	FALSE
878	57-55-6	Propylene gylcol	$4.94x10^{2}$	$6.86x10^{-5}$	No OEL		
878	110-86-1	Pyridine	$2.90x10^{2}$	$4.03x10^{-5}$	$1.50x10^{2}$	$1.77x10^{-1}$	FALSE
878	78-92-2	sec-Butyl alcohol	$2.01x10^{3}$	$2.79x10^{-4}$	$3.00x10^{3}$	3.54	FALSE
878	8052-41-3	Stoddard solvent	$3.41x10^{2}$	$4.73x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	75-65-0	t-Butyl alcohol	5.10	$7.09x10^{-7}$	$3.00x10^{3}$	3.54	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	546-68-9	Titanium isopropoxides	$1.06x10^{2}$	$1.48x10^{-5}$	No OEL		
878	26471-62-5	Toluene diisocyanate	$4.43x10^{3}$	$6.15x10^{-4}$	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	$3.06x10^{1}$	$4.25x10^{-6}$	$7.00x10^{-1}$	$8.26x10^{-4}$	FALSE
878	102-71-6	Triethanolamine	$4.02x10^{1}$	$5.58x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	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 $\mu g/m^3$	TEV g/sec	RESULTS
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		
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	7.85×10^{2}	1.09×10^{-4}	4.90×10^{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/m³	TEV g/sec	RESULTS
878	108-93-0	Cyclohexanol	$1.60x10^{1}$	$2.22x10^{-6}$	$2.00x10^{3}$	2.36	FALSE
878	108-91-8	Cyclohexylamine	$3.65x10^{4}$	$5.07x10^{-3}$	$4.00x10^{2}$	$4.72x10^{-1}$	FALSE
878	124-18-5	Decane	$7.00x10^{2}$	$9.72x10^{-5}$	No OEL		
878	115-10-6	Dimethyl ether	$1.83x10^{3}$	$2.55x10^{-4}$	$1.91x10^{4}$	$2.26x10^{1}$	FALSE
878	67-68-5	Dimethylsulfoxide	$8.80x10^{3}$	$1.22x10^{-3}$	No OEL		
878	109-87-5	Dimethyoxymethane (methylal)	6.80	$9.45x10^{-7}$	$3.10x10^{4}$	$3.66x10^{1}$	FALSE
878	2807-30-9	Ektasolve ep	$4.54x10^{1}$	$6.30x10^{-6}$	$8.50x10^{2}$	1.00	FALSE
878	64-17-5	Ethanol	$1.77x10^{5}$	$2.46x10^{-2}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
878	141-78-6	Ethyl acetate	$9.75x10^{2}$	$1.35x10^{-4}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
878	78-10-4	Ethyl silicate	$9.57x10^{2}$	$1.33x10^{-4}$	$8.50x10^{2}$	1.00	FALSE
878	74-85-1	Ethylene	$1.03x10^{5}$	$1.44x10^{-2}$	No OEL		
878	64-18-6	Formic acid	$1.14x10^{4}$	$1.58x10^{-3}$	$9.00x10^{1}$	$1.06x10^{-1}$	FALSE
878	75-28-5	Isobutane	$3.41x10^{3}$	$4.74x10^{-4}$	$1.90x10^{4}$	$2.24x10^{1}$	FALSE
878	110-19-0	Isobutyl acetate	$1.02x10^{2}$	$1.42x10^{-5}$	$7.00x10^{3}$	8.26	FALSE
878	67-63-0	Isopropyl alcohol	$4.42x10^{5}$	$6.14x10^{-2}$	$4.90x10^{3}$	5.79	FALSE
878	64742-88-7	Medium aliphatic solvent naphtha	$5.22x10^{2}$	$7.24x10^{-5}$	No OEL		
878	108-65-6	Methoxy acetate	$1.06x10^{3}$	$1.47x10^{-4}$	$2.75x10^{3}$	3.25	FALSE
878	4253-34-3	Methyltriacetoxy silane	$1.45x10^{2}$	$2.02x10^{-5}$	No OEL		
878	1185-55-3	Methyltrimethoysilane	$1.74x10^{2}$	$2.41x10^{-5}$	No OEL		
878	628-63-7	n-Amyl acetate	$8.76x10^{2}$	$1.22x10^{-4}$	$2.60x10^{3}$	3.07	FALSE
878	106-97-8	n-Butane	$3.83x10^{2}$	$5.32x10^{-5}$	$1.90x10^{4}$	$2.24x10^{1}$	FALSE
878	123-86-4	n-Butyl acetate	$2.73x10^{3}$	$3.79x10^{-4}$	$7.10x10^{3}$	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/m^3	TEV g/sec	RESULTS
878	71-23-8	n-Butyl alcohol	$1.35x10^4$	$1.87x10^{-3}$	$3.00x10^3$	3.54	FALSE
878	2426-08-6	n-Butyl glycidyl ether (BGE)	$5.44x10^2$	$7.56x10^{-5}$	$1.33x10^3$	1.57	FALSE
878	142-82-5	n-Heptane	$1.21x10^3$	$1.67x10^{-4}$	$3.50x10^3$	4.13	FALSE
878	872-50-4	N-Methyl-2-pyrrolidone	$7.39x10^4$	$1.03x10^{-2}$	$8.00x10^2$	$9.45x10^{-1}$	FALSE
878	109-66-0	Pentane	$6.49x10^2$	$9.02x10^{-5}$	$3.50x10^3$	4.13	FALSE
878	8002-05-9	Petroleum	$9.07x10^2$	$1.26x10^{-4}$	No OEL		
878	64742-47-8	Petroleum distillate	$3.46x10^3$	$4.81x10^{-4}$	$3.50x10^3$	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	$2.10x10^2$	$2.92x10^{-5}$	$8.50x10^2$	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	$1.01x10^1$	$1.40x10^{-6}$	No OEL		
878	74-98-6	Propane	$4.25x10^3$	$5.91x10^{-4}$	$1.80x10^4$	$2.13x10^1$	FALSE
878	71-23-8	Propyl alcohol	$8.11x10^3$	$1.13x10^{-3}$	$4.92x10^3$	5.81	FALSE
878	57-55-6	Propylene gylcol	$6.58x10^2$	$9.14x10^{-5}$	No OEL		
878	110-86-1	Pyridine	$3.87x10^2$	$5.38x10^{-5}$	$1.50x10^2$	$1.77x10^{-1}$	FALSE
878	78-92-2	sec-Butyl alcohol	$2.67x10^3$	$3.71x10^{-4}$	$3.00x10^3$	3.54	FALSE
878	8052-41-3	Stoddard solvent	$4.54x10^2$	$6.31x10^{-5}$	$3.50x10^3$	4.13	FALSE
878	75-65-0	t-Butyl alcohol	6.80	$9.45x10^{-7}$	$3.00x10^3$	3.54	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	546-68-9	Titanium isopropoxides	$1.42x10^2$	$1.97x10^{-5}$	No OEL		
878	26471-62-5	Toluene diisocyanate	$5.90x10^3$	$8.20x10^{-4}$	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	$4.08x10^1$	$5.67x10^{-6}$	$7.00x10^{-1}$	$8.26x10^{-4}$	FALSE
878	102-71-6	Triethanolamine	$5.36x10^1$	$7.44x10^{-6}$	$5.00x10^1$	$5.90x10^{-2}$	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/m^3	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	$4.54x10^{2}$	$6.30x10^{-5}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
605	79-09-4	Propionic acid	$1.03x10^{2}$	$1.43x10^{-5}$	$3.00x10^{2}$	$3.54x10^{-1}$	FALSE
6580	64-17-5	Ethanol	$2.97x10^{1}$	$4.12x10^{-6}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
6580	141-78-6	Ethyl acetate	$3.60x10^{3}$	$5.00x10^{-4}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
858	64-19-7	Acetic acid	$2.16x10^{4}$	$3.00x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
858	107-83-5	Isohexanes	$9.38x10^{2}$	$1.30x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
858	108-65-6	Methoxy acetate	$3.98x10^{4}$	$5.53x10^{-3}$	$2.75x10^{3}$	3.25	FALSE
870	872-50-4	1-Methyl-2-Pyrrolidinone	$1.54x10^{4}$	$2.14x10^{-3}$	$8.00x10^{2}$	$9.45x10^{-1}$	FALSE
870	100-51-6	Alcohol, Benzyl	$7.89x10^{5}$	$1.10x10^{-1}$	No OEL		
870	64-17-5	Alcohol, Ethyl	$3.08x10^{7}$	4.28	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
878	110-71-4	1,2-Dimethoxyethane	$7.18x10^{2}$	$9.97x10^{-5}$	No OEL		
878	142-96-1	1-Butoxybutane, butyl ether	$6.53x10^{2}$	$9.07x10^{-5}$	No OEL		
878	90-72-2	2,4,6-Tri(dimethylaminomethyl) phenol	$2.69x10^{3}$	$3.74x10^{-4}$	No OEL		
878	112-34-5	2-Butyl oxyethanol dipropylene glycol	$3.94x10^{4}$	$5.47x10^{-3}$	$1.00x10^{3}$	1.18	FALSE
878	111-15-9	2-Ethoxyethyl acetate	$8.53x10^{3}$	$1.18x10^{-3}$	$2.70x10^{1}$	$3.19x10^{-2}$	FALSE
878	64-19-7	Acetic acid	$1.28x10^{4}$	$1.77x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
878	64742-89-8	Aliphatic petroleum distillates	$4.52x10^{3}$	$6.27x10^{-4}$	No OEL		
878	100-51-6	Benzyl alcohol	$1.25x10^{4}$	$1.74x10^{-3}$	No OEL		
878	111-76-2	Butyl cellosolve (R)	$5.97x10^{3}$	$8.29x10^{-4}$	$2.40x10^{2}$	$2.83x10^{-1}$	FALSE
878	76-22-2	Camphor	$7.44x10^{1}$	$1.03x10^{-5}$	$2.00x10^{1}$	$2.36x10^{-2}$	FALSE
878	76-12-0	Chlorofluorocarbon-112	$1.25x10^{2}$	$1.74x10^{-5}$	$1.69x10^{4}$	$2.00x10^{1}$	FALSE
878	110-82-7	Cyclohexane	$3.40x10^{2}$	$4.73x10^{-5}$	$7.00x10^{3}$	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	$6.74x10^{3}$	$9.36x10^{-4}$	$3.00x10^{3}$	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	872-50-4	N-Methyl-2-pyrrolidone	$3.70x10^{4}$	$5.13x10^{-3}$	$8.00x10^{2}$	$9.45x10^{-1}$	FALSE
878	109-66-0	Pentane	$3.25x10^{2}$	$4.51x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	8002-05-9	Petroleum	$4.53x10^{2}$	$6.30x10^{-5}$	No OEL		
878	64742-47-8	Petroleum distillate	$1.73x10^{3}$	$2.40x10^{-4}$	$3.50x10^{3}$	4.13	FALSE
878	9003-53-6	Phenlylethylene (styrene, monomer)	$1.05x10^{2}$	$1.46x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
878	9036-19-5	Poly(oxy-1,2-ethandiyl)	5.03	$6.99x10^{-7}$	No OEL		
878	74-98-6	Propane	$2.13x10^{3}$	$2.95x10^{-4}$	$1.80x10^{4}$	$2.13x10^{1}$	FALSE
878	71-23-8	Propyl alcohol	$4.06x10^{3}$	$5.63x10^{-4}$	$4.92x10^{3}$	5.81	FALSE
878	57-55-6	Propylene gylcol	$3.29x10^{2}$	$4.57x10^{-5}$	No OEL		
878	110-86-1	Pyridine	$1.94x10^{2}$	$2.69x10^{-5}$	$1.50x10^{2}$	$1.77x10^{-1}$	FALSE
878	78-92-2	sec-Butyl alcohol	$1.34x10^{3}$	$1.86x10^{-4}$	$3.00x10^{3}$	3.54	FALSE
878	8052-41-3	Stoddard solvent	$2.27x10^{2}$	$3.15x10^{-5}$	$3.50x10^{3}$	4.13	FALSE
878	75-65-0	t-Butyl alcohol	3.40	$4.72x10^{-7}$	$3.00x10^{3}$	3.54	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	546-68-9	Titanium isopropoxides	$7.09x10^{1}$	$9.84x10^{-6}$	No OEL		
878	26471-62-5	Toluene diisocyanate	$2.95x10^{3}$	$4.10x10^{-4}$	No OEL		
878	91-08-7	Toluene-2,6-diisocyanate	$2.04x10^{1}$	$2.83x10^{-6}$	$7.00x10^{-1}$	$8.26x10^{-4}$	FALSE
878	102-71-6	Triethanolamine	$2.68x10^{1}$	$3.72x10^{-6}$	$5.00x10^{1}$	$5.90x10^{-2}$	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/m^3	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	$4.51x10^{1}$	$6.26x10^{-6}$	$2.50x10^{-1}$	$2.95x10^{-4}$	FALSE
897	64-19-7	Acetic acid	$4.56x10^{4}$	$6.33x10^{-3}$	$2.50x10^{2}$	$2.95x10^{-1}$	FALSE
897	75-36-5	Acetyl chloride	$1.41x10^{3}$	$1.96x10^{-4}$	No OEL		
897	106-92-3	Allyl glycidyl ether	$1.54x10^{1}$	$2.13x10^{-6}$	$2.20x10^{2}$	$2.60x10^{-1}$	FALSE
897	100-51-6	Benzyl alcohol	$4.79x10^{2}$	$6.66x10^{-5}$	No OEL		
897	128-37-0	Butylated hydroxytoluene	$9.11x10^{1}$	$1.26x10^{-5}$	$1.00x10^{2}$	$1.18x10^{-1}$	FALSE
897	110-82-7	Cyclohexane	2.75	$3.82x10^{-7}$	$7.00x10^{3}$	8.26	FALSE
897	124-40-3	Dimethylamine	$3.66x10^{2}$	$5.09x10^{-5}$	$4.00x10^{1}$	$4.72x10^{-2}$	FALSE
897	67-68-5	Dimethylsulfoxide	$1.03x10^{3}$	$1.44x10^{-4}$	No OEL		
897	64-17-5	Ethanol	$7.69x10^{1}$	$1.07x10^{-5}$	$1.88x10^{4}$	$2.22x10^{1}$	FALSE
897	141-78-6	Ethyl acetate	$1.64x10^{4}$	$2.28x10^{-3}$	$1.40x10^{4}$	$1.65x10^{1}$	FALSE
897	60-29-7	Ethyl ether (diethyl ether)	$2.01x10^{4}$	$2.79x10^{-3}$	$1.20x10^{4}$	$1.42x10^{1}$	FALSE
897	78-10-4	Ethyl silicate	$5.77x10^{2}$	$8.02x10^{-5}$	$8.50x10^{2}$	1.00	FALSE
897	107-83-5	Isohexanes	$1.30x10^{4}$	$1.80x10^{-3}$	$3.50x10^{3}$	4.13	FALSE
897	67-63-0	Isopropyl alcohol	$7.15x10^{4}$	$9.93x10^{-3}$	$4.90x10^{3}$	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	1.36×10^{4}	1.89×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
858	7784-42-1	Arsine (15%)	1.55×10^{3}	2.16×10^{-4}	1.60	1.89×10^{-3}	FALSE
858	7782-50-5	Chlorine	9.90×10^{4}	1.38×10^{-2}	1.50×10^{1}	1.77×10^{-2}	FALSE
858	7782-41-4	Fluorine (5%) in argon	1.70×10^{3}	2.36×10^{-4}	2.00	2.36×10^{-3}	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	1.37×10^{4}	1.91×10^{-3}	6.70×10^{1}	7.91×10^{-2}	FALSE
858	7783-54-2	Nitrogen trifluoride	5.00×10^{3}	6.94×10^{-4}	2.90×10^{2}	3.42×10^{-1}	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	1.68×10^{3}	2.33×10^{-4}	1.50×10^{3}	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	4.02×10^{4}	5.59×10^{-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.1–17. 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	2.38×10^{4}	3.31×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
858	7784-42-1	Arsine (15%)	2.71×10^{3}	3.77×10^{-4}	1.60	1.89×10^{-3}	FALSE
858	7782-50-5	Chlorine	1.73×10^{5}	2.41×10^{-2}	1.50×10^{1}	1.77×10^{-2}	TRUE
858	7782-41-4	Fluorine (5%) in argon	2.98×10^{3}	4.13×10^{-4}	2.00	2.36×10^{-3}	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	2.40×10^{4}	3.34×10^{-3}	6.70×10^{1}	7.91×10^{-2}	FALSE
858	7783-54-2	Nitrogen trifluoride	8.74×10^{3}	1.21×10^{-3}	2.90×10^{2}	3.42×10^{-1}	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	2.94×10^{3}	4.08×10^{-4}	1.50×10^{3}	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	7.04×10^{4}	9.78×10^{-3}	7.90×10^{3}	9.33	FALSE
878	1336-21-6	Ammonium hydroxide	1.76×10^{6}	2.45×10^{-1}	1.4×10^{2}	1.65×10^{-1}	TRUE
878	7697-37-2	Nitric acid	9.49×10^{4}	1.32×10^{-2}	5.00×10^{1}	5.90×10^{-2}	FALSE
893	7664-41-7	Ammonia	2.72×10^{4}	3.78×10^{-3}	1.40×10^{2}	1.65×10^{-1}	FALSE
893	7784-42-1	Arsine	1.11×10^{5}	1.54×10^{-2}	1.60	1.89×10^{-3}	TRUE
893	7783-07-5	Hydrogen selenide	9.54×10^{4}	1.33×10^{-2}	1.60	1.89×10^{-3}	TRUE
893	7803-51-2	Phosphine (100%)	4.54×10^{3}	6.30×10^{-4}	1.40	1.65×10^{-3}	FALSE
893	7803-62-5	Silane (silicon tetrafluoride)	2.06×10^{3}	2.86×10^{-4}	6.60×10^{1}	7.79×10^{-3}	FALSE
893	7446-09-5	Sulfur dioxide	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.1–18. Additional Chemical List, 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	RESULT
858	7664-41-7	Ammonia	$2.55x10^{4}$	$3.54x10^{-3}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
858	7784-42-1	Arsine (15%)	$2.91x10^{3}$	$4.04x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
858	7782-50-5	Chlorine	$1.86x10^{5}$	$2.58x10^{-2}$	$1.50x10^{1}$	$1.77x10^{-2}$	TRUE
858	7782-41-4	Fluorine (5%) in argon	$3.19x10^{3}$	$4.43x10^{-4}$	2.00	$2.36x10^{-3}$	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	$2.58x10^{4}$	$3.58x10^{-3}$	$6.70x10^{1}$	$7.91x10^{-2}$	FALSE
858	7783-54-2	Nitrogen trifluoride	$9.37x10^{3}$	$1.30x10^{-3}$	$2.90x10^{2}$	$3.42x10^{-1}$	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	$3.15x10^{3}$	$4.37x10^{-4}$	$1.50x10^{3}$	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	$7.54x10^{4}$	$1.05x10^{-2}$	$7.90x10^{3}$	9.33	FALSE
878	1336-21-6	Ammonium hydroxide	$2.35x10^{6}$	$3.26x10^{-1}$	$1.4x10^{2}$	$1.65x10^{-1}$	TRUE
878	7697-37-2	Nitric acid	$1.27x10^{5}$	$1.76x10^{-2}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
893	7664-41-7	Ammonia[a]	$2.72x10^{4}$	$3.78x10^{-3}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
893	7784-42-1	Arsine[a]	$1.11x10^{5}$	$1.54x10^{-2}$	1.60	$1.89x10^{-3}$	TRUE
893	7783-07-5	Hydrogen selenide[a]	$9.54x10^{4}$	$1.33x10^{-2}$	1.60	$1.89x10^{-3}$	TRUE
893	7803-51-2	Phosphine (100%)[a]	$4.54x10^{3}$	$6.30x10^{-4}$	1.40	$1.65x10^{-3}$	FALSE
893	7803-62-5	Silane (silicon tetrafluoride) [a]	$2.06x10^{3}$	$2.86x10^{-4}$	$6.60x10^{1}$	$7.79x10^{-3}$	FALSE
893	7446-09-5	Sulfur dioxide[a]	$3.02x10^{2}$	$4.19x10^{-5}$	$5.00x10^{1}$	$5.90x10^{-2}$	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 µg/m^3	TEV g/sec	RESULT
858	7664-41-7	Ammonia	$9.12x10^{3}$	$1.27x10^{-3}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
858	7784-42-1	Arsine (15%)	$1.04x10^{3}$	$1.44x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
858	7782-50-5	Chlorine	$6.63x10^{4}$	$9.21x10^{-3}$	$1.50x10^{1}$	$1.77x10^{-2}$	FALSE
858	7782-41-4	Fluorine (5%) in argon	$1.14x10^{3}$	$1.58x10^{-4}$	2.00	$2.36x10^{-3}$	FALSE
858	10035-10-6	Hydrogen bromide (hydrobromic acid)	$9.21x10^{3}$	$1.28x10^{-3}$	$6.70x10^{1}$	$7.91x10^{-2}$	FALSE
858	7783-54-2	Nitrogen trifluoride	$3.35x10^{3}$	$4.65x10^{-4}$	$2.90x10^{2}$	$3.42x10^{-1}$	FALSE
858	109-99-9	Tetrahydrofuran, anhydrous, 99.9%	$1.12x10^{3}$	$1.56x10^{-4}$	$1.50x10^{3}$	1.77	FALSE
858	156-60-5	Trans,1,2-dichloroethylene	$2.70x10^{4}$	$3.74x10^{-3}$	$7.90x10^{3}$	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.1–20. 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/m^3	TEV (g/sec)	RESULT
			g/yr	EF				
858	7782-50-5	Chlorine	$1.73x10^{5}$	0.00	0.00	$1.50x10^{1}$	$1.77x10^{-2}$	FALSE
858	7722-84-1	Hydrogen peroxide (concentration > 52%)	$3.10x10^{6}$	$3.00x10^{-4}$	$1.29x10^{-4}$	$1.40x10^{1}$	$1.65x10^{-2}$	FALSE
858	7697-37-2	Nitric acid	$3.99x10^{6}$	$3.00x10^{-4}$	$1.66x10^{-4}$	$5.00x10^{1}$	$5.90x10^{-2}$	FALSE
858	1310-73-2	Sodium hydroxide	$6.12x10^{7}$	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	$1.10x10^{5}$	$1.00x10^{-2}$	$1.53x10^{-3}$	$4.00x10^{1}$	$1.18x10^{-2}$	FALSE
870	7631-86-9	Silica	$9.04x10^{5}$	$2.50x10^{-1}$	$3.14x10^{-2}$	$6.00x10^{1}$	$4.72x10^{-2}$	FALSE
870	7664-93-9	Sulfuric Acid	$1.10x10^{5}$	$1.00x10^{-2}$	$1.53x10^{-4}$	$1.00x10^{1}$	$1.18x10^{-2}$	FALSE
878	1344-28-1	Aluminum oxide (fibrous forms)	$2.50x10^{6}$	0.00	0.00	$1.00x10^{2}$	$5.90x10^{-2}$	FALSE
878	1336-21-6	Ammonium Hydroxide	$1.76x10^{6}$	$2.00x10^{-1}$	$4.89x10^{-2}$	$1.40x10^{2}$	$1.65x10^{-1}$	FALSE
878	7440-48-4	Cobalt	$3.03x10^{4}$	0.01	$4.21x10^{-5}$	$2.00x10^{-1}$	$2.36x10^{-4}$	FALSE
878	7440-50-8	Copper dusts and mists, as copper	$1.14x10^{5}$	0.26	$4.12x10^{-3}$	$1.00x10^{1}$	$1.18x10^{-2}$	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	$1.32x10^4$	0.01	$1.83x10^{-5}$	1.00	$1.18x10^{-3}$	FALSE
878	7439-92-1	Lead	$7.97x10^3$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	7439-97-6	Mercury	$4.08x10^4$	0.00	0.00	$2.50x10^{-1}$	$2.95x10^{-4}$	FALSE
878	14808-60-7	Quartz	$6.03x10^3$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	7631-86-9	Silica, fused (respirable)	$9.68x10^3$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
878	7440-22-4	Silver metal	$2.10x10^4$	0.00	0.00	$1.00x10^{-1}$	$1.18x10^{-4}$	FALSE
878	584-84-9	Toluene-2,4-diisocyanate	$4.33x10^3$	0.03	$1.80x10^{-5}$	$3.60x10^{-1}$	$4.25x10^{-4}$	FALSE
878	7440-62-2	Vanadium (fume or dust)	$3.27x10^4$	0.00	0.00	$5.00x10^{-1}$	$5.90x10^{-4}$	FALSE
893	7784-42-1	Arsine	$1.11x10^5$	0.00	0.00	1.60	$1.89x10^{-3}$	FALSE
893	7783-07-5	Hydrogen selenide	$9.54x10^4$	$1.50x10^{-2}$	$1.99x10^{-4}$	1.60	$1.89x10^{-3}$	FALSE
981	7664-93-9	Sulfuric acid	$1.41x10^5$	0.033	$6.45x10^{-4}$	$1.00x10^1$	$1.18x10^{-2}$	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		ER (g/sec)	OEL/100 µg/m³	TEV (g/sec)	RESULT
			g/yr	EF				
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)	2.18×10^4	0.00	0.00	5.00×10^{-1}	5.90×10^{-4}	FALSE
893	7784-42-1	Arsine	5.54×10^4	0.00	0.00	1.60	1.89×10^{-3}	FALSE
893	7783-07-5	Hydrogen selenide	4.77×10^4	1.50×10^{-2}	9.94×10^{-5}	1.60	1.89×10^{-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 $1.0x10^{-8}$ for an exposed individual. This cancer risk represents an incremental cancer risk of one-in-one-million ($1.0x10^{-6}$) (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 $1.0x10^{-8}$ as the cancer risk screening level.

The calculated concentration representing a cancer risk of $1.0x10^{-8}$ 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 $1.0x10^{-8}$ 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 $1.0x10^{-8}$. 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 $1.0x10^{-8}$ 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		10^{-8} RISK LEVEL µg/m^3	TEV g/sec	RESULT
			g/yr	g/sec			
6580	67-66-3	Chloroform (Trichloromethane)	$5.91x10^{3}$	$8.21x10^{-4}$	$4.35x10^{-4}$	$1.24x10^{-5}$	TRUE
870	71-43-2	Benzene	$2.36x10^{4}$	$3.28x10^{-3}$	$1.20x10^{-3}$	$3.41x10^{-5}$	TRUE
870	75-09-2	Dichloromethane (Methylene chloride)	$6.67x10^{4}$	$9.26x10^{-3}$	$2.13x10^{-2}$	$6.05x10^{-4}$	TRUE
870	7440-02-0	Nickel (28%)	$5.44x10^{3}$	$7.56x10^{-4}$	$2.06x10^{-5}$	$5.85x10^{-7}$	TRUE
878	123-91-1	1,4-Dioxane[a]	$2.38x10^{3}$	$3.30x10^{-4}$	NA	NA	NA
878	107-13-1	Acrylonitrile	$1.00x10^{-1}$	$1.39x10^{-8}$	$1.47x10^{-4}$	$4.18x10^{-6}$	FALSE
878	71-43-2	Benzene	$8.71x10^{1}$	$1.21x10^{-5}$	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
878	7440-43-9	Cadmium	$4.79x10^{2}$	$6.65x10^{-5}$	$5.56x10^{-6}$	$1.58x10^{-7}$	TRUE
878	75-09-2	Dichloromethane (Methylene chloride)	$9.82x10^{4}$	$1.36x10^{-2}$	$2.13x10^{-2}$	$6.05x10^{-4}$	TRUE
878	106-89-8	Epichlorohydrin	$2.23x10^{2}$	$3.10x10^{-5}$	$8.33x10^{-3}$	$2.37x10^{-4}$	FALSE
878	50-00-0	Formaldehyde	$1.87x10^{4}$	$2.60x10^{-3}$	$7.41x10^{-4}$	$2.11x10^{-5}$	TRUE
878	7440-02-0	Nickel	$1.62x10^{4}$	$2.26x10^{-3}$	$2.06x10^{-5}$	$5.85x10^{-7}$	TRUE
878	79-01-6	Trichloroethylene	$7.49x10^{5}$	$1.04x10^{-1}$	$5.83x10^{-3}$	$1.66x10^{-4}$	TRUE
893	107-06-2	1,2-Dichloroethane (Ethylene dichloride)	$6.27x10^{2}$	$8.72x10^{-5}$	$3.77x10^{-4}$	$1.07x10^{-5}$	TRUE
897	764-41-0	1,4-Dichloro-2-butene	$4.90x10^{1}$	$6.81x10^{-6}$	$3.76x10^{-6}$	$1.07x10^{-7}$	TRUE
897	123-91-1	1,4-Dioxane[a]	$5.25x10^{1}$	$7.29x10^{-6}$	NA	NA	NA
897	107-13-1	Acrylonitrile	$7.98x10^{1}$	$1.11x10^{-5}$	$1.47x10^{-4}$	$4.18x10^{-6}$	TRUE
897	71-43-2	Benzene	$1.08x10^{2}$	$1.50x10^{-5}$	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
897	75-25-2	Bromoform (Tribromomethane)	$4.95x10^{1}$	$6.87x10^{-6}$	$9.09x10^{-3}$	$2.58x10^{-4}$	FALSE
897	67-66-3	Chloroform (Trichloromethane)	$1.48x10^{4}$	$2.05x10^{-3}$	$4.35x10^{-4}$	$1.24x10^{-5}$	TRUE
897	75-09-2	Dichloromethane (Methylene chloride)	$4.25x10^{4}$	$5.90x10^{-3}$	$2.13x10^{-2}$	$6.05x10^{-4}$	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/m³	TEV g/sec	RESULT
			g/yr	EF	g/sec			
6580	67-66-3	Chloroform (Trichloromethane)	$1.18x10^{4}$	0.10	$1.64x10^{-4}$	$4.35x10^{-4}$	$1.24x10^{-5}$	TRUE
870	71-43-2	Benzene	$7.98x10^{4}$	0	0	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
870	75-09-2	Dichloromethane (Methylene chloride)	$2.01x10^{5}$	0.37	$1.03x10^{-2}$	$2.13x10^{-2}$	$6.05x10^{-4}$	TRUE
870	7440-02-0	Nickel (28%)	$1.68x10^{4}$	0	0	$2.06x10^{-5}$	$5.85x10^{-7}$	FALSE
878	123-91-1	1,4-Dioxane[a]	$3.56x10^{3}$	1.00	$4.95x10^{-4}$	NA	NA	NA
878	107-13-1	Acrylonitrile	$1.50x10^{-1}$	1.00	$2.08x10^{-8}$	$1.47x10^{-4}$	$4.18x10^{-6}$	FALSE
878	71-43-2	Benzene	$1.31x10^{2}$	0.11	$2.00x10^{-6}$	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
878	7440-43-9	Cadmium	$7.18x10^{2}$	0	0	$5.56x10^{-6}$	$1.58x10^{-7}$	FALSE
878	75-09-2	Dichloromethane (Methylene chloride)	$1.47x10^{5}$	0.03	$6.14x10^{-4}$	$2.13x10^{-2}$	$6.05x10^{-4}$	TRUE
878	106-89-8	Epichlorohydrin	$3.35x10^{2}$	1.00	$4.66x10^{-5}$	$8.33x10^{-3}$	$2.37x10^{-4}$	FALSE
878	50-00-0	Formaldehyde	$2.81x10^{4}$	0.01	$3.90x10^{-5}$	$7.41x10^{-4}$	$2.11x10^{-5}$	TRUE
878	7440-02-0	Nickel	$2.44x10^{4}$	0	0	$2.06x10^{-5}$	$5.85x10^{-7}$	FALSE
878	79-01-6	Trichloroethylene	$1.12x10^{6}$	0.02	$3.12x10^{-3}$	$5.83x10^{-3}$	$1.66x10^{-4}$	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	$4.90x10^{1}$	1.00	$6.81x10^{-6}$	$3.76x10^{-6}$	$1.07x10^{-7}$	TRUE
897	123-91-1	1,4-Dioxane[a]	$5.25x10^{1}$	1.00	$7.29x10^{-6}$	NA	NA	NA
897	107-13-1	Acrylonitrile	$7.98x10^{1}$	1.00	$1.11x10^{-5}$	$1.47x10^{-4}$	$4.18x10^{-6}$	TRUE
897	71-43-2	Benzene	$1.08x10^{2}$	0.11	$1.65x10^{-6}$	$1.20x10^{-3}$	$3.41x10^{-5}$	FALSE
897	75-25-2	Bromoform (Tribromomethane)	$4.95x10^{1}$	1.00	$6.87x10^{-6}$	$9.09x10^{-3}$	$2.58x10^{-4}$	FALSE
897	67-66-3	Chloroform (Trichloromethane)	$1.48x10^{4}$	0.10	$2.05x10^{-4}$	$4.35x10^{-4}$	$1.24x10^{-5}$	TRUE
897	75-09-2	Dichloromethane (Methylene chloride)	$4.25x10^{4}$	0.05	$2.95x10^{-4}$	$2.13x10^{-2}$	$6.05x10^{-4}$	FALSE
897	75-56-9	Propylene oxide (1,2-Epoxypropane)	1.50	1.00	$2.08x10^{-7}$	$2.70x10^{-3}$	$7.67x10^{-5}$	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/m^3	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^{-8} RISK LEVEL $\mu g/m^3$	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 $\mu g/m^3$	TEV g/sec	RESULT
			g/yr	EF	g/sec			
897	79-01-6	Trichloroethylene	$2.70x10^{4}$	$7.00x10^{-2}$	$2.63x10^{-4}$	$5.83x10^{-3}$	$1.66x10^{-4}$	TRUE
905	75-09-2	Dichloromethane (Methylene chloride)	$3.98x10^{3}$	$2.00x10^{-2}$	$1.11x10^{-5}$	$2.13x10^{-2}$	$6.05x10^{-4}$	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	$1.64x10^{-5}$	$1.24x10^{-5}$
Dichloromethane (Methylene chloride)	870	$1.03x10^{-2}$	$6.05x10^{-4}$
Dichloromethane (Methylene chloride)	878	$6.14x10^{-4}$	$6.05x10^{-4}$
Formaldehyde	878	$3.90x10^{-5}$	$2.11x10^{-5}$
Trichloroethylene	878	$3.12x10^{-3}$	$1.66x10^{-4}$
1,2-Dichloroethane (Ethylene dichloride)	893	$8.72x10^{-5}$	$1.07x10^{-5}$
1,4-Dichloro-2-butene	897	$6.81x10^{-6}$	$1.07x10^{-7}$
Acrylonitrile	897	$1.11x10^{-5}$	$4.18x10^{-6}$
Chloroform (trichloromethane)	897	$2.05x10^{-5}$	$1.24x10^{-5}$
Trichloroethylene	897	$2.86x10^{-4}$	$1.66x10^{-4}$

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	$1.23x10^{-5}$	$1.24x10^{-5}$
Dichloromethane (Methylene chloride)	870	$1.03x10^{-2}$	$6.05x10^{-4}$
Dichloromethane (Methylene chloride)	878	$8.19x10^{-4}$	$6.05x10^{-4}$
Formaldehyde	878	$5.19x10^{-5}$	$2.11x10^{-5}$
Trichloroethylene	878	$4.16x10^{-3}$	$1.66x10^{-4}$
1,2-Dichloroethane (Ethylene dichloride)[a]	893	$1.74x10^{-4}$	$1.07x10^{-5}$
1,4-Dichloro-2-butene	897	$6.81x10^{-6}$	$1.07x10^{-7}$
Acrylonitrile	897	$1.11x10^{-5}$	$4.18x10^{-6}$
Chloroform (trichloromethane)	897	$2.05x10^{-5}$	$1.24x10^{-5}$
Trichloroethylene	897	$2.86x10^{-4}$	$1.66x10^{-4}$

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.

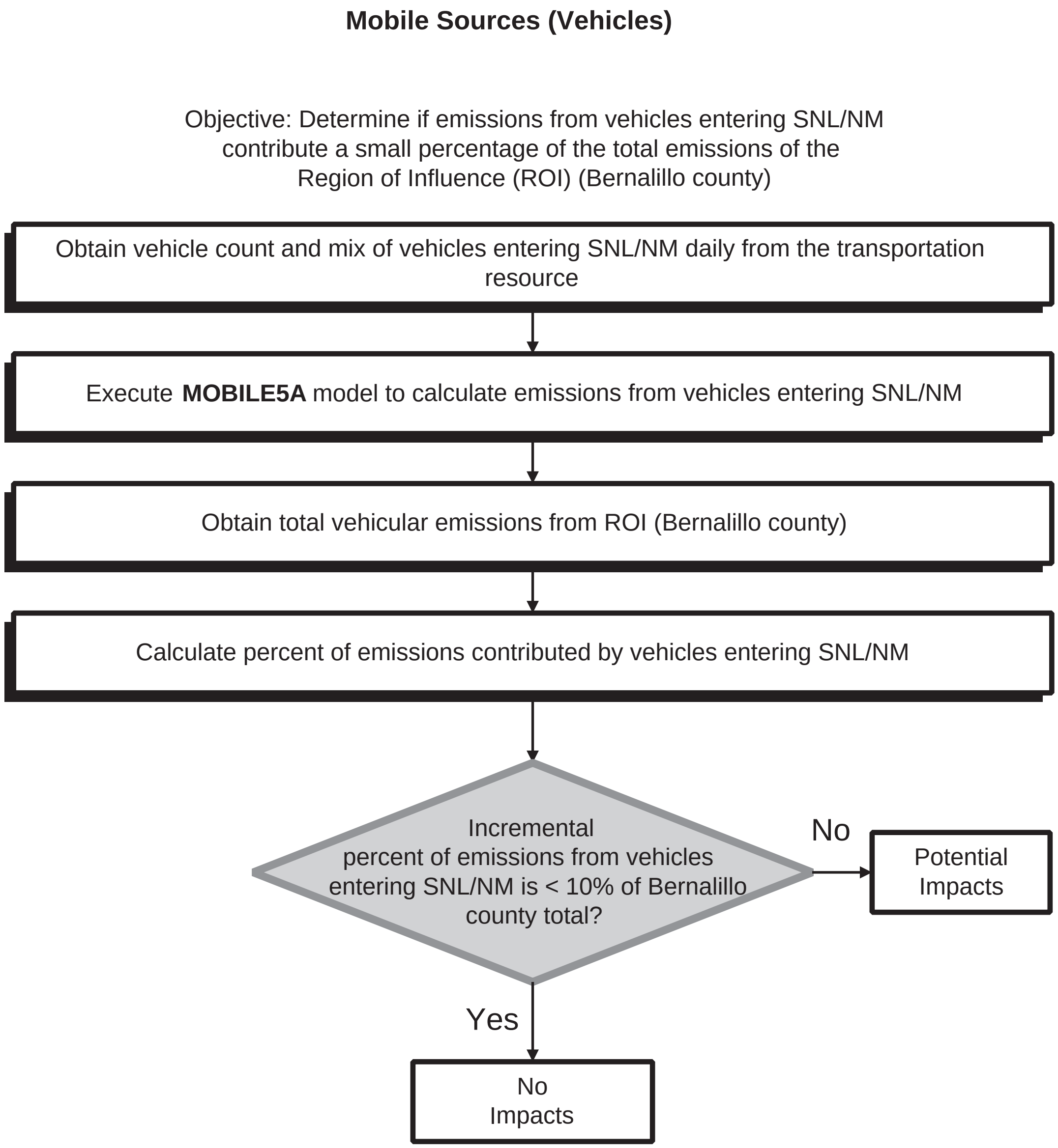
Table D.1–30. Estimated Carbon Monoxide Emissions from SNL/NM

COMMUTER		ONBASE		PARAMETER
1996 BASELINE				
13,582.0 x 30.0 407,460.0		600.0 x 30.0 18,000.0		SNL/NM vehicles per day Miles per day per vehicle Total miles per day
x 33.4 13,609,164.0		x 33.4 601,200.0		Emission factor (grams per mile) Carbon monoxide emissions (grams per day)
x 1.1023×10^{-6} 15.0		x 1.1023×10^{-6} 0.66		Conversion factor: grams to tons Carbon monoxide emissions (tons per day)
x 261.0 3,915.0		x 261.0 172.0		Working days per year 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 x 30.0 407,460.0		600.0 x 30.0 18,000.0		SNL/NM vehicles per day Miles per day per vehicle Total miles per day
x 28.5 11,612,610.0		x 28.5 513,000.0		Emission factor (grams per mile) Carbon monoxide emissions (grams per day)
x 1.1023×10^{-6} 12.8		x 1.1023×10^{-6} 0.57		Conversion factor: grams to tons Carbon monoxide emissions (tons per day)
x 261.0 3,341.0		x 261.0 148.0		Working days per year 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 x 30.0 448,200.0		660.0 x 30.0 19,800.0		SNL/NM vehicles per day Miles per day per vehicle Total miles per day
x 28.5 12,773,700.0		x 28.5 564,300.0		Emission factor (grams per mile) Carbon monoxide emissions (grams per day)
x 1.1023×10^{-6} 14.08		x 1.1023×10^{-6} 0.622		Conversion factor: grams to tons Carbon monoxide emissions (tons per day)
x 261.0 3,674.88		x 261.0 162.35		Working days per year 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



Source: Original

Figure D.1–5. Flow Chart for Evaluation of Mobile Source Emissions

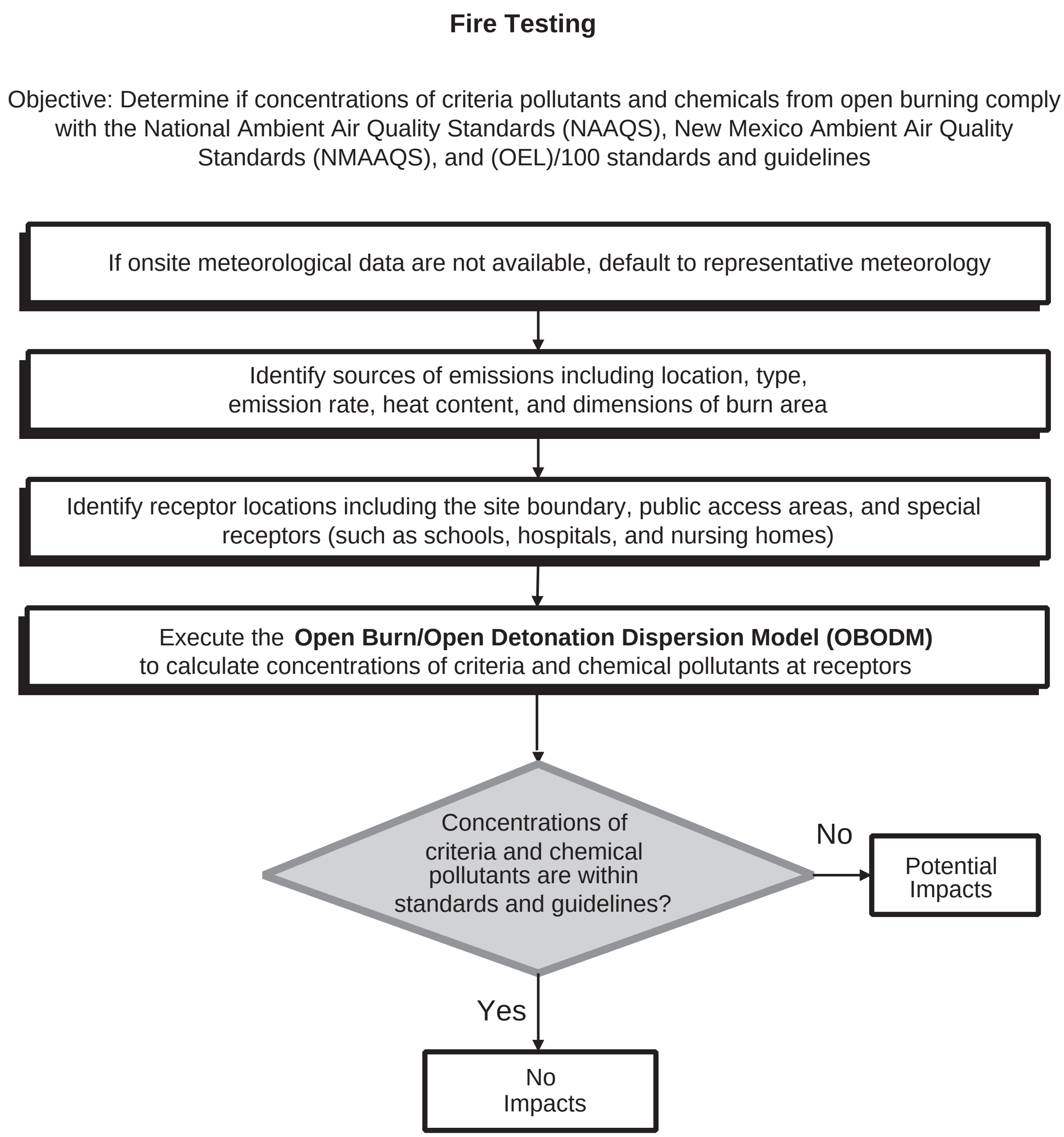
Various data are input into the MOBILE5A computer model to measure mobile source carbon monoxide emissions from SNL/NM commuters versus Bernalillo County mobile source carbon monoxide emissions.

- 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.



Source: Original

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/m^3)	ESTIMATED 8-HOUR CONCENTRATION (μg/m^3)
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/m^3)	ESTIMATED 8-HOUR CONCENTRATION (μg/m^3)
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/m^3: 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/m^3/1,000 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

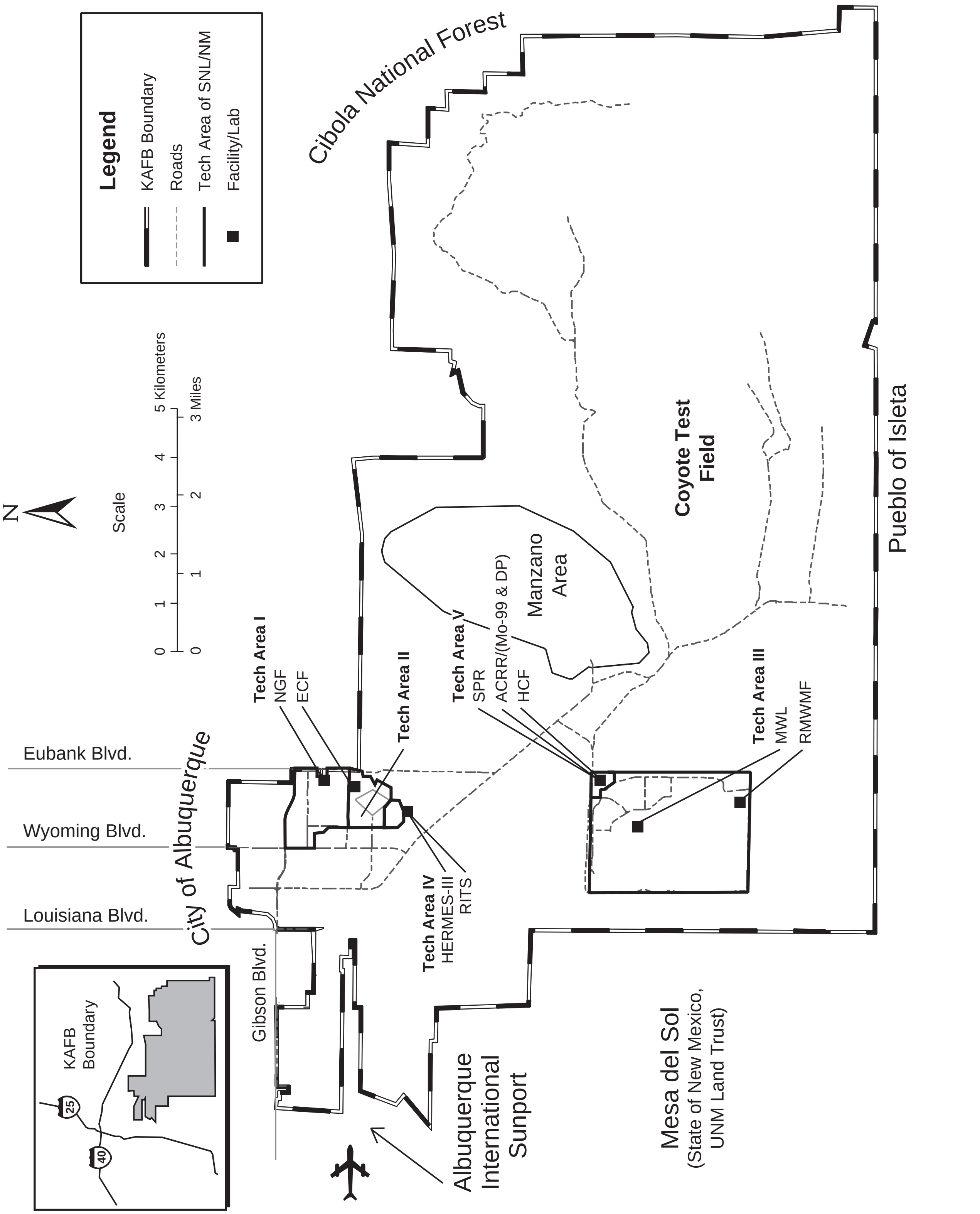

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Figure D.2–1. SNL/NM Facilities that Release Radionuclides

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

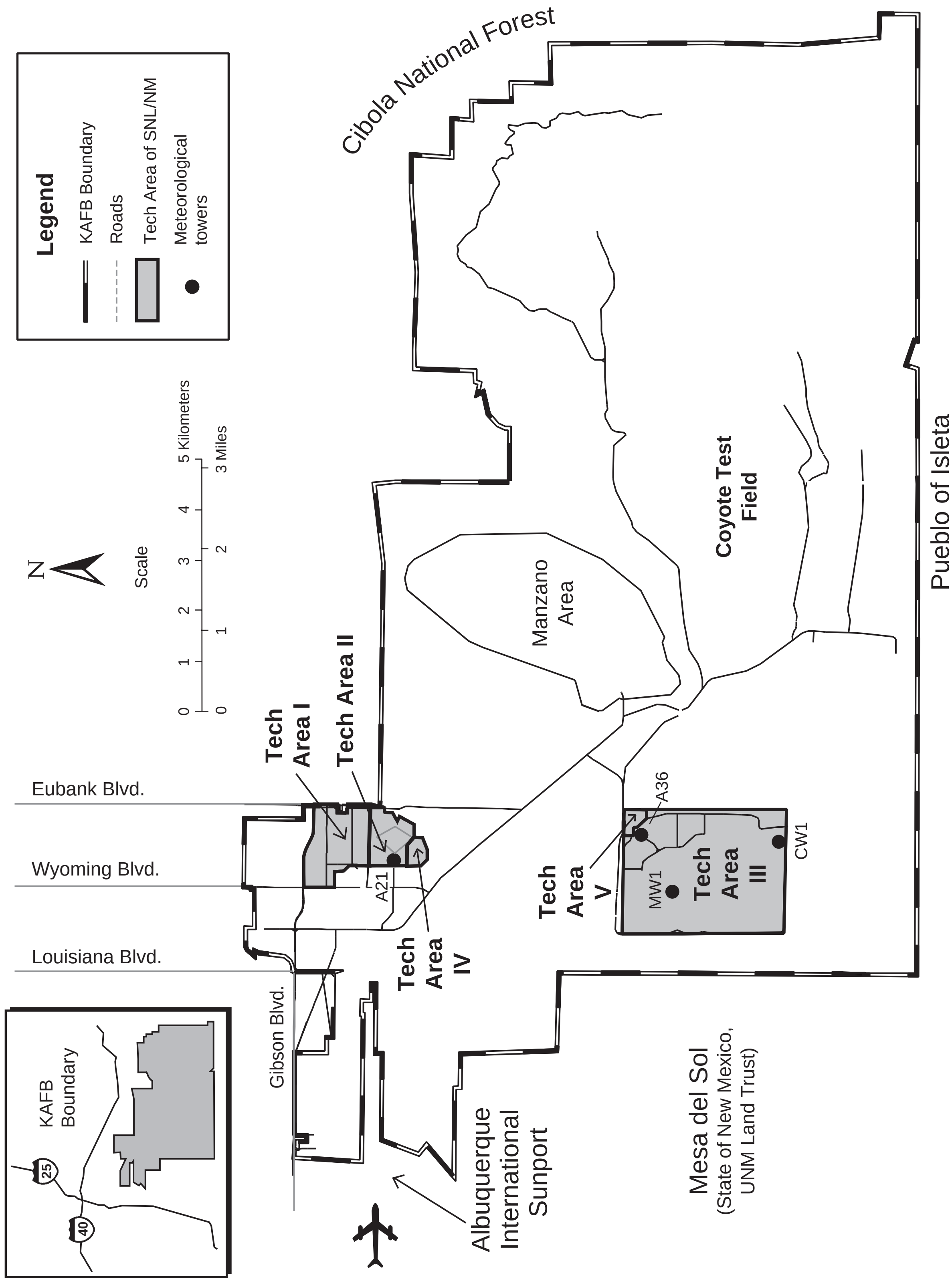
FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	NO ACTION RELEASE (Ci/yr)	EXPANDED OPERATIONS RELEASE (Ci/yr)	REDUCED OPERATIONS RELEASE (Ci/yr)
Annular Core Research Reactor, Building 6588 (ACRR, DP configuration)	V	Argon-41	2.6	7.8	0
Annular Core Research Reactor, Building 6588 (ACRR, medical isotopes 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}	2.0x-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

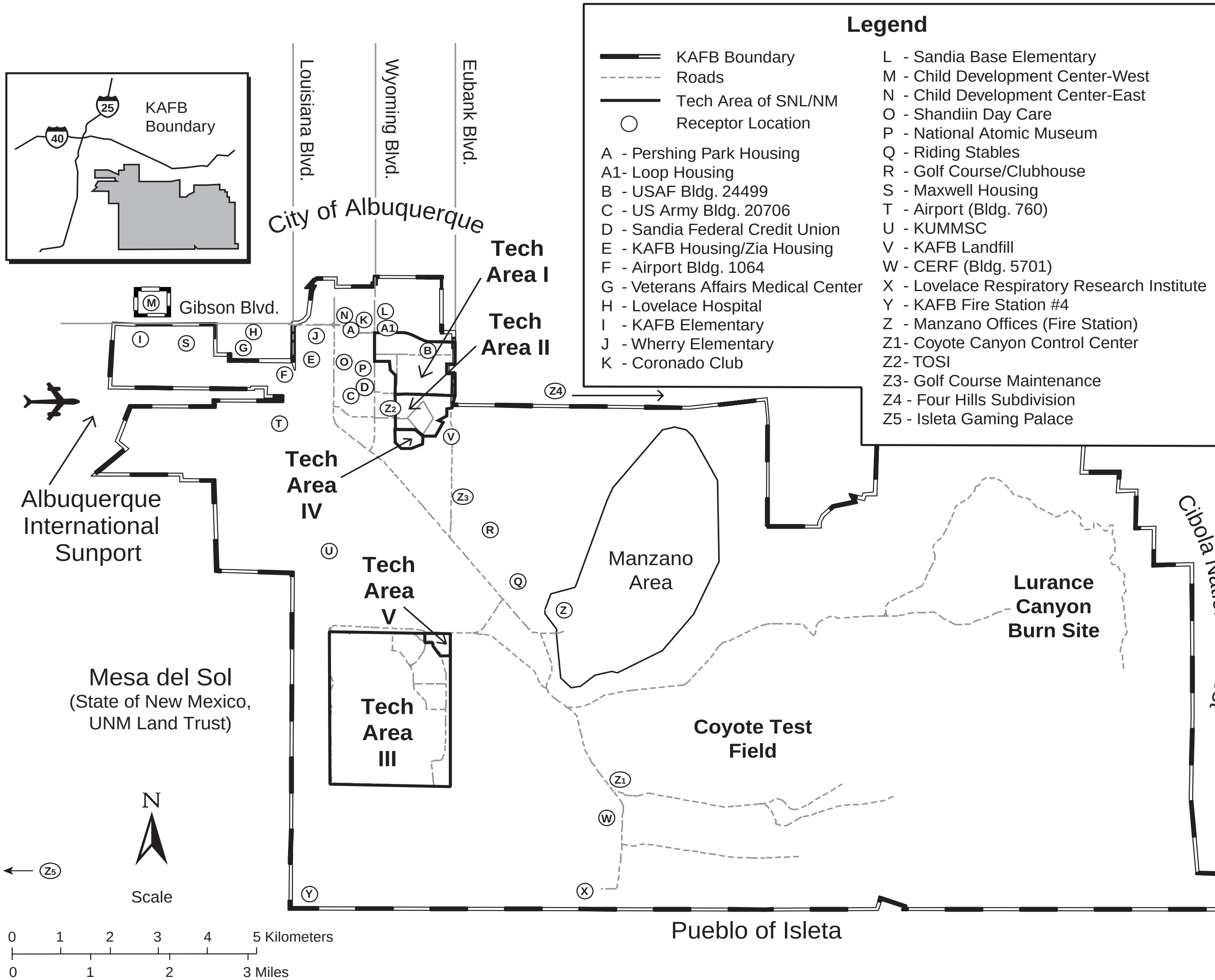
locations were selected based on the review of the NESHAP compliance reports for the public MEI, SNL/NM site information documents, and receptor locations that are in close proximity to the sources, site boundary, or are in prevailing wind directions and that represent children, sick, and elderly (schools, 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	$1.5x10^{-4}$	$2.3x10^{-5}$	$4.4x10^{-5}$	$2.2x10^{-2}$	$7.3x10^{-8}$	$7.8x10^{-8}$	$2.3x10^{-6}$	$1.0x10^{-7}$	$5.6x10^{-3}$	$7.0x10^{-6}$	$2.8x10^{-2}$
Building 24499	$9.6x10^{-5}$	$1.5x10^{-5}$	$2.9x10^{-5}$	$1.4x10^{-2}$	$2.0x10^{-8}$	$6.7x10^{-7}$	$2.0x10^{-6}$	$7.3x10^{-8}$	$6.1x10^{-3}$	$2.0x10^{-6}$	$2.0x10^{-2}$
Civil Engineering Research Facility (Bldg. 5701)	$9.0x10^{-5}$	$1.4x10^{-5}$	$2.7x10^{-5}$	$1.2x10^{-2}$	$5.2x10^{-10}$	$6.8x10^{-7}$	$4.4x10^{-6}$	$2.1x10^{-9}$	$1.5x10^{-4}$	$5.2x10^{-6}$	$1.2x10^{-2}$
Child Development Center-East	$1.0x10^{-4}$	$1.5x10^{-5}$	$2.9x10^{-5}$	$1.5x10^{-2}$	$1.3x10^{-8}$	$8.3x10^{-7}$	$1.8x10^{-6}$	$2.9x10^{-8}$	$3.6x10^{-3}$	$1.3x10^{-6}$	$1.8x10^{-2}$
Child Development Center-West	$1.1x10^{-4}$	$1.7x10^{-5}$	$3.2x10^{-5}$	$1.8x10^{-2}$	$2.1x10^{-9}$	$8.4x10^{-7}$	$2.1x10^{-6}$	$8.3x10^{-9}$	$7.3x10^{-4}$	$2.0x10^{-7}$	$1.9x10^{-2}$
Coronado Club	$1.0x10^{-4}$	$1.5x10^{-5}$	$2.9x10^{-5}$	$1.5x10^{-2}$	$1.5x10^{-8}$	$6.3x10^{-7}$	$1.8x10^{-6}$	$3.2x10^{-8}$	$4.2x10^{-3}$	$1.4x10^{-6}$	$2.0x10^{-2}$
Coyote Canyon Control Center	$8.9x10^{-5}$	$1.4x10^{-5}$	$2.6x10^{-5}$	$1.2x10^{-2}$	$4.1x10^{-10}$	$5.7x10^{-7}$	$4.0x10^{-6}$	$2.2x10^{-9}$	$1.6x10^{-4}$	$3.9x10^{-8}$	$1.2x10^{-2}$
Golf Course Clubhouse	$5.4x10^{-4}$	$9.0x10^{-5}$	$1.8x10^{-4}$	$7.0x10^{-2}$	$2.1x10^{-8}$	$2.0x10^{-6}$	$4.7x10^{-6}$	$1.1x10^{-8}$	$6.7x10^{-4}$	$2.0x10^{-6}$	$7.2x10^{-2}$
Golf Course Maintenance Area	$3.4x10^{-4}$	$5.6x10^{-4}$	$1.1x10^{-4}$	$4.4x10^{-2}$	$3.8x10^{-8}$	$1.5x10^{-6}$	$3.9x10^{-6}$	$1.7x10^{-8}$	$9.7x10^{-4}$	$3.7x10^{-6}$	$4.5x10^{-2}$
Lovelace Respiratory Research Institute	$8.6x10^{-5}$	$1.3x10^{-5}$	$2.5x10^{-5}$	$1.2x10^{-2}$	$3.3x10^{-10}$	$5.5x10^{-10}$	$4.0x10^{-6}$	$1.8x10^{-8}$	$1.3x10^{-4}$	$3.2x10^{-8}$	$1.2x10^{-2}$
Kirtland Elementary School	$1.1x10^{-4}$	$1.6x10^{-5}$	$3.1x10^{-5}$	$1.8x10^{-2}$	$1.8x10^{-9}$	$8.2x10^{-7}$	$2.1x10^{-6}$	$7.6x10^{-9}$	$7.3x10^{-4}$	$1.7x10^{-7}$	$1.9x10^{-2}$
KAFB Firestation #4 (Bldg. 9002)	$1.3x10^{-4}$	$2.0x10^{-5}$	$3.7x10^{-5}$	$1.7x10^{-2}$	$1.6x10^{-10}$	$1.3x10^{-6}$	$9.8x1^{-6}$	$2.4x10^{-9}$	$1.8x10^{-4}$	$1.6x10^{-8}$	$1.7x10^{-2}$
KAFB Landfill	$1.9x10^{-4}$	$3.0x10^{-5}$	$5.9x10^{-5}$	$2.6x1^{-2}$	$1.5x10^{-7}$	$9.8x10^{-7}$	$2.9x10^{-6}$	$5.8x10^{-8}$	$2.4x10^{-3}$	$1.4x10^{-5}$	$2.9x10^{-2}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	$1.3x10^{-3}$	$2.1x10^{-4}$	$4.2x10^{-4}$	$1.5x10^{-1}$	$1.0x10^{-8}$	$4.0x10^{-6}$	$7.5x10^{-6}$	$9.9x10^{-9}$	$7.4x10^{-4}$	$9.8x10^{-7}$	$1.5x10^{-1}$
Loop Housing	$9.1x10^{-5}$	$1.4x10^{-5}$	$2.7x10^{-5}$	$1.4x10^{-2}$	$2.2x10^{-8}$	$6.0x10^{-7}$	$1.9x10^{-6}$	$5.8x10^{-8}$	$7.0x10^{-3}$	$2.1x10^{-6}$	$2.1x10^{-2}$

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	$8.4x10^{-5}$	$1.3x10^{-5}$	$2.4x10^{-5}$	$1.3x10^{-2}$	$4.1x10^{-9}$	$7.2x10^{-7}$	$2.4x10^{-6}$	$1.3x10^{-8}$	$1.2x10^{-3}$	$4.1x10^{-7}$	$1.4x10^{-2}$
Manzano Offices (Fire Station)	$2.7x10^{-4}$	$4.3x10^{-5}$	$8.6x10^{-5}$	$3.3x10^{-2}$	$2.6x10^{-9}$	$1.2x10^{-6}$	$4.9x10^{-6}$	$5.1x10^{-9}$	$3.5x10^{-4}$	$2.6x10^{-7}$	$3.4x10^{-2}$
Maxwell Housing	$1.3x10^{-4}$	$1.9x10^{-5}$	$3.7x10^{-5}$	$2.1x10^{-2}$	$3.0x10^{-9}$	$9.0x10^{-7}$	$2.3x10^{-6}$	$1.0x10^{-8}$	$9.4x10^{-4}$	$2.9x10^{-6}$	$2.2x10^{-2}$
National Atomic Museum	$1.2x10^{-4}$	$1.9x10^{-5}$	$3.6x10^{-5}$	$1.8x10^{-2}$	$3.3x10^{-8}$	$1.0x10^{-6}$	$2.1x1^{-6}$	$5.2x10^{-8}$	$7.2x10^{-3}$	$2.4x10^{-6}$	$2.5x10^{-2}$
Pershing Park Housing	$7.6x10^{-5}$	$1.4x10^{-5}$	$2.7x10^{-5}$	$1.4x10^{-2}$	$1.1x10^{-8}$	$5.3x10^{-7}$	$1.7x10^{-6}$	$3.2x10^{-8}$	$3.5x10^{-3}$	$1.1x10^{-6}$	$1.7x10^{-2}$
Riding Club/Stables	$5.1x10^{-4}$	$8.8x10^{-5}$	$1.8x10^{-4}$	$6.2x10^{-2}$	$5.5x10^{-9}$	$1.8x10^{-6}$	$5.5x10^{-6}$	$8.5x10^{-8}$	$4.5x10^{-4}$	$5.2x10^{-7}$	$6.3x10^{-2}$
Sandia Base Elementary	$7.8x10^{-5}$	$1.2x10^{-5}$	$2.3x10^{-5}$	$1.2x10^{-2}$	$1.3x10^{-8}$	$6.1x10^{-7}$	$2.5x10^{-6}$	$3.2x10^{-8}$	$4.1x10^{-3}$	$1.3x10^{-6}$	$1.7x10^{-2}$
Sandia Federal Credit Union	$1.3x10^{-4}$	$2.0x10^{-5}$	$3.8x10^{-5}$	$1.9x10^{-2}$	$4.1x10^{-8}$	$6.9x10^{-7}$	$2.1x10^{-6}$	$9.7x10^{-7}$	$1.2x10^{-2}$	$4.1x10^{-6}$	$3.1x10^{-2}$
Shandiin Day Care Center	$1.2x10^{-4}$	$1.8x10^{-5}$	$3.4x10^{-5}$	$1.7x10^{-2}$	$2.0x10^{-8}$	$9.7x10^{-7}$	$2.0x10^{-6}$	$3.5x10^{-8}$	$4.6x10^{-3}$	$1.9x10^{-6}$	$2.2x10^{-2}$
Sunport (Bldg. 760)	$1.4x10^{-4}$	$3.6x10^{-5}$	$7.0x10^{-5}$	$3.7x10^{-2}$	$1.6x10^{-8}$	$1.0x10^{-6}$	$3.2x10^{-6}$	$2.4x10^{-8}$	$1.7x10^{-3}$	$1.6x10^{-6}$	$3.9x10^{-2}$
Sunport (Bldg. 1064)	$1.1x10^{-4}$	$1.7x10^{-5}$	$3.2x10^{-5}$	$1.6x10^{-2}$	$1.1x10^{-8}$	$8.2x10^{-7}$	$2.8x10^{-6}$	$2.3x10^{-8}$	$2.0x10^{-3}$	$1.1x10^{-6}$	$1.8x10^{-2}$
Technical Onsite Inspection Facility	$1.9x10^{-4}$	$3.0x10^{-5}$	$5.9x10^{-5}$	$2.8x10^{-2}$	$3.1x10^{-7}$	$9.7x10^{-7}$	$2.7x10^{-6}$	$6.9x10^{-9}$	$3.9x10^{-3}$	$2.9x10^{-5}$	$3.3x10^{-2}$
Veterans Affairs Medical Center	$1.6x10^{-4}$	$2.3x10^{-5}$	$4.5x10^{-5}$	$2.5x10^{-2}$	$5.2x10^{-9}$	$7.9x10^{-7}$	$2.5x10^{-6}$	$1.4x10^{-8}$	$1.4x10^{-3}$	$5.1x10^{-7}$	$2.7x10^{-2}$
Wherry Elementary School	$9.8x10^{-5}$	$1.5x10^{-5}$	$2.8x10^{-5}$	$1.5x10^{-2}$	$1.0x10^{-8}$	$7.9x10^{-7}$	$2.5x10^{-6}$	$2.4x10^{-8}$	$2.9x10^{-3}$	$9.8x10^{-7}$	$1.8x10^{-2}$
Zia Park Housing	$1.2x10^{-4}$	$1.9x10^{-5}$	$3.7x10^{-5}$	$1.9x10^{-2}$	$2.2x10^{-8}$	$8.9x10^{-7}$	$2.9x10^{-6}$	$4.2x10^{-8}$	$3.9x10^{-3}$	$2.1x10^{-6}$	$2.4x10^{-2}$
OFFSITE POTENTIAL MEI (mrem/yr)											
Albuquerque City Offices	$1.9x10^{-4}$	$4.4x10^{-5}$	$5.4x10^{-5}$	$4.1x10^{-2}$	$5.5x10^{-9}$	$6.4x10^{-6}$	$2.2x10^{-5}$	$1.3x10^{-7}$	$1.0x10^{-2}$	$1.2x10^{-8}$	$5.1x10^{-2}$
East Resident	$1.2x10^{-5}$	$1.8x10^{-5}$	$3.4x10^{-6}$	$1.4x10^{-2}$	$1.5x10^{-11}$	$4.3x10^{-6}$	$1.7x10^{-5}$	$1.2x10^{-7}$	$9.5x10^{-3}$	$3.2x10^{-11}$	$2.4x10^{-2}$
Eubank Gate Area (Bldg. 8895)	$1.0x10^{-4}$	$3.3x10^{-5}$	$3.2x10^{-5}$	$2.8x10^{-2}$	$2.8x10^{-8}$	$4.9x10^{-6}$	$1.9x10^{-5}$	$1.9x10^{-7}$	$1.7x10^{-2}$	$6.1x10^{-8}$	$4.5x10^{-2}$

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	$6.0x10^{-4}$	8.910^{-5}	$1.6x10^{-4}$	0.14	$1.6x10^{-8}$	$6.4x10^{-6}$	$2.2x10^{-5}$	$1.3x10^{-7}$	$1.0x10^{-2}$	$7.2x10^{-7}$	$1.5x10^{-1}$
East Resident	$3.7x10^{-5}$	$3.5x10^{-5}$	$1.0x10^{-5}$	0.048	$4.2x10^{-11}$	$4.3x10^{-6}$	$1.7x10^{-5}$	$1.2x10^{-7}$	$9.5x10^{-3}$	$1.9x10^{-9}$	$5.8x10^{-2}$
Eubank Gate Area (Bldg. 8895)	$3.3x10^{-4}$	$6.5x10^{-5}$	$9.5x10^{-5}$	0.095	$8.1x10^{-8}$	$4.9x10^{-6}$	$1.9x10^{-5}$	$1.9x10^{-7}$	$1.7x10^{-2}$	$3.6x10^{-6}$	$1.1x10^{-1}$
Four Hills Subdivision	$3.8x10^{-4}$	$7.0x10^{-5}$	$1.1x10^{-4}$	0.10	$2.5x10^{-8}$	$4.9x10^{-6}$	$1.9x10^{-5}$	$1.3x10^{-7}$	$1.0x10^{-2}$	$1.1x10^{-6}$	$1.1x10^{-1}$
Isleta Gaming Palace	$8.6x10^{-5}$	$4.0x10^{-5}$	$2.3x1^{-5}$	0.056	$1.2x10^{-10}$	$4.6x10^{-6}$	$2.1x10^{-5}$	$1.2x10^{-7}$	$9.6x10^{-3}$	$5.1x10^{-9}$	$6.6x10^{-2}$
Northeast Resident	$1.7x10^{-4}$	$4.8x10^{-5}$	$4.7x10^{-5}$	0.068	$2.4x10^{-9}$	$4.5x10^{-6}$	$1.8x10^{-5}$	$1.2x10^{-7}$	$9.6x10^{-3}$	$1.1x10^{-7}$	$7.8x10^{-2}$
Seismic Center (USGS)	$1.1x10^{-4}$	$4.2x10^{-5}$	$2.9x10^{-5}$	0.058	$3.1x10^{-10}$	$4.4x10^{-6}$	$1.8x10^{-5}$	$1.2x10^{-7}$	$9.5x10^{-3}$	$1.4x10^{-8}$	$6.8x10^{-2}$
Tijeras Arroyo (West)	$8.6x10^{-4}$	$1.1x10^{-4}$	$2.3x10^{-4}$	0.18	$2.3x10^{-8}$	$7.5x10^{-6}$	$2.4x10^{-5}$	$1.3x10^{-7}$	$1.0x10^{-2}$	1.010^{-6}	$1.9x10^{-1}$
POPULATION DOSE (person-rem)	**0.0801**	**0.0107**	**0.0216**	**15.4**	$6.06x10^{-7}$	$6.16x10^{-4}$	$3.24x10^{-3}$	$4.19x10^{-6}$	**0.322**	$2.69x10^{-5}$	**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	2.5×10^{-4}	2.7×10^{-6}	0	1.3×10^{-3}	3.3×10^{-10}	7.2×10^{-7}	2.4×10^{-6}	1.3×10^{-9}	1.2×10^{-3}	6.8×10^{-8}	2.8×10^{-3}
Manzano Offices (Fire Station)	8.2×10^{-5}	9.5×10^{-6}	0	3.3×10^{-3}	2.1×10^{-10}	1.2×10^{-6}	4.9×10^{-6}	5.1×10^{-10}	3.5×10^{-4}	4.3×10^{-8}	3.8×10^{-3}
Maxwell Housing	3.9×10^{-5}	4.3×10^{-6}	0	1.2×10^{-3}	2.4×10^{-10}	9.0×10^{-7}	2.3×10^{-6}	1.0×10^{-9}	9.4×10^{-4}	4.8×10^{-8}	2.2×10^{-3}
National Atomic Museum	3.7×10^{-5}	4.0×10^{-6}	0	1.8×10^{-3}	2.6×10^{-9}	1.0×10^{-6}	2.1×10^{-6}	5.2×10^{-9}	7.2×10^{-3}	4.0×10^{-7}	9.0×10^{-3}
Pershing Park Housing	$2..3\times10^{-5}$	3.1×10^{-6}	0	1.4×10^{-3}	8.9×10^{-10}	5.3×10^{-7}	1.7×10^{-6}	3.2×10^{-9}	3.5×10^{-3}	1.8×10^{-7}	4.9×10^{-3}
Riding Club	1.5×10^{-4}	2.0×10^{-5}	0	6.2×10^{-3}	4.4×10^{-10}	1.8×10^{-6}	5.5×10^{-6}	8.5×10^{-9}	4.5×10^{-4}	8.6×10^{-8}	6.8×10^{-3}
Sandia Base Elementary	2.4×10^{-5}	2.6×10^{-6}	0	1.2×10^{-3}	1.1×10^{-9}	6.1×10^{-7}	2.5×10^{-6}	3.2×10^{-9}	4.1×10^{-3}	2.1×10^{-7}	4.1×10^{-3}
Sandia Federal Credit Union	3.8×10^{-5}	4.3×10^{-6}	0	1.9×10^{-3}	3.3×10^{-9}	6.9×10^{-7}	2.1×10^{-6}	9.7×10^{-9}	1.2×10^{-2}	6.8×10^{-7}	1.4×10^{-2}
Shandiin Day Care Center	3.5×10^{-5}	3.9×10^{-6}	0	1.7×10^{-3}	1.6×10^{-9}	9.7×10^{-7}	2.0×10^{-6}	3.5×10^{-9}	4.6×10^{-3}	3.1×10^{-7}	6.3×10^{-3}
Sunport (Bldg. 1064)	3.2×10^{-5}	3.6×10^{-6}	0	1.6×10^{-3}	8.9×10^{-10}	8.2×10^{-7}	2.8×10^{-6}	2.3×10^{-9}	2.0×10^{-3}	1.8×10^{-7}	3.6×10^{-3}
Sunport (Bldg. 760)	4.1×10^{-5}	7.7×10^{-6}	0	3.7×10^{-3}	1.3×10^{-9}	1.0×10^{-6}	3.2×10^{-6}	2.4×10^{-9}	1.7×10^{-3}	2.6×10^{-7}	5.4×10^{-3}
Technical Onsite Inspection Facility	5.8×10^{-5}	6.5×10^{-6}	0	2.8×10^{-3}	2.5×10^{-8}	9.7×10^{-7}	2.7×10^{-6}	6.9×10^{-10}	3.9×10^{-3}	4.8×10^{-6}	6.8×10^{-3}
Veterans Affairs Medical Center	4.8×10^{-5}	5.0×10^{-6}	0	2.5×10^{-3}	4.2×10^{-10}	7.9×10^{-7}	2.5×10^{-6}	1.4×10^{-9}	1.4×10^{-3}	8.5×10^{-8}	4.0×10^{-3}
Wherry Elementary School	2.9×10^{-5}	3.2×10^{-6}	0	1.5×10^{-3}	8.3×10^{-10}	7.9×10^{-7}	2.5×10^{-6}	2.4×10^{-9}	2.9×10^{-3}	1.6×10^{-7}	4.5×10^{-3}
Zia Park Housing	3.7×10^{-5}	4.1×10^{-6}	0	1.9×10^{-3}	1.8×10^{-9}	8.9×10^{-7}	2.9×10^{-6}	4.2×10^{-9}	3.9×10^{-3}	3.5×10^{-7}	5.8×10^{-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 (concluded)

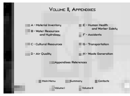
RECEPTORS	SPR (Bldg. 6590)	ACRR (Mo-99) (Bldg. 6588)	ACRR (DP) (Bldg. 6588)	HCF (Bldg. 6580)	HERMES III (Bldg. 970)	MWL	RMWMF (Bldg. 6920)	ECF (Bldg. 905)	NGF (Bldg. 870)	RITS (Bldg. 970)	TOTAL
OFFSITE POTENTIAL MEI (mrem/yr)											
Albuquerque City Offices	5.7×10^{-4}	9.7×10^{-6}	0	4.1×10^{-3}	4.4×10^{-10}	6.4×10^{-6}	2.2×10^{-5}	1.3×10^{-8}	1.0×10^{-2}	9.0×10^{-8}	1.5×10^{-2}
East Resident	3.5×10^{-6}	3.8×10^{-6}	0	1.4×10^{-3}	1.2×10^{-12}	4.3×10^{-6}	1.7×10^{-5}	1.2×10^{-8}	9.5×10^{-3}	2.4×10^{-10}	1.1×10^{-2}
Eubank Gate Area (Bldg. 8895)	3.1×10^{-5}	7.1×10^{-6}	0	2.8×10^{-3}	2.2×10^{-9}	4.9×10^{-6}	1.9×10^{-5}	1.9×10^{-8}	1.7×10^{-2}	4.5×10^{-7}	2.0×10^{-2}
Four Hills Subdivision	3.6×10^{-5}	7.6×10^{-6}	0	3.1×10^{-3}	6.9×10^{-10}	4.9×10^{-6}	1.9×10^{-5}	1.3×10^{-8}	1.0×10^{-2}	1.4×10^{-7}	1.0×10^{-2}
Isleta Gaming Palace	8.2×10^{-6}	4.4×10^{-6}	0	1.7×10^{-3}	3.3×10^{-12}	4.6×10^{-6}	2.1×10^{-5}	1.2×10^{-8}	9.6×10^{-3}	6.4×10^{-10}	1.1×10^{-2}
Northeast Resident	1.6×10^{-5}	5.2×10^{-6}	0	2.0×10^{-3}	6.6×10^{-11}	4.5×10^{-6}	1.8×10^{-5}	1.2×10^{-8}	9.6×10^{-3}	1.4×10^{-8}	1.2×10^{-2}
Seismic Center (USGS)	1.0×10^{-5}	4.6×10^{-6}	0	1.7×10^{-3}	8.6×10^{-12}	4.4×10^{-6}	1.8×10^{-5}	1.2×10^{-8}	9.5×10^{-3}	1.8×10^{-9}	1.1×10^{-2}
Tijeras Arroyo (West)	8.2×10^{-5}	1.2×10^{-5}	0	5.3×10^{-3}	6.4×10^{-10}	7.5×10^{-6}	2.4×10^{-5}	1.3×10^{-8}	1.0×10^{-2}	1.3×10^{-7}	1.5×10^{-2}
POPULATION DOSE (person-rem/yr)	**7.6×10^{-3}**	**1.2×10^{-3}**	**0**	**0.461**	**1.7×10^{-8}**	**6.16×10^{-4}**	**3.24×10^{-3}**	**4.19×10^{-7}**	**0.322**	**3.4×10^{-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.



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E

Human Health and Worker Safety

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	9.85×10^{-7}	2.36×10^{-6}	5.09×10^{-8}	1.10×10^{-8}	7.84×10^{-8}	2.08×10^{-8}	1.13×10^{-8}	6.52×10^{-8}	1.36×10^{-8}	1.80×10^{-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	1.10×10^{-5}	9.98×10^{-6}	1.35×10^{-7}	3.85×10^{-8}	1.56×10^{-7}	1.84×10^{-7}	3.79×10^{-8}	1.28×10^{-7}	1.67×10^{-7}	5.52×10^{-8}
Dichloromethane (Methylene chloride)	878 870	2.18×10^{-4}	2.95×10^{-4}	7.82×10^{-6}	1.62×10^{-6}	9.43×10^{-6}	4.28×10^{-6}	1.63×10^{-6}	5.51×10^{-6}	2.64×10^{-6}	2.58×10^{-6}
Formaldehyde	878	4.88×10^{-7}	1.05×10^{-6}	2.96×10^{-8}	6.14×10^{-9}	4.08×10^{-8}	1.16×10^{-8}	6.39×10^{-9}	3.75×10^{-8}	7.60×10^{-9}	1.05×10^{-8}
Trichloroethylene	878 897	4.61×10^{-5}	9.21×10^{-5}	2.54×10^{-6}	5.31×10^{-7}	3.46×10^{-6}	1.05×10^{-6}	5.51×10^{-7}	3.15×10^{-6}	6.87×10^{-7}	9.01×10^{-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	$1.97x10^{-6}$	$4.70x10^{-6}$	$1.02x10^{-7}$	$2.20x10^{-8}$	$1.56x10^{-7}$	$4.14x10^{-8}$	$2.26x10^{-8}$	$1.30x10^{-7}$	$2.72x10^{-8}$	$3.60x10^{-8}$
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	$9.48x10^{-6}$	$8.87x10^{-6}$	$1.32x10^{-7}$	$3.59x10^{-8}$	$1.53x10^{-7}$	$1.59x10^{-7}$	$3.54x10^{-8}$	$1.23x10^{-7}$	$1.39x10^{-7}$	$5.20x10^{-8}$
Dichloromethane (Methylene chloride)	878 870	$2.20x10^{-4}$	$3.01x10^{-4}$	$7.97x10^{-6}$	$1.65x10^{-6}$	$9.64x10^{-6}$	$4.34x10^{-6}$	$1.66x10^{-6}$	$7.71x10^{-6}$	$2.68x10^{-6}$	$2.64x10^{-6}$
Formaldehyde	878	$6.49x10^{-7}$	$1.40x10^{-6}$	$3.94x10^{-8}$	$8.18x10^{-9}$	$5.43x10^{-8}$	$1.55x10^{-8}$	$8.51x10^{-9}$	$4.99x10^{-8}$	$1.01x10^{-8}$	$1.40x10^{-8}$
Trichloroethylene	878 897	$5.91x10^{-5}$	$1.20x10^{4}$	$3.33x10^{-6}$	$6.95x10^{-7}$	$4.55x10^{-6}$	$1.36x10^{-6}$	$7.21x10^{-7}$	$4.15x10^{-6}$	$8.89x10^{-7}$	$1.18x10^{-6}$

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	4.36×10^{-7}	2.57×10^{-8}	1.06×10^{-7}	2.08×10^{-7}	3.73×10^{-8}	4.61×10^{-8}	8.40×10^{-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	2.29×10^{-7}	8.40×10^{-8}	1.42×10^{-7}	1.60×10^{-7}	1.44×10^{-7}	5.99×10^{-8}	1.03×10^{-7}
Dichloromethane (Methylene chloride)	878 870	1.77×10^{-5}	2.73×10^{-6}	8.81×10^{-6}	1.10×10^{-5}	3.91×10^{-6}	3.16×10^{-6}	5.83×10^{-6}
Formaldehyde	878	1.62×10^{-7}	1.01×10^{-8}	5.33×10^{-8}	7.92×10^{-8}	1.39×10^{-8}	1.82×10^{-8}	2.89×10^{-8}
Trichloroethylene	878 897	1.33×10^{-5}	8.84×10^{-7}	4.46×10^{6}	6.55×10^{-6}	1.22×10^{-6}	1.53×10^{-6}	2.45×10^{-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 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/m³) 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/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 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/m³.

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	$9.10x10^{-2}$	$2.6x10^{-5}$	IRIS (EPA 1998a)
1,4-Dichloro-2-butene	764-41-0	NF	9.30	$2.66x10^{-3}$	IRIS (EPA 1998a)
Acrylonitrile	107-13-1	B1	$2.38x10^{-1}$	$6.80x10^{-5}$	IRIS (EPA 1998a)
Trichloromethane (chloroform)	67-66-3	B2	$8.05x10^{-2}$	$2.3x10^{-5}$	IRIS (EPA 1998a)
Dichloromethane (methylene chloride)	75-09-2	B2	$1.65x10^{-3}$	$4.70x10^{-7}$	IRIS (EPA 1998a)
Formaldehyde	50-00-0	B1	$4.55x10^{-2}$	$1.3x10^{-5}$	IRIS (EPA 1998a)
Trichloroethylene	79-01-6	B2-C	$6.00x10^{-3}$	$1.71x10^{-6}$	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	$9.10x10^{-2}$	$2.6x10^{-5}$	IRIS (EPA 1998a)
1,4-Dichloro-2-butene	764-41-0	NF	9.30	$2.66x10^{-3}$	IRIS (EPA 1998a)
Acrylonitrile	107-13-1	B1	$2.38x10^{-1}$	$6.80x10^{-5}$	IRIS (EPA 1998a)
Trichloromethane (chloroform)	67-66-3	B2	$8.05x10^{-2}$	$2.3x10^{-5}$	IRIS (EPA 1998a)
Dichloromethane (methylene chloride)	75-09-2	B2	$1.65x10^{-3}$	$4.70x10^{-7}$	IRIS (EPA 1998a)
Formaldehyde	50-00-0	B1	$4.55x10^{-2}$	$1.3x10^{-5}$	IRIS (EPA 1998a)
Trichloroethylene	79-01-6	B2-C	$6.00x10^{-3}$	$1.71x10^{-6}$	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	$5.6x10^{-2}$	IRIS (EPA 1998a)
1,2-Dichloroethane	107-06-2	B2	$9.10x10^{-2}$	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	$9.8x10^{-1}$	IRIS (EPA 1998a)
1,3,5-Trimethylbenzene	108-67-8	NA	NA	IRIS (EPA 1998a)
Acetaldehyde	75-07-0	B2	$7.7x10^{-3}$	IRIS (EPA 1998a)
Benzene	71-43-2	A	$2.9x10^{-2}$	IRIS (EPA 1998a)
Bis (2-chloroethyl) ether	111-44-4	B2	1.16	IRIS (EPA 1998a)
Chloromethane	74-87-3	D	$6.3x10^{-3}$	HEAST (EPA 1997b)
Dichlorodifluoromethane	75-71-8	NA	NA	IRIS (EPA 1998a)
Dichloromethane (methylene chloride)	75-09-2	B2	$1.65x10^{-3}$	IRIS (EPA 1998a); HEAST (EPA 1997b)
Ethylbenzene	100-41-4	NA	NA	IRIS (EPA 1998a)
Hexachlorobutadiene	87-68-3	C	$7.8x10^{-2}$	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:

$$\underset{\text{(CDI or LADD)}}{\text{Chemical Intake}_i \text{ (mg/kg-day)}} = \frac{C_i \times IR \times ET \times EF \times ED}{BW \times AT}$$

(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.

$$\text{Total number of fatal cancers in general population from annual exposure} = \left(\frac{500}{10^6 \text{ person} - \text{rem}}\right) \times \left(\begin{array}{c}\text{annual} \\ \text{collective} \\ \text{dose(person} - \text{rem)}\end{array}\right)$$

or

$$\text{Total number of fatal cancers in worker population from annual exposure} = \left(\frac{400}{10^6 \text{ person} - \text{rem}}\right) \times \left(\begin{array}{c}\text{annual} \\ \text{worker} \\ \text{population} \\ \text{collective} \\ \text{dose} \\ \text{(person} - \text{rem)}\end{array}\right)$$

(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	$7.5x10^{-8}$	$1.5x10^{-8}$	$2.0x10^{-8}$	5.0 (0.55)[a]	$2.5x10^{-3}$	$5.0x10^{-4}$	$6.5x10^{-4}$
Expanded Operations[b]	0.51	$2.6x10^{-7}$	$5.1x10^{-8}$	$6.6x10^{-8}$	15.8 (1.62)[a]	$7.9x10^{-3}$	$1.6x10^{-3}$	$2.1x10^{-3}$
Reduced Operations	0.016	$8.0x10^{-9}$	$1.6x10^{-9}$	$2.1x10^{-9}$	0.80 (0.101)[a]	$4.0x10^{-4}$	$8.0x10^{-5}$	$1.0x10^{-4}$

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	$1.8x10^{-2}$	$9.0x10^{-9}$	$5.4x10^{-2}$	$2.7x10^{-8}$	$5.1x10^{-3}$	$2.6x10^{-9}$
Child Development Center-West	$1.9x10^{-2}$	$9.5x10^{-9}$	$6.2x10^{-2}$	$3.1x10^{-8}$	$2.6x10^{-3}$	$1.3x10^{-9}$
Coronado Club	$2.0x10^{-2}$	$1.0x10^{-8}$	$5.5x10^{-2}$	$2.8x10^{-8}$	$5.7x10^{-3}$	$2.9x10^{-9}$
Four Hills Subdivision	$4.1x 10^{-2}$	$2.1x10^{-8}$	$1.1x10^{-1}$	$5.5x10^{-8}$	$1.0x10^{-2}$	$5.0x10^{-9}$
Golf Course (clubhouse)	$7.2x10^{-2}$	$3.6x10^{-8}$	$2.3x10^{-1}$	$1.2x10^{-7}$	$7.9x10^{-3}$	$4.0x10^{-9}$
Kirtland Elementary School	$1.9x10^{-2}$	$9.5x10^{-9}$	$6.1x10^{-2}$	$3.1x10^{-8}$	$2.5x10^{-3}$	$1.3x10^{-9}$
KAFB Housing (Zia Park Housing)	$2.4x10^{-2}$	$1.2x10^{-8}$	$6.6x10^{-2}$	$3.3x10^{-8}$	$5.8x10^{-3}$	$2.9x10^{-9}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	$1.5x10^{-1}$	$7.5x10^{-8}$	$5.1x10^{-1}$	$2.6x10^{-7}$	$1.6x10^{-2}$	$8.0x10^{-9}$
Lovelace Hospital	$1.4x10^{-2}$	$7.0x10^{-9}$	$4.5x10^{-2}$	$2.3x10^{-8}$	$2.8x10^{-3}$	$1.4x10^{-9}$
National Atomic Museum	$2.5x10^{-2}$	$1.3x10^{-8}$	$6.9x10^{-2}$	$3.5x10^{-8}$	$9.0x10^{-3}$	$4.5x10^{-9}$
Riding Stables	$6.3x10^{-2}$	$3.2x10^{-8}$	$2.1x10^{-1}$	$1.1x10^{-7}$	$6.8x10^{-3}$	$3.4x10^{-9}$
Sandia Base Elementary School	$1.7x10^{-2}$	$8.5x10^{-9}$	$4.3x10^{-2}$	$2.2x10^{-8}$	$4.1x10^{-3}$	$2.1x10^{-9}$
Shandiin Day Care Center	$2.2x10^{-2}$	$1.1x10^{-8}$	$6.3x10^{-2}$	$3.2x10^{-8}$	$6.3x10^{-3}$	$3.2x10^{-9}$
Isleta Gaming Palace	$2.7x10^{-2}$	$1.4x10^{-8}$	$6.6x10^{-2}$	$3.3x10^{-8}$	$1.1x10^{-2}$	$5.5x10^{-9}$
Veterans Affairs Medical Center	$2.7x10^{-2}$	$1.4x10^{-8}$	$8.4x10^{-2}$	$4.2x10^{-8}$	$4.0x10^{-3}$	$2.0x10^{-9}$
Wherry Elementary School	$1.8x10^{-2}$	$9.0x10^{-9}$	$5.2x10^{-2}$	$2.6x10^{-8}$	$4.5x10^{-3}$	$2.3x10^{-9}$

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	1.4×10^{-7}/5.8×10^{-9} (1.1×10^{-7}/4.3×10^{-9})
	Child	0.02/<0.01	$5.3\ \times10^{-8}$/$5.0\times10^{*9}$ (3.9×10^{-8}/3.7×10^{-9})
Four Hills Subdivision[b]	Adult	<0.01/<0.01	2.1×10^{-10}/$1.3\times10^{*-11}$ (2.1×10^{-10}/$1.3\times10^{*-11}$)
	Child	<0.01/<0.01	$8.5\times10^{*-10}$/8.5×10^{-11} ($8.5\times10^{*-10}$/8.5×10^{-11})
Isleta Gaming Palace	Adult	<0.01/<0.01	1.7×10^{-9}/1.7×10^{-11} (4.3×10^{-10}/4.4×10^{-12})
	Child	<0.01/<0.01	1.2×10^{-9}/$1.3\ \times10^{-11}$ (3.0×10^{-10}/3.4×10^{-12})
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	7.8×10^{-10}/8.0×10^{-12} (7.2×10^{-10}/7.4×10^{-12})
	Child	<0.01/<0.01	5.4×10^{-10}/$6.1\ \times10^{-12}$ (5.0×10^{-10}/5.7×10^{-12})
WORKER SCENARIOS			
Center of TA-I[c]	Adult	<0.01/<0.01	9.4×10^{-8}/7.3×10^{-10} (7.9×10^{-8}/6.1×10^{-10})
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	Adult	<0.01/<0.01	$4.5\ \times10^{-10}$/4.7×10^{-12} (3.3×10^{-10}/3.4×10^{-12})
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	7.2×10^{-10}/8.1×10^{-12} ($5.0\times10^{*10}$/5.6×10^{-12})
Child Development Center-West	Child	<0.01/<0.01	1.5×10^{-10}/1.7×10^{-12} (1.1×10^{-10}/1.3×10^{-12})
Coronado Club	Adult	<0.01/<0.01	$1.2\times10^{-9*}$ /1.3×10^{-11} (8.8×10^{-10}/9.0×10^{-12})
	Child	<0.01/<0.01	8.7×10^{-10}/9.8×10^{-12} (6.1×10^{-10}/6.9×10^{-12})
Golf Course (clubhouse)	Adult	<0.01/<0.01	4.4×10^{-10}/4.5×10^{-12} 4.8×10^{-10}/4.9×10^{-12}
Kirtland Elementary School	Child	<0.01/<0.01	4.0×10^{-11}/4.5×10^{-13} (3.5×10^{-11}/3.9×10^{-13})
Lovelace Hospital	Adult	<0.01/<0.01	3.5×10^{-10}/3.6×10^{-12} (2.5×10^{-10}/$2.6\times10^{*12}$)
	Child	<0.01/<0.01	2.5×10^{-10}/2.8×10^{-12} (1.8×10^{-10}/2.0×10^{-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 S*NL/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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F

Accidents

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 $5.0x10^{-4}$ LCFs per rem (or person-rem) and $4.0x10^{-4}$ 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		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		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

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.

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*

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.

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

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.

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	$1.0x10^{-3}$ to $1.0x10^{-6}$	All	$8.4x10^{-5}$	$4.2x10^{-8}$	$7.9x10^{-3}$	$3.2x10^{-6}$
ECF-1	Catastrophic release of building's tritium	$1.0x10^{-3}$ to $1.0x10^{-6}$	All	$7.8x10^{-5}$	$3.9x10^{-8}$	$4.6x10^{-4}$	$1.9x10^{-7}$

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	$1.0x10^{-3}$ to $1.0x10^{-6}$	All	$1.0x10^{-1}$	$5.1x10^{-5}$
ECF-1	Catastrophic release of building's tritium	$1.0x10^{-3}$ to $1.0x10^{-6}$	All	$5.9x10^{-3}$	$3.0x10^{-6}$

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	$1.0x10^{-3}$ to $1.0x10^{-6}$	All	*Golf Course (1.6-2.4 km to SSE)*		*Golf Course (1.6-2.4 km to S)*	
				$3.1x10^{-7}$	$1.5x10^{-10}$	$2.5x10^{-7}$	$1.3x10^{-10}$
				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)*	
				$1.4x10^{-7}$	$7.0x10^{-11}$	$1.5x10^{-7}$	$7.6x10^{-11}$
				Sandia Base Elementary School, Coronado Club (1.6-2.4 km to NNW)		*Wherry Elementary School (2.4-3.2 km to WNW)*	
				$2.0x10^{-7}$	$9.8x10^{-11}$	$7.5x10^{-8}$	$3.7x10^{-11}$
				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)*	
				$8.3x10^{-8}$	$4.2x10^{-11}$	$7.1x10^{-8}$	$3.5x10^{-11}$
				Riding Stables (4.0-4.8 km to SSE)		*Veterans Affairs Medical Center, Lovelace Hospital (4.0-4.8 km to WNW)*	
				$7.9x10^{-8}$	$4.0x10^{-11}$	$3.3x10^{-8}$	$1.7x10^{-11}$
				Child Development Center-West (5.6-6.4 km to WNW)		*Kirtland Elementary School (6.4-7.2 km to WNW)*	
				$1.9x10^{-8}$	$9.4x10^{-12}$	$1.5x10^{-8}$	$7.6x10^{-12}$
NG-1	Catastrophic release of building's tritium	$1.0x10^{-3}$ to $1.0x10^{-6}$	All	*National Atomic Museum (0.8-1.6 km to WNW)*		*Coronado Club (0.8-1.6 km to NW)*	
				$5.7x10^{-6}$	$2.8x10^{-9}$	$6.2x10^{-6}$	$3.1x10^{-9}$

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	1.0×10^{-4} to 1.0×10^{-6}	N	1.92×10^{-5}	9.6×10^{-9}	9.7×10^{-3}	3.9×10^{-6}
ZH3-2	Catastrophic release of building's tritium	1.0×10^{-4} to 1.0×10^{-6}	E	9.6×10^{-4}	4.8×10^{-7}	4.9×10^{-1}	1.9×10^{-4}
ZPu-1	Catastrophic release of building's plutonium	1.0×10^{-4} to 1.0×10^{-6}	N,E	8.85×10^{-4}	4.4×10^{-7}	5.4×10^{-1}	2.2×10^{-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	1.0×10^{-4} to 1.0×10^{-6}	N	5.4×10^{-2}	2.7×10^{-5}
ZH3-2	Catastrophic release of building's tritium	1.0×10^{-4} to 1.0×10^{-6}	N	2.7	1.4×10^{-3}
ZPu-1	Catastrophic release of building's plutonium	1.0×10^{-4} to 1.0×10^{-6}	N,E	1.8	9.2×10^{-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	$7.0x10^{-4}$	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	$3.3x10^{-5}$	SAR Table 3.4-11 (average) + MIPP waste	Y	Fire
	HS-2	Fire in Room 108, #4	$2.0x10^{-7}$	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	$<1x10^{-7}$	SAR Table 3.4-83	N	Criticality
Sandia Pulsed Reactor Facility	S3M-1	Fire in the reactor building	III	$2.469x10^5$g uranium-235 + FPs	N	Fire
	S3M-2	Control element misadjustment before pulse-element insertion	III	$2.469x10^5$g uranium-235 + FPs	Y	High-risk SAR scenario
	S3M-3	Failure of a fissionable experiment	III	Experiment plutonium-239 $7.0x10^3$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	$6.3x10^{-6}$	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, $1.0x10^{-3}$ x 1.0 For plutonium-239, $5.0x10^{-4}$ x 0.5
	HS-2G	Fire in room 108, maximum inventories	Ground	No	NA	For uranium-235, $1.0x10^{-3}$ x 1.0 For plutonium-239, $5.0x10^{-4}$ x 0.5
	HC-1	Earthquake - building collapse	Ground	No	NA	For uranium-235, $1.0x10^{-3}$ x 1.0 For plutonium-239, $5.0x10^{-4}$ x 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, $1.0x10^{-3}$ x 1.0
	S3M-3	Failure of a fissionable experiment	Ground	No	NA	For core fission products, see Table F.2–6 For plutonium-239, $5.0x10^{-4}$ x 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, $5.0x10^{-4}$ x 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, $5.0x10^{-4}$x 0.5
	S4-1	Control element misadjustment before insert	Ground	No	NA	For core fission products, see Table F.2–6 For uranium-235, $1.0x10^{-3}$ x 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, $5.0 \times 10^{-4} \times 0.5$
	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 $1x10^{-6}$ 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, $1x10^{-6}$ 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 $1.8x10^{17}$ 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 $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 $4.1x10^{18}$. The analysis assumes that all the fission products from the $4.1x10^{18}$ 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.

> **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."

*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 ($1x10^{-4}$ to $1x10^{-6}$ 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 $8.6x10^{18}$ 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 $8.6x10^{18}$ 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 ($1x10^{-4}$ to $1x10^{-6}$ 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 $6.3x10^{-6}$ 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 $6.3x10^{-6}$ 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 $1\text{x}10^{-6}$ 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 $1\text{x}10^{-4}$ to $1\text{x}10^{-2}$ 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 = $5\text{x}10^{-4}$
- 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	$<1.0\times10^{-6}$	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	$2.0x10^{-7}$	All	$1.3x10^{-2}$	$6.6x10^{-6}$	$1.8x10^{-2}$	$7.4x10^{-6}$
S3M-2	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$2.9x10^{-4}$	$1.5x10^{-7}$	$6.3x10^{-1}$	$2.5x10^{-4}$
S3M-3	Failure of a fissionable experiment	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.7x10^{-3}$	$8.4x10^{-7}$	4.8	$3.8x10^{-3}$
SS-1	Airplane crash into North Vault storage vault	$6.3x10^{-6}$	All	$1.2x10^{-3}$	$5.8x10^{-7}$	$6.9x10^{-1}$	$5.5x10^{-4}$
S4-1	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$5.5x10^{-4}$	$2.7x10^{-7}$	1.2	$4.7x10^{-4}$
AR-1	Uncontrolled addition of reactivity	$<1.0x10^{-6}$	N, E	$1.9x10^{-3}$	$9.3x10^{-7}$	$2.9x10^{-1}$	$1.2x10^{-4}$
AR-2	Rupture of waterlogged fuel element	$1.0x10^{-1}$ to $1.0x10^{-2}$	N, E	$3.5x10^{-4}$	$1.7x10^{-7}$	$3.0x10^{-2}$	$1.2x10^{-5}$
AR-4	Fire in reactor room with experiment present	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$2.0x10^{-3}$	$1.0x10^{-6}$	$3.4x10^{-1}$	$1.4x10^{-4}$
AR-6	Airplane crash - collapse of bridge crane	$6.3x10^{-6}$	N, E	$1.7x10^{-3}$	$8.4x10^{-7}$	$5.6x10^{-1}$	$2.2x10^{-4}$

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	$6.3x10^{-6}$	All	3.9	$2.0x10^{-3}$
AM-3	Rupture of waterlogged fuel element	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	$9.8x10^{-1}$	$4.9x10^{-4}$
AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$7.8x10^{-1}$	$3.9x10^{-4}$
AM-5	Fuel handling accident - irradiated element	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	9.9	$4.9x10^{-3}$
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3x10^{-6}$	All	$3.3x10^{-3}$	$1.6x10^{-6}$
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0x10^{-6}$	All	$7.9x10^{-1}$	$3.9x10^{-4}$
HM-1	Operator error - molybdenum-99 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	All	$7.6x10^{-2}$	$3.8x10^{-5}$
HM-2	Operator error - iodine-125 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	All	$3.1x10^{-3}$	$1.6x10^{-6}$
HM-4	Fire in steel containment box	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	5.2	$2.6x10^{-3}$
HS-1	Fire in room 108, average inventories	$3.3x10^{-5}$	All	4.3	$2.1x10^{-3}$
HS-2	Fire in room 108, maximum inventories	$2.0x10^{-7}$	All	$1.6x10^{2}$	$7.9x10^{-2}$
S3M-2	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	2.4	$1.2x10^{-3}$
S3M-3	Failure of a fissionable experiment	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.6x10^{1}$	$7.9x10^{-3}$
SS-1	Airplane crash into North Vault storage vault	$6.3x10^{-6}$	All	$1.8x10^{1}$	$9.2x10^{-3}$
S4-1	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	4.5	$2.2x10^{-3}$

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	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.6x10^{-3}$	$8.1x10^{-7}$	$1.7x10^{-3}$	$8.4x10^{-7}$
SS-1	Airplane crash into North Vault storage vault	$6.3x10^{-6}$	All	$1.2x10^{-3}$	$5.8x10^{-7}$	$1.1x10^{-3}$	$5.5x10^{-7}$
S4-1	Control element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	E	$5.3x10^{-4}$	$2.6x10^{-7}$	$5.5x10^{-4}$	$2.7x10^{-7}$
AR-1	Uncontrolled addition of reactivity	$<1.0x10^{-6}$	N, E	$1.8x10^{-3}$	$8.9x10^{-7}$	$1.9x10^{-3}$	$9.3x10^{-7}$
AR-2	Rupture of waterlogged fuel element	$1.0x10^{-1}$ to $1.0x10^{-2}$	N, E	$3.2x10^{-4}$	$1.6x10^{-7}$	$3.5x10^{-4}$	$1.7x10^{-7}$
AR-4	Fire in reactor room with experiment present	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$2.0x10^{-3}$	$9.8x10^{-7}$	$2.0x10^{-3}$	$1.0x10^{-6}$
AR-6	Airplane crash – collapse of bridge crane	$6.3x10^{-6}$	N, E	$1.6x10^{-3}$	$7.8x10^{-7}$	$1.7x10^{-3}$	$8.4x10^{-7}$
				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	$6.3x10^{-6}$	All	$3.7x10^{-4}$	$1.9x10^{-7}$	$7.7x10^{-5}$	$3.9x10^{-8}$
AM-3	Rupture of waterlogged fuel element	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	$8.2x10^{-5}$	$4.1x10^{-8}$	$1.9x10^{-5}$	$9.3x10^{-9}$
AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$6.5x10^{-5}$	$3.3x10^{-8}$	$1.5x10^{-5}$	$7.5x10^{-9}$
AM-5	Fuel handling accident – irradiated element	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$9.7x10^{-4}$	$4.8x10^{-7}$	$1.4x10^{-4}$	$7.0x10^{-8}$

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	$<1.0\times10^{-6}$	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	$<1.0\times10^{-6}$	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	$1.0x10^{-4}$ to $1.0x10^{-6}$	N, E	$1.6x10^{-3}$	$8.0x10^{-7}$	$2.2x10^{-4}$	$1.1x10^{-7}$
AR-6	Airplane crash – collapse of bridge crane	$6.3x10^{-6}$	N, E	$1.3x10^{-3}$	$6.5x10^{-7}$	$2.4x10^{-4}$	$1.2x10^{-7}$
				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	$6.3x10^{-6}$	All	$6.4x10^{-5}$	$3.2x10^{-8}$	$4.9x10^{-5}$	$2.5x10^{-8}$
AM-3	Rupture of waterlogged fuel element	$1.0x10^{-2}$ to $1.0x10^{-4}$	All	$1.6x10^{-5}$	$7.8x10^{-9}$	$1.2x10^{-5}$	$6.0x10^{-9}$
AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.2x10^{-5}$	$6.2x10^{-9}$	$9.5x10^{-6}$	$4.7x10^{-9}$
AM-5	Fuel handling accident - irradiated element	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.1x10^{-4}$	$5.7x10^{-8}$	$8.2x10^{-5}$	$4.1x10^{-8}$
AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3x10^{-6}$	All	$3.2x10^{-8}$	$1.6x10^{-11}$	$2.4x10^{-8}$	$1.2x10^{-11}$
AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	<$1.0x10^{-6}$	All	$1.3x10^{-5}$	$6.5x10^{-9}$	$9.8x10^{-6}$	$4.9x10^{-9}$
HM-1	Operator error – molybdenum-99 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	All	$1.2x10^{-6}$	$6.1x10^{-10}$	$9.2x10^{-7}$	$4.6x10^{-10}$
HM-2	Operator error – iodine-125 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	All	$4.4x10^{-8}$	$2.2x10^{-11}$	$3.5x10^{-8}$	$1.7x10^{-11}$

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	$<1.0 \times 10^{-6}$	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	$<1.0 \times 10^{-6}$	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	$<1.0 \times 10^{-6}$	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	$<1.0 \times 10^{-6}$	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	1.0×10^{-2} to 1.0×10^{-4}	All	4.9×10^{-4}	2.5×10^{-7}	3.2×10^{-1}	1.3×10^{-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	1.0×10^{-2} to 1.0×10^{-4}	All	3.7	1.8×10^{-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:

$$VHI = \log(VHR) = \log[(VP*1.0x10^{6}) / (\text{acceptable concentration}*760\ mmHg)]$$

(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:

$$RHI = \log(VHR * \text{inventory}) = \log(VHR) + \log(\text{inventory}) = VHI + \log(\text{inventory})$$

(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.

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)

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 (mmHg)	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 (mmHg)	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 (mmHg)	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 (mmHg)	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 (mmHg)	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 (mmHg)	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 (mmHg)	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 (mmHg)	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		CHEMICAL NAME	BUILDING INVENTORY	BUILDING INVENTORY	VHI INDEX	RHI INDEX
NAME	NUMBER					
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
ft^3: 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		CHEMICAL NAME	AMOUNT RELEASED (pounds)	ERPG-2 LEVEL (ppm)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)
NAME	NUMBER				
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 Building	880	Hydrofluoric Acid	2.0	20	NR
Photovoltaic Device Fabrication Laboratory	883	Phosphine	6.8	0.5	3,357
6-MeV Tandem Van 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

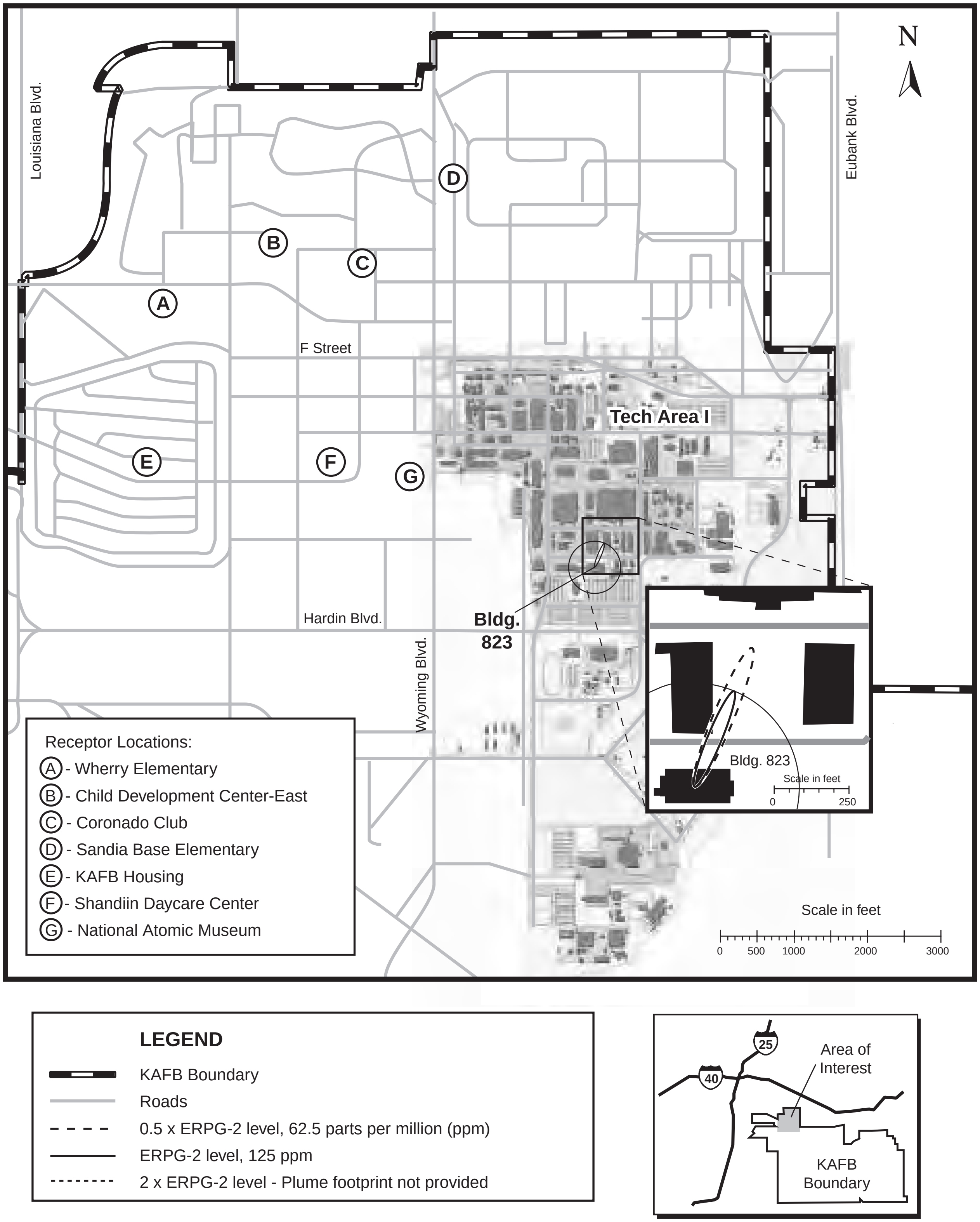
RECEPTOR LOCATION	DIRECTION FROM RELEASE POINT	RELEASE POINT	CHEMICAL RELEASED
A	WNW	Building 893 (CSRL)	Arsine
B	NW	Building 893 (CSRL)	Arsine
	WNW	MESA Complex	Arsine
C	NW	Building 893 (CSRL)	Arsine
	WNW	MESA Complex	Arsine
D	NNW	Building 893 (CSRL)	Arsine
	NW	MESA Complex	Arsine
E	W	Building 893 (CSRL)	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 (pounds)	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 Building	880	Hydrofluoric acid	2	NR	NR
Photovoltaic Device Fabrication Laboratory	883	Phosphine	6.8	3,357	100
6-MeV Tandem Van 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

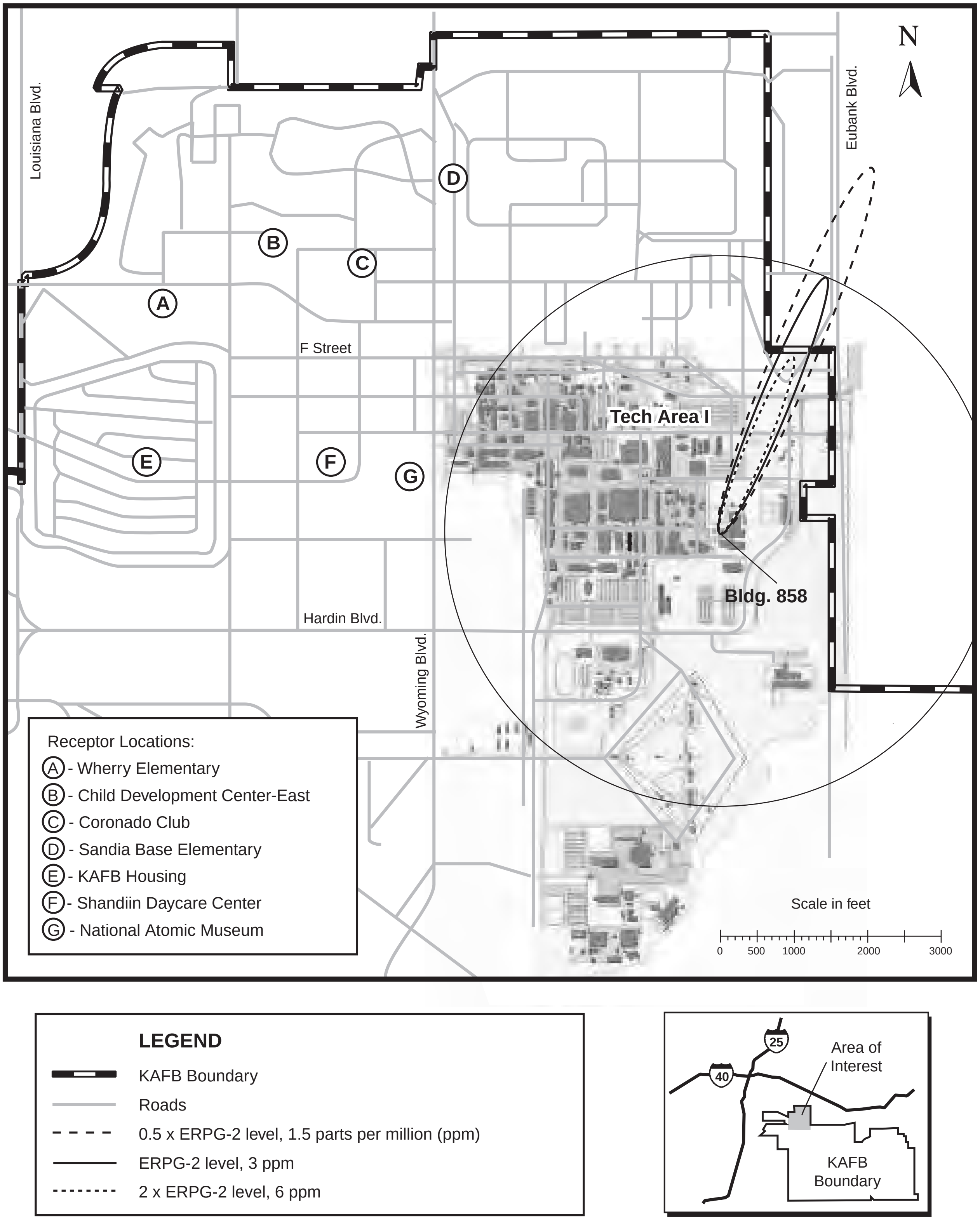
Source: Original
ALOHA: Areal Location of Hazardous Atmospheres computer code
ERPG-2: Emergency Response Planning Guideline Level 2
ft: feet
NR: Not reported. The *ALOHA* model did not provide a plume footprint because the effects of near-field patchiness made dispersion prediction unreliable for short 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

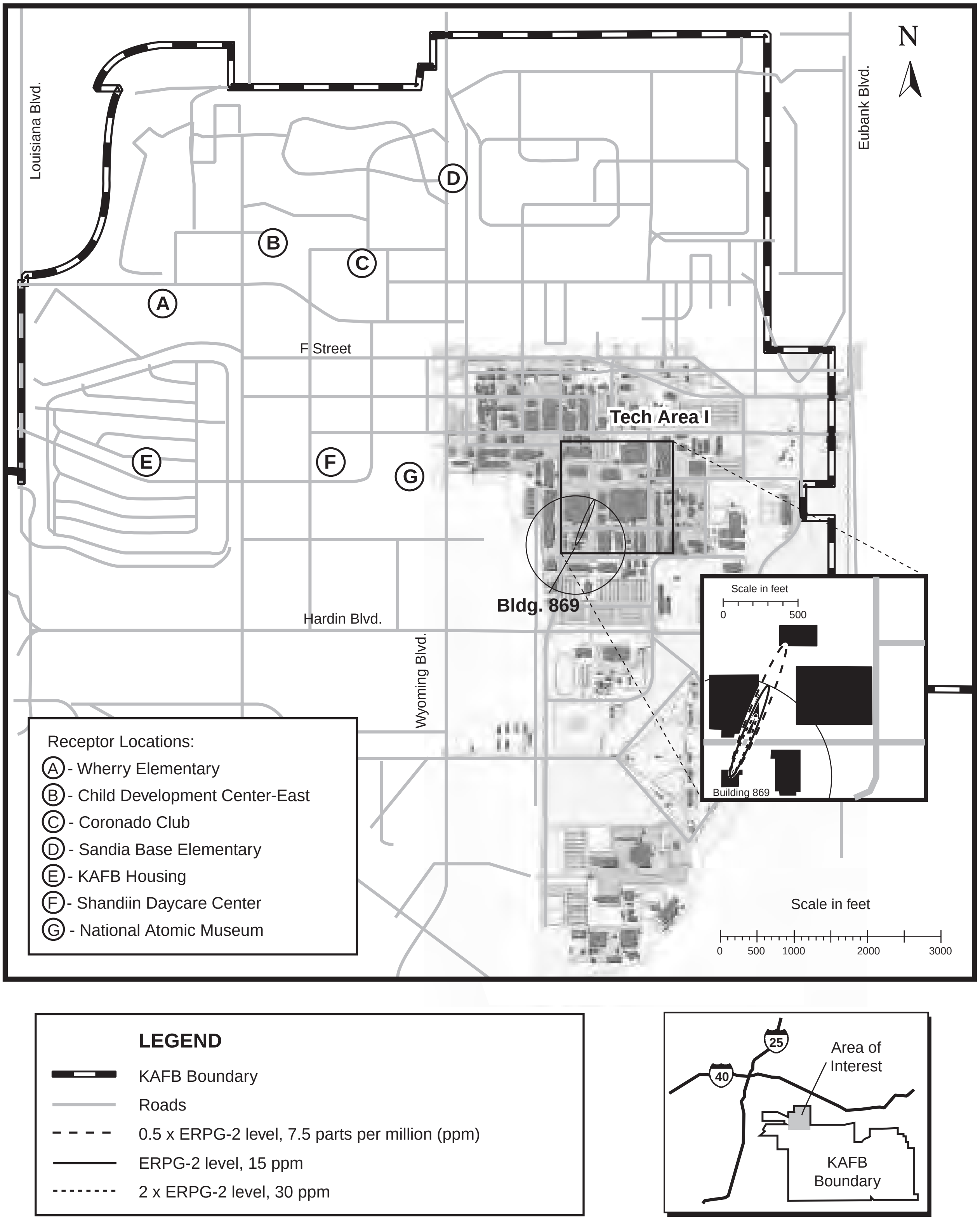
An accidental release of nitrous oxide from Building 823 could affect an area with ERPG-2 levels of exposure extending as far as 351 ft from the source.



Source: Original
See Table F.3–4.

Figure F.3–2. Accidental Release of Chlorine from Building 858

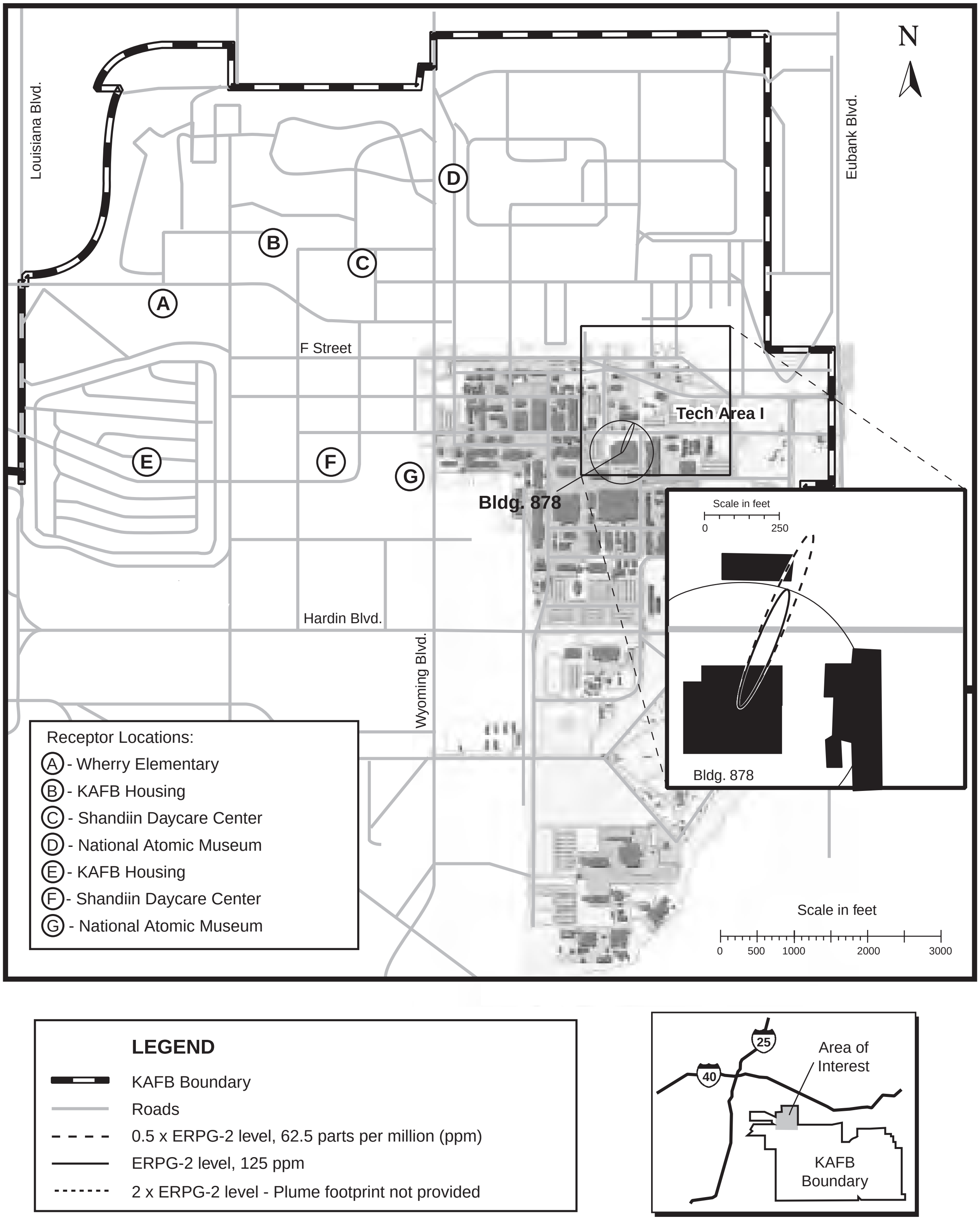
An accidental release of chlorine from Building 858 could affect an area with ERPG-2 levels of exposure extending as far as 3,726 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–3. Accidental Release of Nitric Acid from Building 869

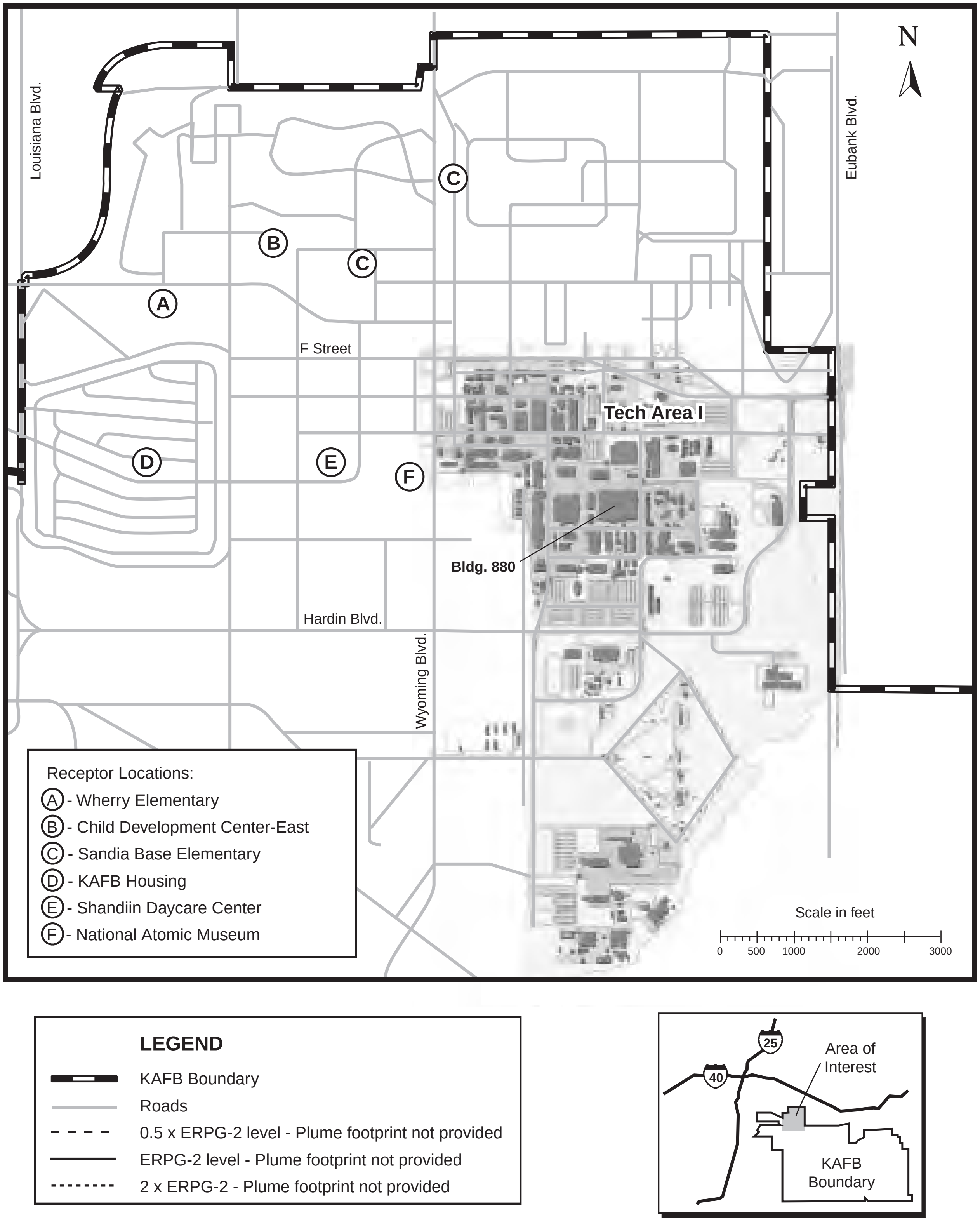
An accidental release of nitric acid from Building 869 could affect an area with ERPG-2 levels of exposure extending as far as 666 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–4. Accidental Release of Nitrous Oxide from Building 878

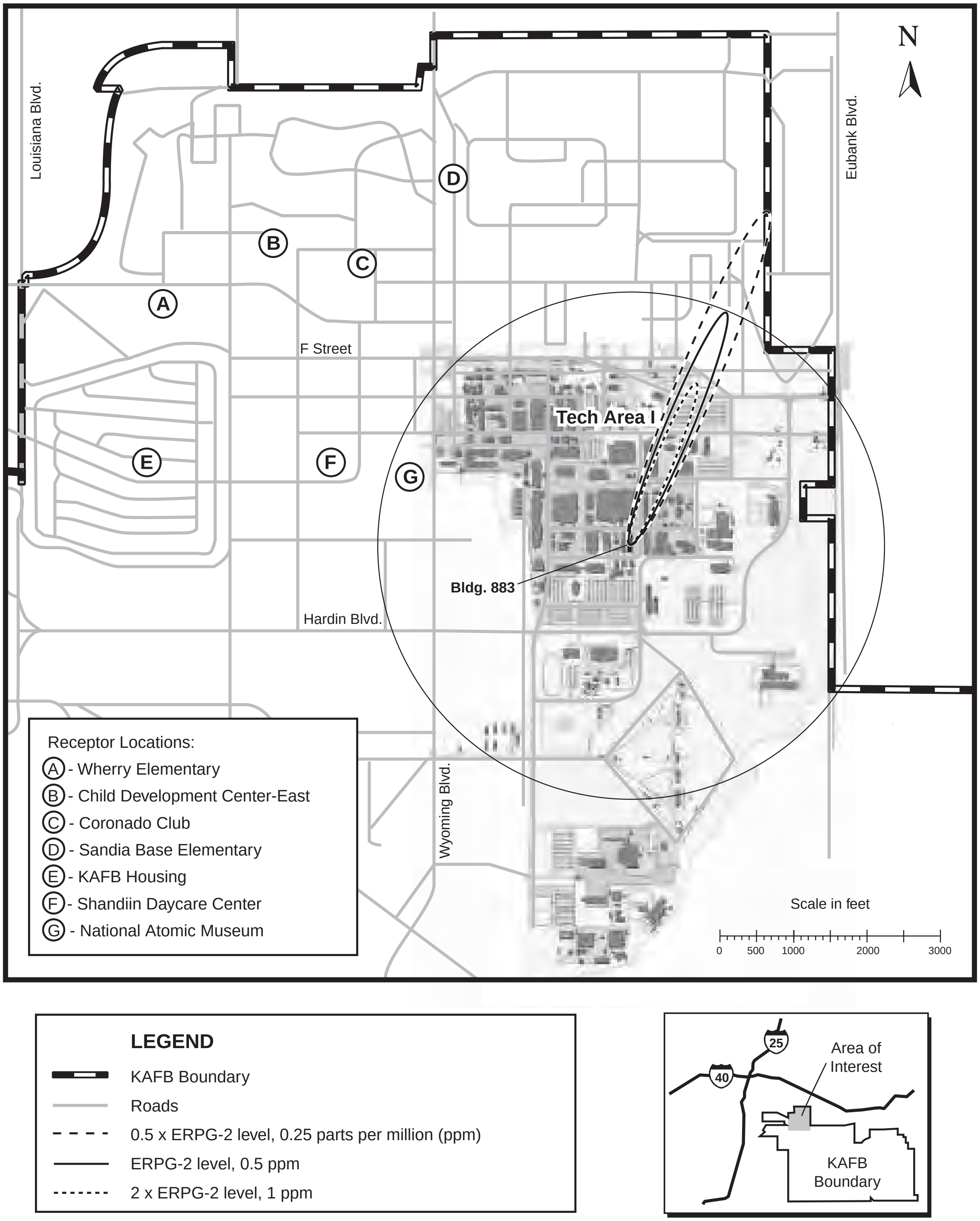
An accidental release of nitrous oxide from Building 878 could affect an area with ERPG-2 levels of exposure extending as far as 426 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–5. Accidental Release of Hydrofluoric Acid from Building 880

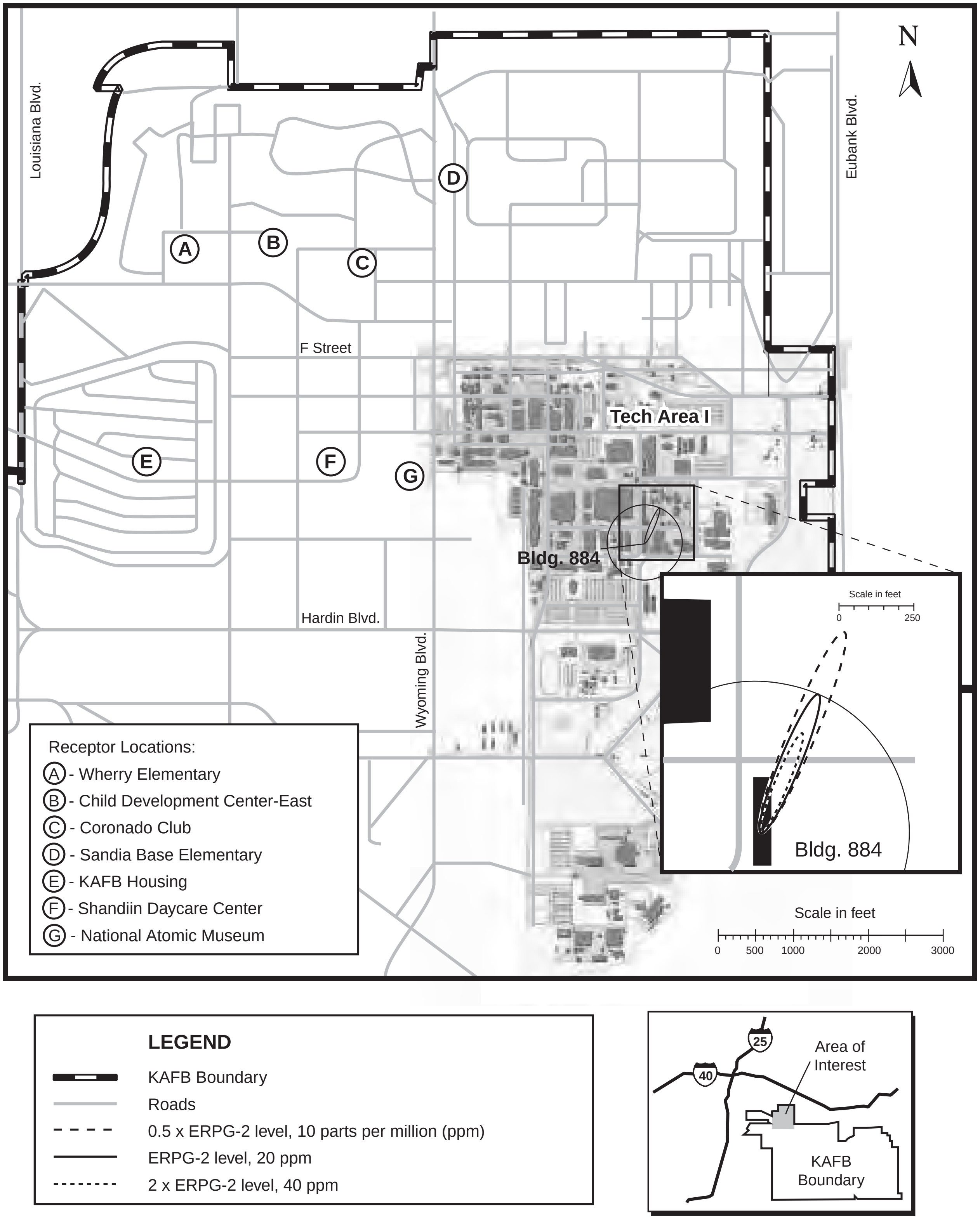
The three plumes are too small to be shown and do not extend outside of Building 880.



Source: Original
Note: See Table F.3–4.

Figure F.3–6. Accidental Release of Phosphine from Building 883

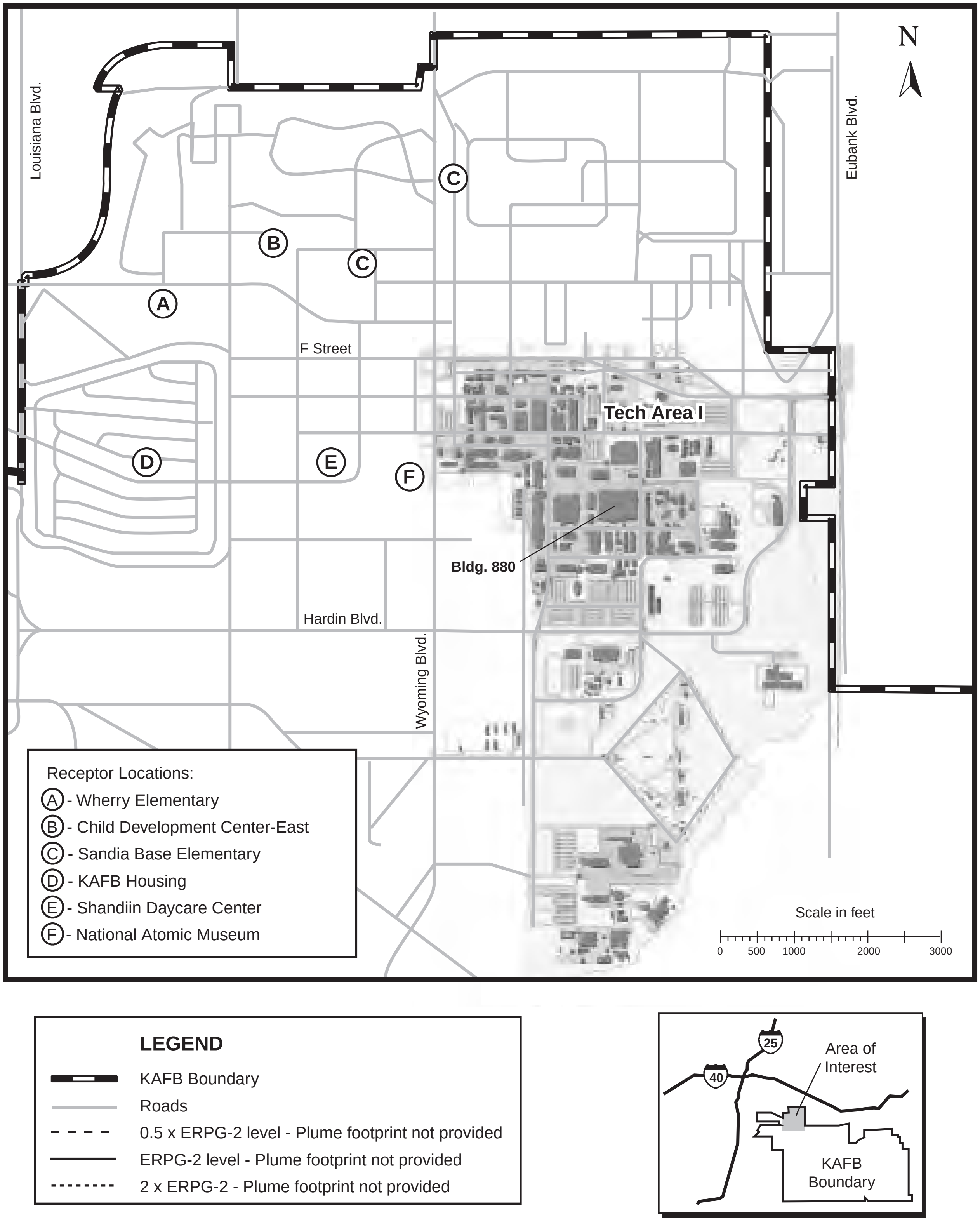
An accidental release of phosphine from Building 883 could affect an area with ERPG-2 levels of exposure extending as far as 3,357 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–7. Accidental Release of Hydrofluoric Acid from Building 884

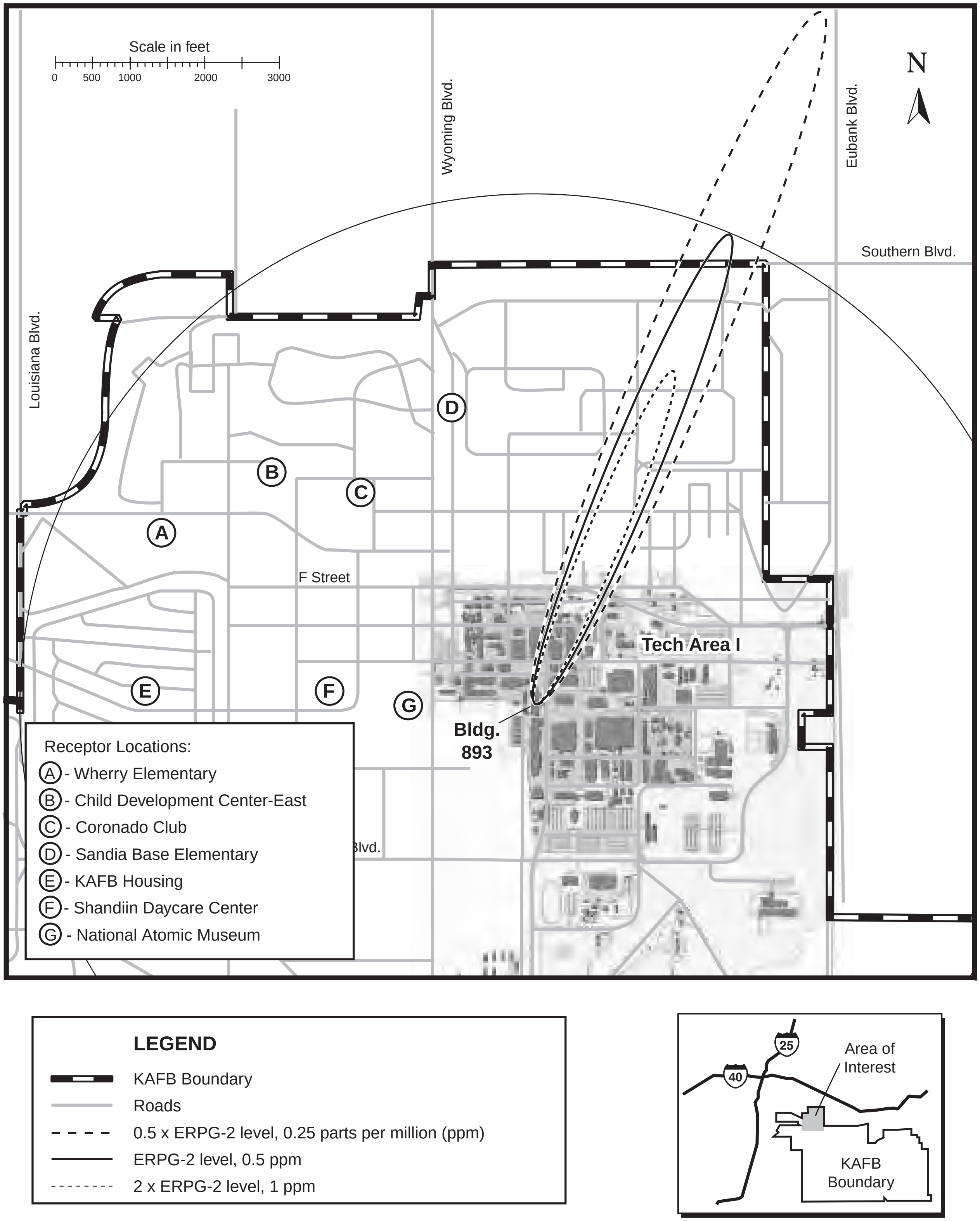
An accidental release of hydrofluoric acid from Building 884 could affct an area with ERPG-2 levels of exposure extrending as far as 504 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–8. Accidental Release of Fluorine from Building 888

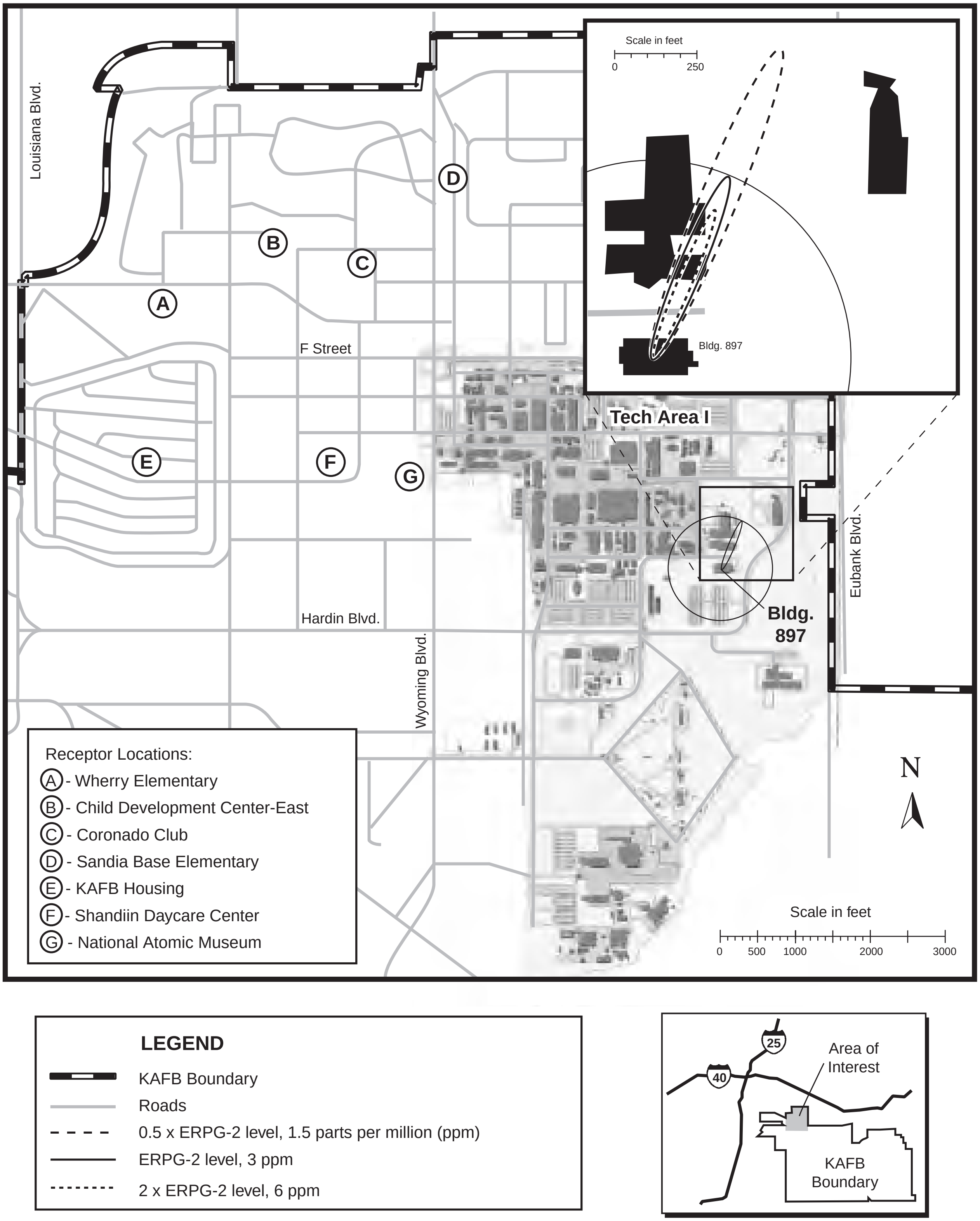
The three plumes are too small to be shown and do not extend outside of Building 888.



Source: Original
Note: See Table F.3–4.

Figure F.3–9. Accidental Release of Arsine from Building 893

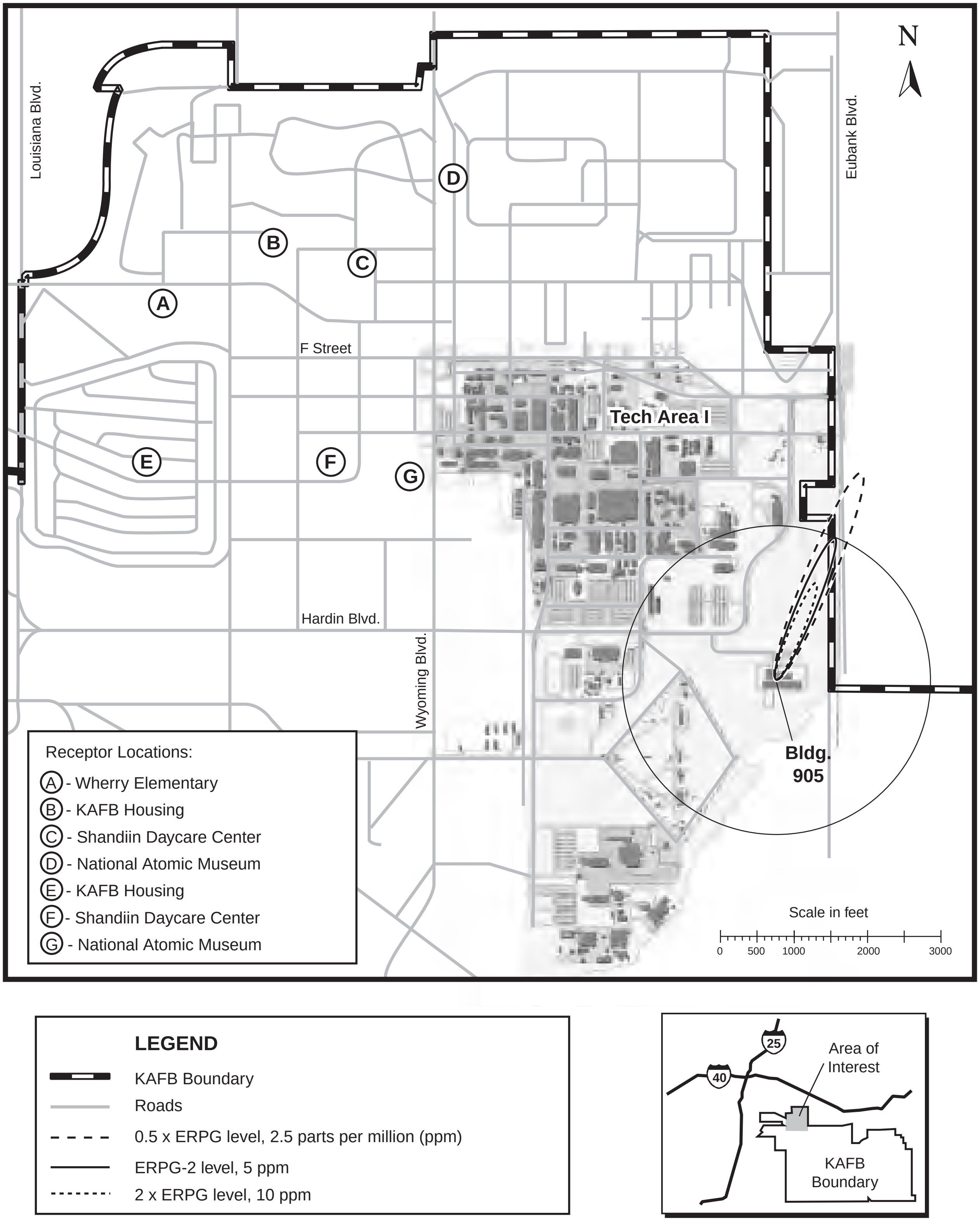
An accidental release of arsine from Building 893 could affect an area with ERPG-2 levels of exposure extending as far as 6,891 ft from the source.



Source: Original
Note: See Table F.3–4.

Figure F.3–10. Accidental Release of Chlorine from Building 897

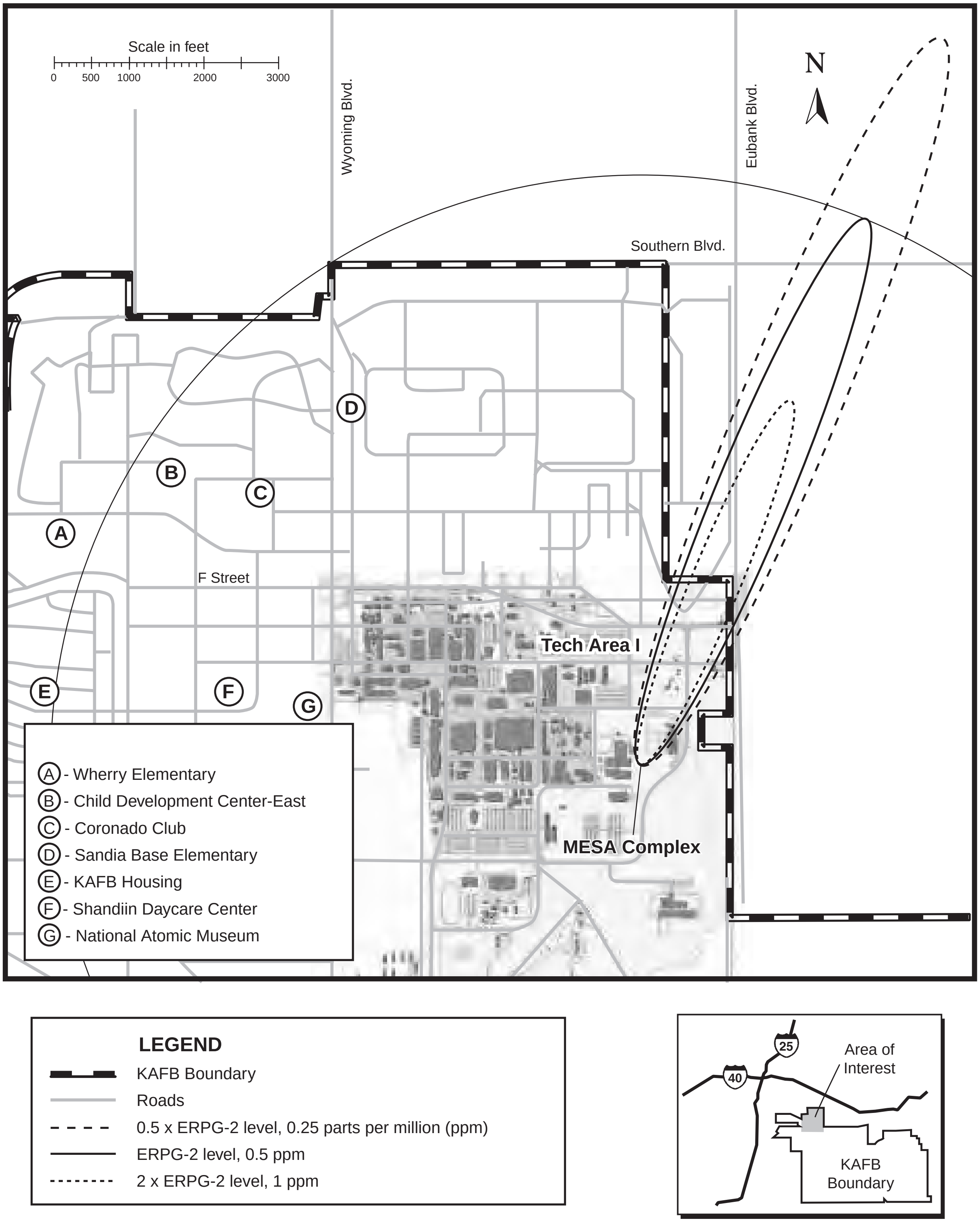
An accidental release of chlorine from Building 897 could affect an area with ERPG-2 levels of exposure extending as far as 699 ft from the source.



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-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.

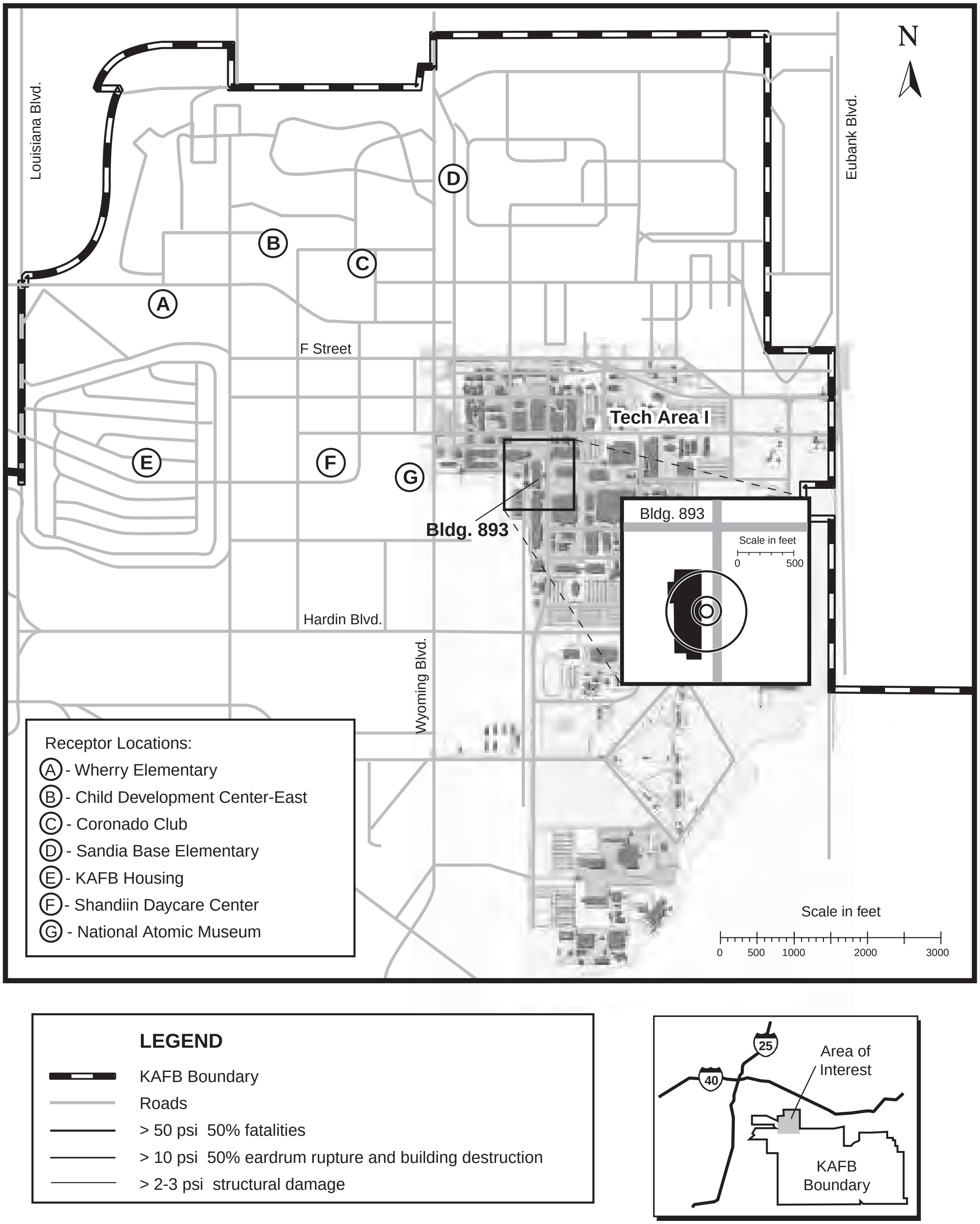
F.4.3 Explosions Involving High Explosives

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

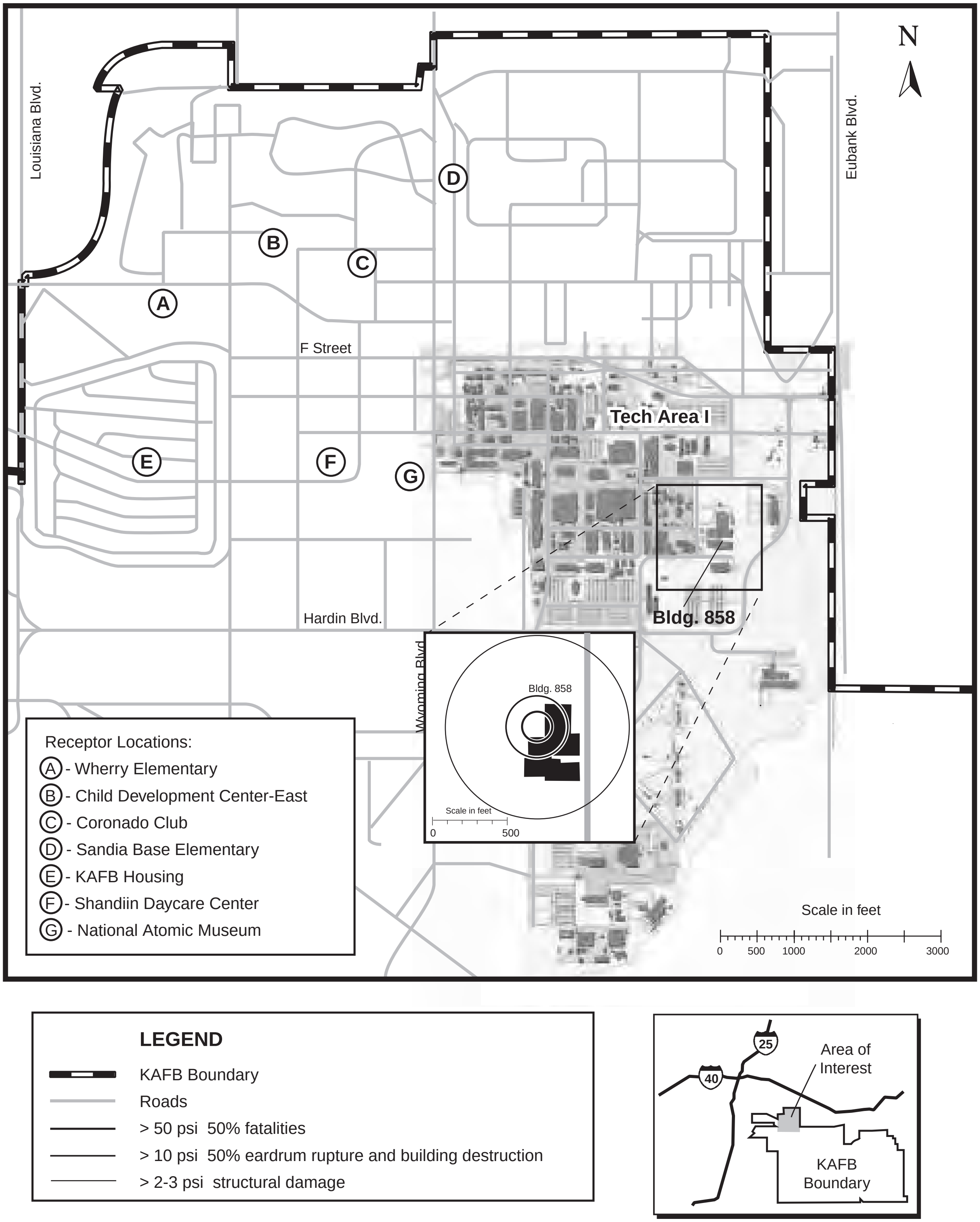
Source: Original
ft: feet
lb TNT: weight expressed as equivalent pounds of trinitrotoluene.
P_r: reflected pressure
psi: pounds per square inch
Z_G: scaled ground distance
[a] Dominant impact



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)	10,120-lb TNT		55-lb TNT		25-lb TNT	
	Z_G (lb/ft$^{1/3}$)	P_r(psi)	Z_G (lb/ft$^{1/3}$)	P_r(psi)	Z_G (lb/ft$^{1/3}$)	P_r(psi)
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);

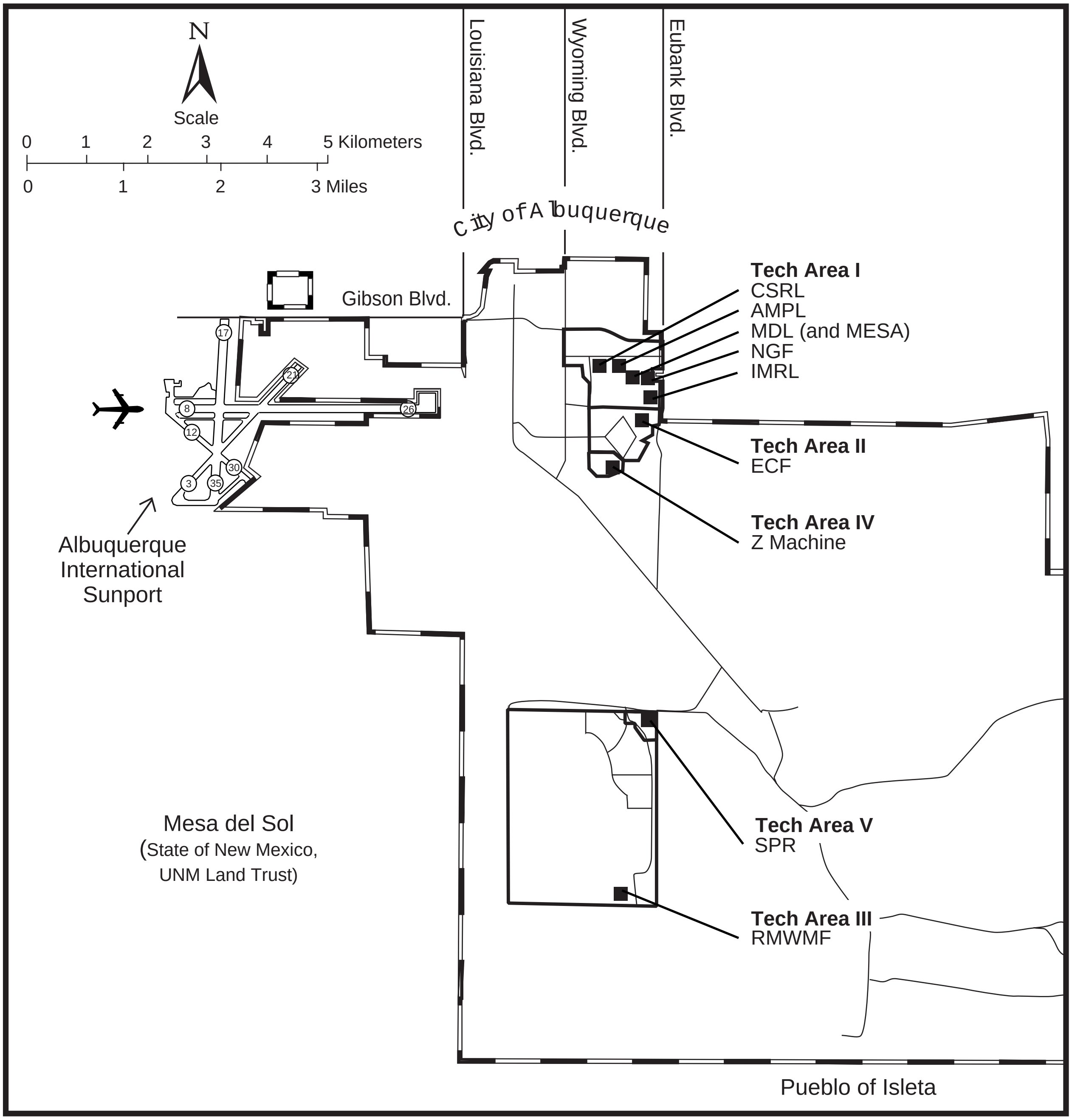
j = index for aircraft category or subcategory; and

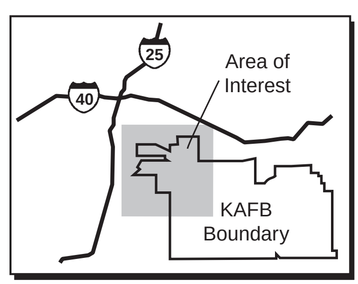
k = index for flight source (specific runways).

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 ortho-normal 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								
	8	26	17	35	3	21	12	30	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	**TAKEOFFS BY RUNWAY**								
	8	26	17	35	3	21	12	30	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	$9.0x10^{-5}$
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)	$5.6x10^{-6}$
	Fixed-Wing – Single Engine (Landing)	$6.9x10^{-6}$
	Fixed-Wing – Twin Engine (Takeoff)	$1.6x10^{-6}$
	Fixed-Wing – Twin Engine (Landing)	$2.7x10^{-6}$
	Fixed-Wing – Turbojet (Takeoff)	$4.0x10^{-8}$
	Fixed-Wing – Turbojet (Landing)	$9.0x10^{-8}$
	Commercial Aviation Air Carrier (Takeoff)	$6.4x10^{-6}$
	Commercial Aviation Air Carrier (Landing)	$3.5x10^{-6}$
	Commercial Aviation Air Taxi (Takeoff)	$1.1x10^{-5}$
	Commercial Aviation Air Taxi (Landing)	$7.5x10^{-6}$
	Military Aviation Large Aircraft (Takeoff)	$1.4x10^{-7}$
	Military Aviation Large Aircraft (Landing)	$3.6x10^{-7}$
	Military Aviation Small Aircraft (Takeoff)	$5.4x10^{-6}$
	Military Aviation Small Aircraft (Landing)	$3.3x10^{-6}$
Total of Airport Operations Aircraft Crash Frequency		**$5.6x10^{-5}$**
Nonairport	General Aviation	$1.0x10^{-5}$
	Commercial Aviation Air Carrier	$7.0x10^{-9}$
	Commercial Aviation Air Taxi	$9.5x10^{-9}$
	Military Aviation Large Aircraft	$2.9x10^{-9}$
	Military Aviation Small Aircraft	$9.4x10^{-8}$
Total of Nonairport Operations Aircraft Crash Frequency		**$1.0x10^{-5}$**
TOTAL AIRCRAFT CRASH FREQUENCY		**$6.6x10^{-5}$**

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)	$1.0x10^{-5}$
	Fixed-Wing – Single Engine (Landing)	$1.2x10^{-5}$
	Fixed-Wing – Twin Engine (Takeoff)	$2.9x10^{-6}$
	Fixed-Wing – Twin Engine (Landing)	$1.5x10^{-6}$
	Fixed-Wing – Turbojet (Takeoff)	$7.3x10^{-8}$
	Fixed-Wing – Turbojet (Landing)	$1.6x10^{-7}$
	Commercial Aviation Air Carrier (Takeoff)	$1.1x10^{-5}$
	Commercial Aviation Air Carrier (Landing)	$2.3x10^{-6}$
	Commercial Aviation Air Taxi (Takeoff)	$1.9x10^{-5}$
	Commercial Aviation Air Taxi (Landing)	$4.7x10^{-6}$
	Military Aviation Large Aircraft (Takeoff)	$2.2x10^{-7}$
	Military Aviation Large Aircraft (Landing)	$4.6x10^{-7}$
	Military Aviation Small Aircraft (Takeoff)	$9.6x10^{-6}$
	Military Aviation Small Aircraft (Landing)	$4.1x10^{-6}$
Total of Airport Operations Aircraft Crash Frequency		**$7.9x10^{-5}$**
Nonairport	General Aviation	$1.9x10^{-5}$
	Commercial Aviation Air Carrier	$1.2x10^{-8}$
	Commercial Aviation Air Taxi	$1.7x10^{-8}$
	Military Aviation Large Aircraft	$4.6x10^{-9}$
	Military Aviation Small Aircraft	$1.6x10^{-7}$
Total of Nonairport Operations Aircraft Crash Frequency		**$1.9x10^{-5}$**
TOTAL AIRCRAFT CRASH FREQUENCY		**$9.7x10^{-5}$**

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)	$4.4x10^{-6}$
	Fixed-Wing – Single Engine (Landing)	$5.3x10^{-6}$
	Fixed-Wing – Twin Engine (Takeoff)	$1.2x10^{-6}$
	Fixed-Wing – Twin Engine (Landing)	$2.0x10^{-6}$
	Fixed-Wing – Turbojet (Takeoff)	$3.1x10^{-8}$
	Fixed-Wing – Turbojet (Landing)	$6.9x10^{-8}$
	Commercial Aviation Air Carrier (Takeoff)	$2.8x10^{-6}$
	Commercial Aviation Air Carrier (Landing)	$1.5x10^{-7}$
	Commercial Aviation Air Taxi (Takeoff)	$4.3x10^{-6}$
	Commercial Aviation Air Taxi (Landing)	$2.9x10^{-7}$
	Military Aviation Large Aircraft (Takeoff)	$8.3x10^{-7}$
	Military Aviation Large Aircraft (Landing)	$2.4x10^{-7}$
	Military Aviation Small Aircraft (Takeoff)	$3.6x10^{-7}$
	Military Aviation Small Aircraft (Landing)	$1.9x10^{-6}$
Total of Airport Operations Aircraft Crash Frequency		**$2.4x10^{-5}$**
Nonairport	General Aviation	$7.8x10^{-6}$
	Commercial Aviation Air Carrier	$3.0x10^{-9}$
	Commercial Aviation Air Taxi	$3.7x10^{-9}$
	Military Aviation Large Aircraft	$1.8x10^{-9}$
	Military Aviation Small Aircraft	$4.6x10^{-8}$
Total of Nonairport Operations Aircraft Crash Frequency		**$7.9x10^{-6}$**
TOTAL AIRCRAFT CRASH FREQUENCY		**$3.2x10^{-5}$**

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		**7.7×10^{-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		**1.3×10^{-5}**
TOTAL AIRCRAFT CRASH FREQUENCY		**9.0×10^{-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)	$2.5x10^{-6}$
	Fixed-Wing – Single Engine (Landing)	$2.0x10^{-6}$
	Fixed-Wing – Twin Engine (Takeoff)	$7.2x10^{-7}$
	Fixed-Wing – Twin Engine (Landing)	$7.8x10^{-7}$
	Fixed-Wing – Turbojet (Takeoff)	$1.8x10^{-8}$
	Fixed-Wing – Turbojet (Landing)	$2.7x10^{-8}$
	Commercial Aviation Air Carrier (Takeoff)	$7.0x10^{-7}$
	Commercial Aviation Air Carrier (Landing)	$8.5x10^{-9}$
	Commercial Aviation Air Taxi (Takeoff)	$1.2x10^{-6}$
	Commercial Aviation Air Taxi (Landing)	$3.0x10^{-8}$
	Military Aviation Large Aircraft (Takeoff)	$3.0x10^{-7}$
	Military Aviation Large Aircraft (Landing)	$3.2x10^{-7}$
	Military Aviation Small Aircraft (Takeoff)	$2.5x10^{-6}$
	Military Aviation Small Aircraft (Landing)	$1.8x10^{-6}$
Total of Airport Operations Aircraft Crash Frequency		**$1.3x10^{-5}$**
Nonairport	General Aviation	$5.1x10^{-6}$
	Commercial Aviation Air Carrier	$2.6x10^{-9}$
	Commercial Aviation Air Taxi	$3.0x10^{-9}$
	Military Aviation Large Aircraft	$1.4x10^{-9}$
	Military Aviation Small Aircraft	$3.2x10^{-8}$
Total of Nonairport Operations Aircraft Crash Frequency		**$5.1x10^{-6}$**
TOTAL AIRCRAFT CRASH FREQUENCY		**$1.8x10^{-5}$**

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)	$0.0x10^{1}$
	Fixed-Wing – Single Engine (Landing)	$9.9x10^{-9}$
	Fixed-Wing – Twin Engine (Takeoff)	$0.0x10^{1}$
	Fixed-Wing – Twin Engine (Landing)	$3.8x10^{-9}$
	Fixed-Wing – Turbojet (Takeoff)	0.0
	Fixed-Wing – Turbojet (Landing)	$1.3x10^{-10}$
	Commercial Aviation Air Carrier (Takeoff)	$7.7x10^{-9}$
	Commercial Aviation Air Carrier (Landing)	0.0
	Commercial Aviation Air Taxi (Takeoff)	$1.2x10^{-8}$
	Commercial Aviation Air Taxi (Landing)	0.0
	Military Aviation Large Aircraft (Takeoff)	0.0
	Military Aviation Large Aircraft (Landing)	$7.6x10^{-9}$
	Military Aviation Small Aircraft (Takeoff)	$2.9x10^{-7}$
	Military Aviation Small Aircraft (Landing)	0.0
Total of Airport Operations Aircraft Crash Frequency		**$3.3x10^{-7}$**
Nonairport	General Aviation	$2.4x10^{-6}$
	Commercial Aviation Air Carrier	$2.0x10^{-9}$
	Commercial Aviation Air Taxi	$2.2x10^{-9}$
	Military Aviation Large Aircraft	$8.3x10^{-10}$
	Military Aviation Small Aircraft	$2.4x10^{-8}$
Total of Nonairport Operations Aircraft Crash Frequency		**$2.4x10^{-6}$**
TOTAL AIRCRAFT CRASH FREQUENCY		**$2.8x10^{-6}$**

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)	$1.7x10^{-6}$
	Fixed-Wing – Single Engine (Landing)	$8.4x10^{-7}$
	Fixed-Wing – Twin Engine (Takeoff)	$4.9x10^{-7}$
	Fixed-Wing – Twin Engine (Landing)	$3.2x10^{-7}$
	Fixed-Wing – Turbojet (Takeoff)	$1.2x10^{-8}$
	Fixed-Wing – Turbojet (Landing)	$1.1x10^{-8}$
	Commercial Aviation Air Carrier (Takeoff)	$2.7x10^{-8}$
	Commercial Aviation Air Carrier (Landing)	0.0
	Commercial Aviation Air Taxi (Takeoff)	$5.3x10^{-8}$
	Commercial Aviation Air Taxi (Landing)	$1.5x10^{-7}$
	Military Aviation Large Aircraft (Takeoff)	0.0
	Military Aviation Large Aircraft (Landing)	$4.8x10^{-8}$
	Military Aviation Small Aircraft (Takeoff)	$1.0x10^{-7}$
	Military Aviation Small Aircraft (Landing)	$3.4x10^{-8}$
Total of Airport Operations Aircraft Crash Frequency		**$3.8x10^{-6}$**
Nonairport	General Aviation	$2.5x10^{-6}$
	Commercial Aviation Air Carrier	$3.2x10^{-9}$
	Commercial Aviation Air Taxi	$4.0x10^{-9}$
	Military Aviation Large Aircraft	$1.4x10^{-9}$
	Military Aviation Small Aircraft	$3.2x10^{-8}$
Total of Nonairport Operations Aircraft Crash Frequency		**$2.5x10^{-6}$**
TOTAL AIRCRAFT CRASH FREQUENCY		**$6.3x10^{-6}$**

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)	$2.7x10^{-6}$
	Fixed-Wing – Single Engine (Landing)	$3.0x10^{-6}$
	Fixed-Wing – Twin Engine (Takeoff)	$7.6x10^{-7}$
	Fixed-Wing – Twin Engine (Landing)	$1.2x10^{-6}$
	Fixed-Wing – Turbojet (Takeoff)	$1.9x10^{-8}$
	Fixed-Wing – Turbojet (Landing)	$4.0x10^{-8}$
	Commercial Aviation Air Carrier (Takeoff)	$5.3x10^{-6}$
	Commercial Aviation Air Carrier (Landing)	$2.9x10^{-6}$
	Commercial Aviation Air Taxi (Takeoff)	$9.1x10^{-6}$
	Commercial Aviation Air Taxi (Landing)	$6.3x10^{-6}$
	Military Aviation Large Aircraft (Takeoff)	$1.0x10^{-6}$
	Military Aviation Large Aircraft (Landing)	$2.1x10^{-7}$
	Military Aviation Small Aircraft (Takeoff)	$3.2x10^{-6}$
	Military Aviation Small Aircraft (Landing)	$2.2x10^{-6}$
Total of Airport Operations Aircraft Crash Frequency		**$3.9x10^{-5}$**
Nonairport	General Aviation	$4.8x10^{-6}$
	Commercial Aviation Air Carrier	$5.8x10^{-9}$
	Commercial Aviation Air Taxi	$8.0x10^{-9}$
	Military Aviation Large Aircraft	$2.2x10^{-9}$
	Military Aviation Small Aircraft	$6.0x10^{-8}$
Total of Nonairport Operations Aircraft Crash Frequency		**$4.9X10^{-6}$**
TOTAL AIRCRAFT CRASH FREQUENCY		**$4.3X10^{-5}$**

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 1×10^{-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 3.8×10^{-4} rem and an increased probability of a latent cancer fatality of 1.5×10^{-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 4.4×10^{-7} rem and an increased probability of a latent cancer fatality of 2.2×10^{-10}. The public, out to a distance of 50 miles, would receive an estimated dose of 4.3×10^{-3} person-rem and an increased number of latent cancer fatalities of 2.1×10^{-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 1.0×10^{-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 4.0×10^{-4} rem and an increased probability of a latent cancer fatality of 2.0×10^{-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 1.8×10^{-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	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$4.6x10^{-8}$	$2.3x10^{-11}$	$3.6x10^{-8}$	$1.8x10^{-11}$
ACF-2	IHE Explosion	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$3.9x10^{-5}$	$1.9x10^{-8}$	$3.1x10^{-5}$	$1.5x10^{-8}$
				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	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$2.3x10^{-8}$	$1.2x10^{-11}$	$9.9x10^{-9}$	$4.9x10^{-12}$
ACF-2	IHE Explosion	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.8x10^{-5}$	$9.0x10^{-9}$	$8.3x10^{-6}$	$4.2x10^{-9}$
				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	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.9x10^{-10}$	$9.4x10^{-14}$		
ACF-2	IHE Explosion	$1.0x10^{-4}$ to $1.0x10^{-6}$	All	$1.6x10^{-5}$	$7.9x10^{-9}$		

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 $1.0x10^{-3}$, while an acceleration of 0.22 *g* has a frequency of $7.0x10^{-4}$. For a site-wide earthquake-induced release of chemicals, an acceleration of 0.17 *g* with a frequency of $1.0x10^{-3}$ is used. For an earthquake-induced release of radiological material, a ground acceleration of 0.22 *g* with a frequency of $7.0x10^{-4}$ 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	$7.0x10^{-4}$	$2.9x10^{-6}$	$1.4x10^{-9}$	$7.9x10^{-3}$	$3.2x10^{-6}$
Technical Area-II						
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$3.1x10^{-7}$	$1.5x10^{-10}$	$4.6x10^{-4}$	$1.9x10^{-7}$
Technical Area-V						
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$4.8x10^{-4}$	$2.4x10^{-7}$	$1.9x10^{-1}$	$7.4x10^{-5}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.4x10^{-2}$	$6.9x10^{-6}$	$3.7x10^{1}$	$3.0x10^{-2}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.2x10^{-3}$	$5.8x10^{-7}$	$6.9x10^{-1}$	$2.7x10^{-4}$
AR-5	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$1.7x10^{-3}$	$8.4x10^{-7}$	$5.6x10^{-1}$	$2.2x10^{-4}$
NO ACTION ALTERNATIVE TOTALS			**$1.7x10^{-2}$**	**$8.6x10^{-6}$**	[c]	[c]
EXPANDED OPERATIONS ALTERNATIVE						
Technical Area-I						
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$2.9x10^{-6}$	$1.4x10^{-9}$	$7.9x10^{-3}$	$3.2x10^{-6}$
Technical Area-II						
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$3.1x10^{-7}$	$1.5x10^{-10}$	$4.6x10^{-4}$	$1.9x10^{-7}$

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	$7.0x10^{-4}$	$4.8x10^{-4}$	$2.4x10^{-7}$	$1.9x10^{-1}$	$7.4x10^{-5}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.4x10^{-2}$	$6.9x10^{-6}$	$3.7x10^{1}$	$3.0x10^{-2}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.2x10^{-3}$	$5.8x10^{-7}$	$6.9x10^{-1}$	$2.7x10^{-4}$
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**$1.6x10^{-2}$**	**$7.8x10^{-6}$**	[c]	[c]
REDUCED OPERATIONS ALTERNATIVE						
Technical Area-I						
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$2.9x10^{-6}$	$1.4x10^{-9}$	$7.9x10^{-3}$	$3.2x10^{-6}$
Technical Area-II						
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$3.1x10^{-7}$	$1.5x10^{-10}$	$4.6x10^{-4}$	$1.9x10^{-7}$
Technical Area-V						
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$4.8x10^{-4}$	$2.4x10^{-7}$	$1.9x10^{-1}$	$7.4x10^{-5}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.4x10^{-2}$	$6.9x10^{-6}$	$3.7x10^{1}$	$3.0x10^{-2}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.2x10^{-3}$	$5.8x10^{-7}$	$6.9x10^{-1}$	$2.7x10^{-4}$
REDUCED OPERATIONS ALTERNATIVE TOTALS			**$1.6x10^{-2}$**	**$7.8x10^{-6}$**	[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	7.0×10^{-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}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	1.7×10^{-3}	8.4×10^{-7}	1.6×10^{-3}	8.1×10^{-7}
NO ACTION ALTERNATIVE			**1.7×10^{-2}**	**8.3×10^{-6}**	**1.5×10^{-2}**	**7.6×10^{-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}
AR-5	Earthquake - collapse of bridge crane	7.0×10^{-4}	1.3×10^{-3}	6.5×10^{-7}	2.4×10^{-4}	1.2×10^{-7}
NO ACTION ALTERNATIVE TOTALS			**1.3×10^{-2}**	**6.6×10^{-6}**	**2.0×10^{-3}**	**9.9×10^{-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}

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	$7.0x10^{-4}$	$6.4x10^{-5}$	$3.2x10^{-8}$	$5.4x10^{-5}$	$2.7x10^{-8}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.2x10^{-3}$	$6.2x10^{-7}$	$1.0x10^{-3}$	$5.1x10^{-7}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.8x10^{-4}$	$8.9x10^{-8}$	$1.5x10^{-4}$	$7.4x10^{-8}$
AR-5	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$1.9x10^{-4}$	$9.7x10^{-8}$	$1.6x10^{-4}$	$7.9x10^{-8}$
NO ACTION ALTERNATIVE TOTALS			**$1.6x10^{-3}$**	**$8.1x10^{-7}$**	**$1.3x10^{-3}$**	**$6.6x10^{-7}$**
			Kirtland Elementary School		***Child Development Center-West***	
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$3.3x10^{-7}$	$1.7x10^{-10}$	$4.3x10^{-7}$	$2.1x10^{-10}$
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$1.5x10^{-8}$	$7.6x10^{-12}$	$1.9x10^{-8}$	$9.4x10^{-12}$
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$3.0x10^{-5}$	$1.5x10^{-8}$	$3.0x10^{-5}$	$1.5x10^{-8}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$5.2x10^{-4}$	$2.6x10^{-7}$	$5.2x10^{-4}$	$2.6x10^{-7}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$8.0x10^{-5}$	$4.0x10^{-8}$	$8.0x10^{-5}$	$4.0x10^{-8}$
AR-5	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$8.2x10^{-5}$	$4.1x10^{-8}$	$8.2x10^{-5}$	$4.1x10^{-8}$
NO ACTION ALTERNATIVE TOTALS			**$6.8x10^{-4}$**	**$3.4x10^{-7}$**	**$6.8x10^{-4}$**	**$3.4x10^{-7}$**
EXPANDED OPERATIONS 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	$7.0x10^{-4}$	$1.2x10^{-3}$	$5.8x10^{-7}$	$1.1x10^{-3}$	$5.3x10^{-7}$
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**$1.5x10^{-2}$**	**$7.7x10^{-6}$**	**$1.4x10^{-2}$**	**$7.1x10^{-6}$**

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			**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}
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**1.8×10^{-3}**	**9.1×10^{-7}**	**1.8×10^{-3}**	**9.1×10^{-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			**1.7×10^{-3}**	**8.3×10^{-7}**	**1.5×10^{-3}**	**7.4×10^{-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	$7.0x10^{-4}$	$6.2x10^{-6}$	$3.1x10^{-9}$	$2.6x10^{-6}$	$1.3x10^{-9}$
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$2.0x10^{-7}$	$9.8x10^{-11}$	$8.3x10^{-8}$	$4.2x10^{-11}$
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$6.4x10^{-5}$	$3.2x10^{-8}$	$6.4x10^{-5}$	$3.2x10^{-8}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.2x10^{-3}$	$6.2x10^{-7}$	$1.2x10^{-3}$	$6.2x10^{-7}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.8x10^{-4}$	$8.9x10^{-8}$	$1.8x10^{-4}$	$8.9x10^{-8}$
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**$1.5x10^{-3}$**	**$7.4x10^{-7}$**	**$1.5x10^{-3}$**	**$7.4x10^{-7}$**
			Veterans Affairs Medical Center		*Lovelace Hospital*	
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$8.2x10^{-7}$	$4.1x10^{-10}$	$8.1x10^{-7}$	$4.0x10^{-10}$
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$3.3x10^{-8}$	$1.7x10^{-11}$	$3.3x10^{-8}$	$1.7x10^{-11}$
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$6.4x10^{-5}$	$3.2x10^{-8}$	$5.4x10^{-5}$	$2.7x10^{-8}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.2x10^{-3}$	$6.2x10^{-7}$	$1.0x10^{-3}$	$5.1x10^{-7}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.8x10^{-4}$	$8.9x10^{-8}$	$1.5x10^{-4}$	$7.4x10^{-8}$
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**$1.5x10^{-3}$**	**$7.4x10^{-7}$**	**$1.2x10^{-3}$**	**$6.1x10^{-7}$**
			Kirtland Elementary School		*Child Development Center-West*	
NG-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$3.3x10^{-7}$	$1.7x10^{-10}$	$4.3x10^{-7}$	$2.1x10^{-10}$
ECF-1	Catastrophic release of building's tritium	$7.0x10^{-4}$	$1.5x10^{-8}$	$7.6x10^{-12}$	$1.9x10^{-8}$	$9.4x10^{-12}$
AM-2	Earthquake - collapse of bridge crane	$7.0x10^{-4}$	$3.0x10^{-5}$	$1.5x10^{-8}$	$3.0x10^{-5}$	$1.5x10^{-8}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$5.2x10^{-4}$	$2.6x10^{-7}$	$5.2x10^{-4}$	$2.6x10^{-7}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$8.0x10^{-5}$	$4.0x10^{-8}$	$8.0x10^{-5}$	$4.0x10^{-8}$
EXPANDED OPERATIONS ALTERNATIVE TOTALS			**$6.3x10^{-4}$**	**$3.2x10^{-7}$**	**$6.3x10^{-4}$**	**$3.2x10^{-7}$**

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	$7.0x10^{-4}$	$2.9x10^{-6}$	$1.4x10^{-9}$	$1.4x10^{-6}$	$6.8x10^{-10}$
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	$7.0x10^{-4}$	$1.2x10^{-3}$	$5.8x10^{-7}$	$1.1x10^{-3}$	$5.3x10^{-7}$
REDUCED OPERATIONS ALTERNATIVE TOTALS			**$1.5x10^{-2}$**	**$7.7x10^{-6}$**	**$1.4x10^{-2}$**	**$7.1x10^{-6}$**
			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	$7.0x10^{-4}$	$9.7x10^{-4}$	$4.8x10^{-7}$	$2.1x10^{-4}$	$1.1x10^{-7}$
REDUCED OPERATIONS ALTERNATIVE TOTALS			**$1.2x10^{-2}$**	**$6.1x10^{-6}$**	**$1.8x10^{-3}$**	**$9.1x10^{-7}$**
			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	$7.0x10^{-4}$	$7.7x10^{-5}$	$3.9x10^{-8}$	$7.7x10^{-5}$	$3.9x10^{-8}$
HC-1	Earthquake - building collapse	$7.0x10^{-4}$	$1.5x10^{-3}$	$7.7x10^{-7}$	$1.5x10^{-3}$	$7.7x10^{-7}$
SP-1	Earthquake - building collapse	$7.0x10^{-4}$	$2.1x10^{-4}$	$1.1x10^{-7}$	$2.1x10^{-4}$	$1.1x10^{-7}$
REDUCED OPERATIONS ALTERNATIVE TOTALS			**$1.8x10^{-3}$**	**$9.1x10^{-7}$**	**$1.8x10^{-3}$**	**$9.1x10^{-7}$**

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

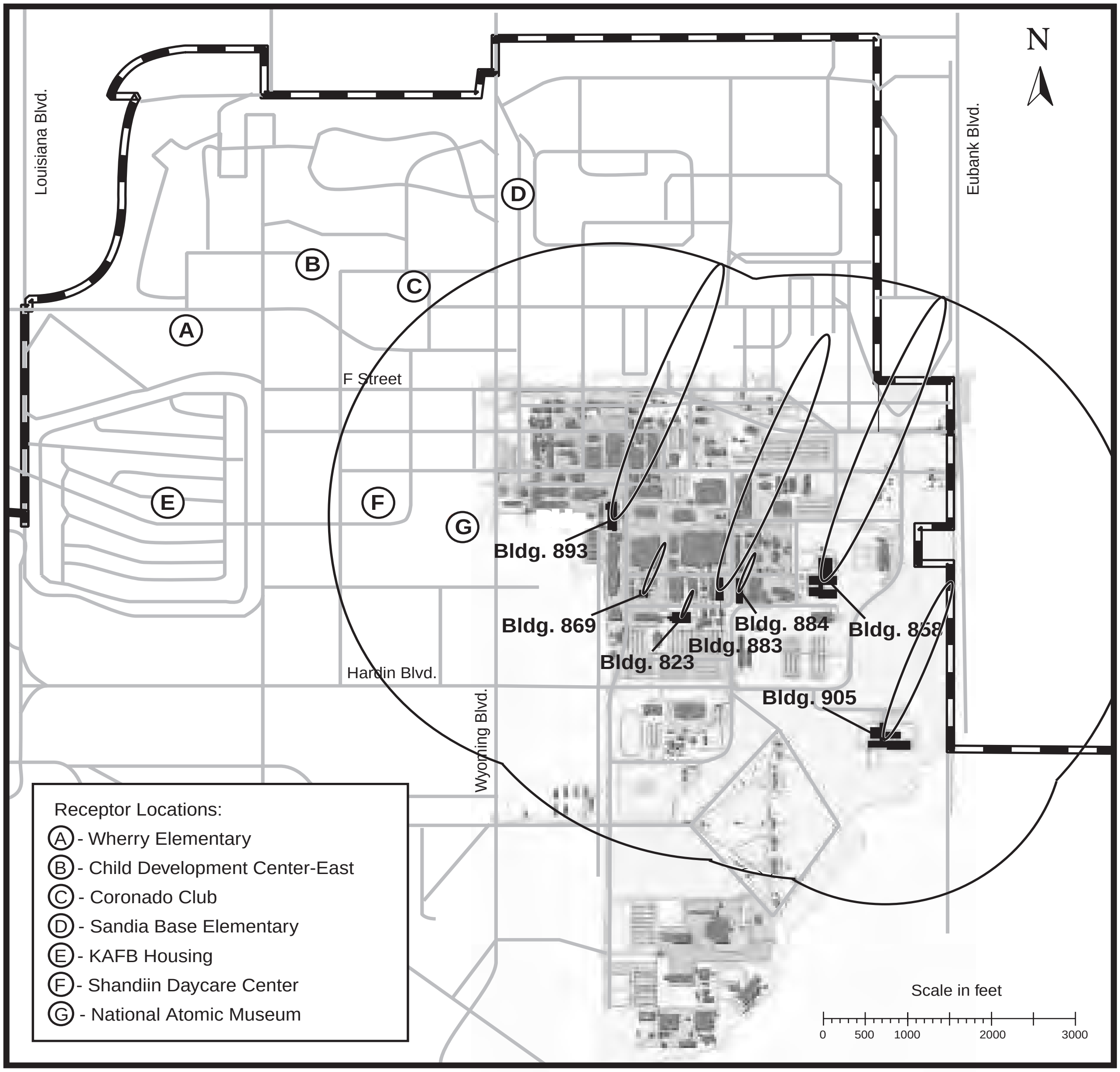
Based on the Paragon life safety study, the following buildings or portions of buildings would fail during a UBC (0.17 *g*) earthquake, releasing the contents of the chemicals stored within the building: Buildings 858, 869, 880, 884, 893, and 905 (Paragon 1997 & 1998). One building, 883, was not included 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.

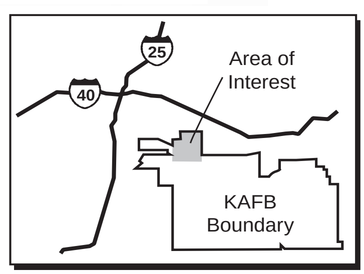
Because there are several chemicals that could be released from one or more buildings, locations of possible overlapping plumes of the same chemical need to be examined. The overlapping areas need to be examined for any that could be above the ERPG-2 concentrations, but that are not already included 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.

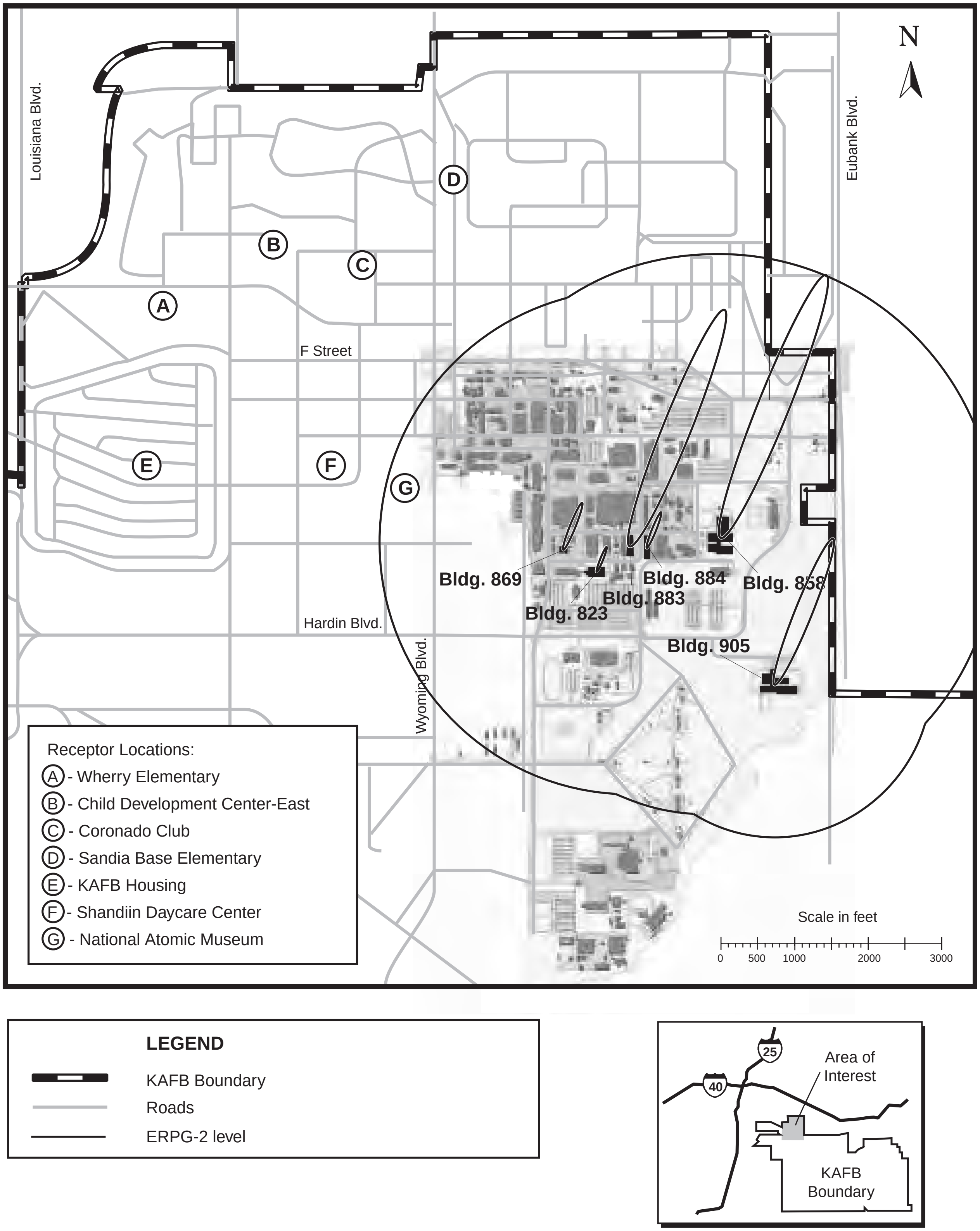




Source: Original

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

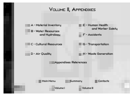
The encircled areas represent potential locations that could be above ERPG-2 levels depending upon the wind direction.



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.



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G

Transportation

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 2003	NO ACTION ALTERNATIVE 2008	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
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

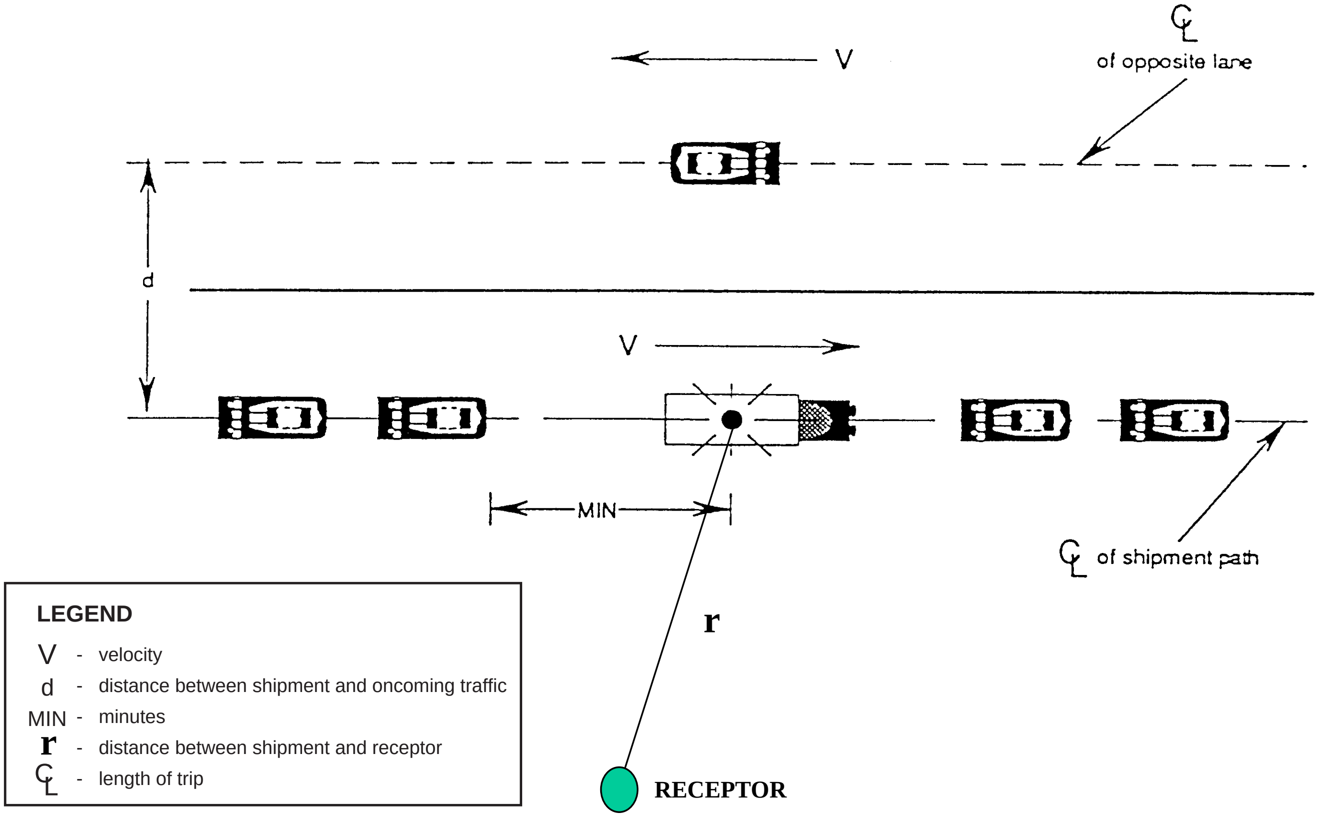

Figure G.4–1. The *RADTRAN 4* Incident-Free Model

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:

$$(1.3 \times 10^{-4}) \times (1.6 \text{ accidents}/10^{5} \text{ km}) \times (5 \text{urban km}) = 1.04 \times 10^{-7}$$

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	$2.3x10^{-3}$	$7.5x10^{-3}$	$7.5x10^{-3}$	$1.2x10^{-2}$	$4.6x10^{-3}$
LLW (D&D)	$2.3x10^{-3}$	$2.3x10^{-3}$	$2.3x10^{-3}$	$2.3x10^{-3}$	$2.3x10^{-3}$
LLMW [c]	$4.6x10^{-11}$	$1.7x10^{-10}$	$1.7x10^{-10}$	$1.7x10^{-10}$	$1.7x10^{-10}$
Medical Isotopes Production	NA	$1.5x10^{-2}$	$1.5x10^{-2}$	$5.2x10^{-2}$	$1.9x10^{-3}$
ANNUAL LCFs					
Radioactive [b]	$1.2x10^{-3}$	$2.2x10^{-3}$	$2.3x10^{-3}$	$6.0x10^{-3}$	$5.5x10^{-4}$
LLW	$1.2x10^{-6}$	$3.8x10^{-6}$	$3.8x10^{-6}$	$6.0x10^{-6}$	$2.3x10^{-6}$
LLW (D&D)	$1.2x10^{-6}$	$1.2x10^{-6}$	$1.2x10^{-6}$	$1.2x10^{-6}$	$1.2x10^{-6}$
LLMW [c]	$2.3x10^{-14}$	$8.5x10^{-14}$	$8.5x10^{-14}$	$8.5x10^{-14}$	$8.5x10^{-14}$
Medical Isotopes Production	NA	$7.5x10^{-6}$	$7.5x10^{-6}$	$3.0x10^{-5}$	$9.6x10^{-7}$
TOTAL RISK[d]	**$1.2X10^{-3}$**	**$2.2X10^{-3}$**	**$2.3X10^{-3}$**	**$6.8X10^{-3}$**	**$5.5X10^{-4}$**

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	$2.4x10^{-8}$	$7.2x10^{-8}$	$9.6x10^{-8}$	$4.8x10^{-8}$
TRU/MTRU (Legacy) [a]	0	0	$4.8x10^{-8}$	$4.8x10^{-8}$	$4.8x10^{-8}$
LLW (Legacy + ER)	0	0	0.11	0.11	0.11
LLMW (Legacy + ER) [b]	0	0	$4.4x10^{-4}$	$4.4x10^{-4}$	$4.4x10^{-4}$
ANNUAL LCFs					
TRU/MTRU [a]	0	$1.2x10^{-11}$	$3.6x10^{-11}$	$4.8x10^{-11}$	$2.4x10^{-11}$
TRU/MTRU (Legacy) [a]	0	0	$2.4x10^{-11}$	$2.4x10^{-11}$	$2.4x10^{-11}$
LLW (Legacy + ER)	0	0	$5.5x10^{-5}$	$5.5x10^{-5}$	$5.5x10^{-5}$
LLMW (Legacy + ER) [b]	0	0	$3.0x10^{-13}$	$3.0x10^{-13}$	$3.0x10^{-13}$
TOTAL [c]		**$1.2x10^{-11}$**	**$5.5x10^{-5}$**	**$5.5x10^{-5}$**	**$5.5x10^{-5}$**

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 $7.2x10^{-6}$ 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	-	-	$1.0x10^{-7}$
Nonoccupational Fatalities/km	$5.3x10^{-8}$	$1.3x10^{-8}$	$7.5x10^{-9}$
Occupational Fatalities/km	$1.5x10^{-8}$	$3.7x10^{-9}$	$2.1x10^{-9}$

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	$3.5x10^{-4}$	$3.5x10^{-4}$	$3.5x10^{-4}$	$3.5x10^{-4}$	$3.5x10^{-4}$
Chemical	$2.1x10^{-6}$	$2.1x10^{-6}$	$2.1x10^{-6}$	$2.1x10^{-6}$	$2.1x10^{-6}$
Explosive	$2.9x10^{-4}$	$2.9x10^{-4}$	$2.9x10^{-4}$	$2.9x10^{-4}$	$2.9x10^{-4}$
LLW	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
LLMW (Receipt)	$2.1x10^{-4}$	$2.1x10^{-4}$	$2.1x10^{-4}$	$2.1x10^{-4}$	$2.1x10^{-4}$
LLMW (Shipment)	$3.0x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$
Hazardous Waste	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
Recyclable Hazardous Waste (California)	$1.5x10^{-4}$	$1.5x10^{-4}$	$1.5x10^{-4}$	$1.5x10^{-4}$	$1.5x10^{-4}$
Recyclable Hazardous Waste (Local)	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$
Solid Waste	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$
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	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$
Biohazardous Waste	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$
Recyclable D&D Hazardous Waste	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$
Recyclable Nonhazardous Solid Waste	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-4}$
Nonhazardous Landscaping Waste	NA	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$
Construction and Demolition Solid Waste	NA	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$
RCRA Hazardous Waste (Receipt)	$6.7x10^{-7}$	$6.7x10^{-7}$	$6.7x10^{-7}$	$6.7x10^{-7}$	$6.7x10^{-7}$
LLW (D&D)	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$

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	$1.9x10^{-5}$	$1.9x10^{-5}$	$1.9x10^{-5}$	$1.9x10^{-5}$
TRU/MTRU (Legacy)	0	0	$1.9x10^{-5}$	$1.9x10^{-5}$	$1.9x10^{-5}$
LLW (Legacy)	0	0	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
LLMW (Legacy)	0	0	$3.0x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$
LLW (ER)	0	0	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
LLMW (ER)	0	0	$3.0x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$
Hazardous Waste (ER)	0	0	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
Nonhazardous Solid Waste (ER)	0	0	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$

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	1.9×10^{-5}	5.7×10^{-5}	7.6×10^{-5}	3.8×10^{-5}
TRU/MTRU (Legacy)	0	0	3.8×10^{-5}	3.8×10^{-5}	3.8×10^{-5}
LLW (Legacy)	0	0	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}
LLMW (Legacy)	0	0	2.4×10^{-3}	2.4×10^{-3}	2.4×10^{-3}
LLW (ER)	0	0	3.0×10^{-2}	3.0×10^{-2}	3.0×10^{-2}
LLMW (ER)	0	0	1.5×10^{-3}	1.5×10^{-3}	1.5×10^{-3}
Hazardous Waste (ER)	0	0	2.5×10^{-2}	2.5×10^{-2}	2.5×10^{-2}
Solid Waste (ER)	0	0	2.3×10^{-5}	2.3×10^{-5}	2.3×10^{-5}
TOTAL[a]			**7.1×10^{-2}**	**7.1×10^{-2}**	**7.1×10^{-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 FACTOR PER URBAN KILOMETER [a]	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	$1.0x10^{-7}$	73	$1.5x10^{-5}$	$4.6x10^{-3}$	$8.4x10^{-3}$	$9.0x10^{-3}$	$2.8x10^{-2}$	$2.1x10^{-3}$
Chemical	$1.0x10^{-7}$	8.0	$1.6x10^{-6}$	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$
Explosive	$1.0x10^{-7}$	48.0	$9.6x10^{-6}$	$2.9x10^{-3}$	$5.3x10^{-3}$	$5.7x10^{-3}$	$1.7x10^{-2}$	$1.3x10^{-3}$
LLW	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	$2.6x10^{-5}$	$8.6x10^{-5}$	$8.6x10^{-5}$	$1.4x10^{-4}$	$5.3x10^{-5}$
LLMW (Receipt)	$1.0x10^{-7}$	35.6	$7.1x10^{-6}$	0	$7.1x10^{-6}$	$7.1x10^{-6}$	$7.1x10^{-6}$	$7.1x10^{-6}$
LLMW (Shipment)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	$8.1x10^{-6}$	$2.4x10^{-5}$	$2.4x10^{-5}$	$2.4x10^{-5}$	$2.4x10^{-5}$
Medical Isotopes Production	-	-	-	NA	$2.0x10^{-3}$	$2.0x10^{-3}$	$1.0x10^{-2}$	$3.5x10^{-4}$
Hazardous Waste	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	$4.2x10^{-4}$	$5.3x10^{-4}$	$5.5x10^{-4}$	$7.4x10^{-4}$	$3.8x10^{-4}$
Recyclable Hazardous Waste (California)	$1.0x10^{-7}$	23.0	$4.6x10^{-6}$	$9.2x10^{-6}$	$1.4x10^{-5}$	$1.4x10^{-5}$	$1.8x10^{-5}$	$9.2x10^{-6}$
Recyclable Hazardous Waste (Local)	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	$7.8x10^{-6}$	$1.0x10^{-5}$	$1.0x10^{-5}$	$4.4x10^{-5}$	$7.8x10^{-6}$
Solid Waste	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
D&D hazardous waste TSCA-PCBs	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$
D&D Hazardous Waste TSCA-Asbestos	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$
Biohazardous Waste	$1.0x10^{-7}$	24.0	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$
Recyclable D&D Hazardous Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$

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 [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		
TRU/MTRU	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	$1.7x10^{-6}$	$5.1x10^{-6}$	$6.8x10^{-6}$	$3.4x10^{-6}$
TRU/MTRU (Legacy)	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	0	$3.4x10^{-6}$	$3.4x10^{-6}$	$3.4x10^{-6}$
LLW (Legacy)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	$3.7x10^{-4}$	$3.7x10^{-4}$	$3.7x10^{-4}$
LLMW (Legacy)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	0	$6.5x10^{-5}$	$6.5x10^{-5}$	$6.5x10^{-5}$
LLW (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	$9.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$
LLMW (ER)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	0	$4.1x10^{-5}$	$4.1x10^{-5}$	$4.1x10^{-5}$
Hazardous Waste (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	$7.5x10^{-4}$	$7.5x10^{-4}$	$7.5x10^{-4}$
Nonhazardous Solid Waste (ER)	$1.0x10^{-7}$	10	$2.0x10^{-6}$	0	0	$1.8x10^{-5}$	$1.8x10^{-5}$	$1.8x10^{-5}$
TOTAL[b]					**$1.7x10^{-6}$**	**$2.1x10^{-3}$**	**$2.1x10^{-3}$**	**$2.1x10^{-3}$**

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	4.6×10^{-2}	9.9×10^{-2}	0.1	0.31	2.4×10^{-2}
Radiological Accident	1.2×10^{-3}	2.2×10^{-3}	2.3×10^{-3}	6.8×10^{-3}	5.5×10^{-4}
Traffic Fatalities	0.22	0.40	0.42	1.2	0.11
LCFs Due to Truck Emissions	1.3×10^{-2}	2.3×10^{-2}	2.4×10^{-2}	6.2×10^{-2}	1.1×10^{-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	5.0×10^{-6}	1.8×10^{-2}	1.8×10^{-2}	1.8×10^{-2}
Radiological Accident	0	1.2×10^{-11}	5.5×10^{-5}	5.5×10^{-5}	5.5×10^{-5}
Traffic Fatalities	0	0	7.1×10^{-2}	7.1×10^{-2}	7.1×10^{-2}
LCFs Due to Truck Emissions	0	1.7×10^{-6}	2.1×10^{-3}	2.1×10^{-3}	2.1×10^{-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	$1.12x10^{-1}$	$1.7x10^{-2}$	$7.1x10^{-2}$	$6.02x10^{-1}$
8	$5.6x10^{-2}$	$1.1x10^{-2}$	$4.4x10^{-2}$	$3.71x10^{-1}$
5	$3.5x10^{-2}$	$6.7x10^{-3}$	$2.7x10^{-2}$	$2.32x10^{-1}$

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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H

Waste Generation

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 (ft^3)					
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 (ft^3)					
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 2003	NO ACTION ALTERNATIVE 2008	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
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 WEIGHT (kg)	LLW IN STORAGE VOLUME (m³)	FACILITY CAPACITY WEIGHT[b] (M kg)	FACILITY CAPACITY VOLUME (m³)
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 NAME	BASE YEAR [a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
HAZARDOUS WASTE, NORMAL OPERATIONS (kg)					
Microelectronics Development Laboratory	2,520	3,150	4,410	4,738	1,688
MESA Complex configuration[b]				(5,938)	
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 NAME	BASE YEAR [a]	NO ACTION ALTERNATIVE 2003	NO ACTION ALTERNATIVE 2008	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
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	VOLUME (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

SUMMARY 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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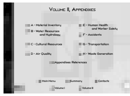

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APPENDIXES

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