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Prepared by
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Annual Site Environmental Report

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ABSTRACT

Sandia National Laboratories/New Mexico (SNL/NM) is operated in support of the U.S. Department of Energy (DOE) mission to provide weapon component technology and hardware for national security needs. SNL/NM also conducts fundamental research and development to advance technology in energy research, computer science, waste management, microelectronics, materials science, and transportation safety for hazardous and nuclear components. In support of SNL's mission, the Environment, Safety and Health (ES&H) Center and the Environmental Restoration (ER) Project at SNL/NM have established extensive environmental programs to assist SNL's line organizations in meeting all applicable local, State, and Federal environmental regulations and DOE requirements. This annual report for calendar year 1998 (CY98) summarizes the compliance status of environmental regulations applicable to SNL site operations. Environmental program activities include terrestrial surveillance; ambient air and meteorological monitoring; hazardous, radioactive, and solid waste management; pollution prevention and waste minimization; environmental remediation; oil and chemical spill prevention; and National Environmental Policy Act (NEPA) activities. This report has been prepared in compliance with DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990).

PREFACE

This Annual Site Environmental Report (ASER) presents summary information on the compliance status and monitoring results for Sandia National Laboratories, New Mexico (SNL/NM). An ASER is also produced for the Kauai Test Facility (KTF) and is attached as Appendix B. A brief overview of Sandia National Laboratories is available on the web at: <http://www.sandia.gov/visit.htm>

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Aerial View of Sandia National Laboratories, Technical Area I Looking Southeast
(The Sandia and Manzano Mountains are seen in the background.)

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ABBREVIATIONS

Acronyms and Abbreviations

ABC/AQCB	Albuquerque-Bernalillo County Air Quality Control Board
ACE	U.S. Army Corps of Engineers
ACRR	Annular Core Research Reactor
AEA	Atomic Energy Act
AED	Albuquerque Economic Development, Inc.
AEHD	Albuquerque Environmental Health Department
AIRFA	American Indian Religious Freedom Act
ALARA	as low as reasonably achievable
AMPL	Advanced Manufacturing Process Laboratory
ARM	Atmospheric Radiation Measurement (Program)
ARPA	Archaeological Resources Protection Act
ASER	Annual Site Environmental Report
CA	Corrective Action
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAMU	Corrective Action Management Unit
CAN	Clean Air Network
CAP88	Clean Air Act Assessment Package-1988
CAS	Chemical Abstract System
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERF	Civil Engineering Research Facility
CFR	Code of Federal Regulations
CIWL	Classified Waste Landfill
CNSAC	Center for National Security and Arms Control
COA	City of Albuquerque
COD	chemical oxygen demand
COIL	Chemical Oxygen Iodine Laser
CPAP	Contractor Performance Assessment Program
CPMS	Criteria Pollutant Monitoring Station
CRADA	Cooperative Research and Development Agreement
CTF	Coyote Test Field
CWA	Clean Water Act
CWL	Chemical Waste Landfill
CY	calendar year
D&D	demolition and decontamination
DCG	derived concentration guide
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
DOE/AL	U.S. Department of Energy/Albuquerque Operations Office
DOE/EH	U.S. Department of Energy/Environmental Health
DOE/EM	U.S. Department of Energy/Office of Environmental Management
DOE/HQ	U.S. Department of Energy/Headquarters
DOE/KAO	U.S. Department of Energy/Kirtland Area Office
DOT	U.S. Department of Transportation
DP	Discharge Plan

ABBREVIATIONS (Continued)

DP	Defense Mode
DQO	data quality objective
DU	depleted uranium
EA	Environmental Assessment
ECF	Explosive Components Facility
EDE	effective dose equivalent
EHS	extremely hazardous substance
EIS	Environmental Impact Statement
EIS/ODIS	Effluent Information System/Onsite Discharge Information System
EMSL	Environmental Monitoring Systems Laboratory
ESEF	Engineering Sciences Experimental Facility
EO	Executive Order
EOC	Emergency Operations Center
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ER	Environmental Restoration
ESA	Endangered Species Act
ES&H	Environment, Safety and Health
FFCAct	Federal Facilities Compliance Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLAME	Fire Laboratory used for the Authentication of Models and Experiments
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	fiscal year
GEL	General Engineering Labs
GIF	Gamma Irradiation Facility
GSA	General Services Administration
GSAF	Generator Set-Aside Fee
GWPP	Groundwater Protection Program
HAP	hazardous air pollutant
HAZMAT	hazardous materials
HCF	Hot Cell Facility
HCFC	hydrochlorofluorocarbon
HDRV	Historical Disposal Requests Validation (Project)
HERMES	High-Energy Radiation Megavolt Electron Source
HLW	high-level radioactive waste
HSWA	Hazardous and Solid Waste Amendments
HWMF	Hazardous Waste Management Facility
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectrum
ICS	Incident Command System
IMRL	Integrated Materials Research Laboratory
INEEL	Idaho National Engineering and Environmental Laboratories
IRP	Installation Restoration Program

ABBREVIATIONS (Continued)

ISMS	Integrated Safety Management System
ISRC	Intelligent Systems and Robotics Center
ISS	Interim Storage Site
ITRI	Inhalation Toxicology Research Institute (now LRRI)
JIC	Joint Information Center
KAFB	Kirtland Air Force Base
KTF	Kauai Test Facility
KUMSC	Kirtland Underground Munitions Storage Complex
LANL	Los Alamos National Laboratory
LDR	Land Disposal Restrictions
LDRD	Lab Directed Research and Development
LECS	Liquid Effluent Control System
LRRI	Lovelace Respiratory Research Institute
LIHE	Light Initiated High Explosives (Facility)
LLW	low-level radioactive waste
LTTD	Low Temperature Thermal Desorption
LWDS	Liquid Waste Disposal System
MAC	maximum allowable concentration
MCL	maximum contaminant limit
MEI	maximally exposed individual
MDA	minimum detectable activity
MDL	minimum detection limit
MDL	Microelectronics Development Laboratory
MIPP	Medical Isotope Production Project
MSDS	Material Safety Data Sheet
MW	mixed waste
MWL	Mixed Waste Landfill
N/A	not available or not applicable
NAAQS	National Ambient Air Quality Standards
ND	not detected
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	No Further Action
NGF	Neutron Generator Facility
NHPA	National Historic Preservation Act
NM	New Mexico
NMAC	New Mexico Administrative Code
NMAQS	New Mexico Air Quality Standards
NMDOA	New Mexico Department of Agriculture
NMED	New Mexico Environment Department
NMGS	New Mexico Geological Society
NMWQCC	New Mexico Water Quality Control Commission
NOAA	National Oceanographic and Atmospheric Administration
NSTTF	National Solar Thermal Test Facility

ABBREVIATIONS (Continued)

NON	Notification of Noncompliance
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	National Response Center – (1-800-424-8802)
NRC	U.S. Nuclear Regulatory Commission
NSPS	New Source Performance Standards
NTNC	Non-Transient, Non-Community
NTS	Nevada Test Site
ODS	ozone-depleting substance
ORPS	Occurrence Reporting Processing System
P2	Pollution Prevention
PA/SI	Preliminary Assessment/Site Inspection
PBR/SDP	Packed Bed Reactor/Silent Discharge Plasma
PBT	Persistent Biochemical Toxics
PCB	polychlorinated biphenyl
PETL	Processing and Environmental Technology Laboratory
PG	Program (Document)
PHS	Preliminary Hazard Screening
PM	particulate matter
PM ₁₀	respirable particulate matter (diameter equal to or less than 10 microns)
POTW	publicly owned treatment works
PPE	personal protective equipment
PPOA	Pollution Prevention Opportunity Assessment
PSD	Prevention of Significant Deterioration
QA	quality assurance
QAP	Quality Assurance Program
QAPjP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RHEPP	Repetitive High Energy Pulsed Power (an accelerator facility)
RFI	RCRA Facility Investigation
RML	Radiation Metrology Laboratory
RMP	Risk Management Plan
RMSEL	Robotic Manufacturing Science and Engineering Laboratory
RMSY	Radioactive Materials Storage Yard
RMWMF	Radioactive and Mixed Waste Management Facility
ROD	Record of Decision
ROI	Return on Investment

ABBREVIATIONS (Continued)

RQ	reportable quantity
RVR	Robotic Vehicle Range
RWL	Radioactive Waste Landfill
SABRE	Sandia Accelerator & Beam Research Experiment
SAF	Soil Amendment Facility
SARA	Superfund Amendments and Reauthorization Act
SATURN	(an accelerator facility)
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SIC	Standard Industrial Classification
SLAMS	state and local air monitoring stations
SMO	Sample Management Office
SNL	Sandia National Laboratories
SNL/CA	Sandia National Laboratories/California
SNL/NM	Sandia National Laboratories/New Mexico
SPCC	Spill Prevention Control and Countermeasures (Plan)
SPDES	State Pollutant Discharge Elimination System
SPHINX	Short Pulse High Intensity Nanosecond X-Radiator (an accelerator facility)
SPR	Sandia Pulsed Reactor
SS&TP	Sandia Science and Technology Park
STAR	Stability Array (NESHAP data files)
STAR	Sample Tracking Analytical Results (SMO database)
STEL	Short-Term Exposure Limit
SVOC	Semi Volatile Organic Compound
SW/ST	Soil Washing / Soil Stabilization
SWEIS	Site-Wide Environmental Impact Statement
SWISH	Small Wind SHielded (facility)
SWMU	Solid Waste Management Unit
SWTF	Solid Waste Transfer Facility
TA	Technical Area
TANDEM	(an accelerator facility)
TCE	trichloroethylene or trichloroethene
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TESLA	(an accelerator facility)
TLD	thermoluminescent dosimeter
TLV	threshold limit value
TNMHC	total non-methane hydrocarbon
TOC	total organic carbon
TRI	Toxic Release Inventory
TRU	transuranic (waste)
TSCA	Toxic Substances Control Act

ABBREVIATIONS (Continued)

TTF	Thermal Treatment Facility
TTR	Tonopah Test Range
TU	Temporary Unit
TWA	time weighted average
USAF	United States Air Force
USGS	United States Geological Survey
UST	underground storage tank
VCM	voluntary corrective measure
VOC	volatile organic compound
WERF	Waste Experimental Reduction Facility
WIPP	Waste Isolation Pilot Plant

ABBREVIATIONS (Continued)

Units of Measure

°C	Celsius degree
cm	centimeter
°F	Fahrenheit degree
ft	feet
g	gram
gal	gallon
hr	hour
in.	inch
kg	kilogram
km	kilometer
kW	kilowatt
L	liter
lb	pound
m	meter
m ³	cubic meter
MBtu	million British thermal unit
mg	milligram
mi	mile
ml	milliliter
ppb	parts per billion
ppm	parts per million
scf	standard cubic feet
sq ft	square feet
sq km	square kilometer
sq mi	square mile
tpy	tons per year
yr	year
μg	microgram

Radioactivity Measurements

Ci	curie
mrem	millirem (unit of radiation dose)
mSv	millisievert (unit of radiation dosage)
person-rem	radiation dose to population (also man-rem)
person-Sv	person-sievert (unit of radiation dosage)
pCi	picocurie
rem	roentgen equivalent man
μCi	microcurie

ABBREVIATIONS (Concluded)

Chemical Abbreviations

CO	carbon monoxide
NO ₂	nitrogen dioxide
NO _x	nitrogen oxides
O ₃	ozone
pH	potential of hydrogen
SO ₂	sulfur dioxide
TCE	trichloroethylene or trichloroethene
TCA	trichloroethane
1,1,1,-TCA	1,1,1,-trichloroethane

Approximate Conversion Factors for Selected SI (Metric) Units

Multiply SI (Metric) Unit	By	To Obtain U.S. Customary Unit
Cubic meters (m ³)	35	Cubic feet (ft ³)
Centimeters (cm)	0.39	Inches (in.)
Meters (m)	3.3	Feet (ft)
Kilometers (km)	0.62	Miles (mi)
Square kilometers (km ²)	0.39	Square miles (mi ²)
Hectares (ha)	2.5	Acres
Liters (L)	0.26	Gallons (gal)
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.2	Pounds (lb)
Micrograms per gram (µg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Celsius (°C)	°F = 9/5 °C + 32	Fahrenheit (°F)

Labs Director Paul Robinson and Executive Vice President Joan Woodard
Inspect a Plasma Chamber in Bldg. 805 During a Tour of the Laboratories

Executive Summary

As required by U.S. Department of Energy (DOE) Order 5400.1, *General Environmental Protection Program* (DOE 1990), this Annual Site Environmental Report (ASER) has been prepared for Sandia National Laboratories/New Mexico (SNL/NM) to characterize current environmental conditions in the vicinity of SNL/NM property and to summarize the compliance status with Federal, State, and local requirements and permits. This report represents a key component of the DOE's effort to keep the public informed about environmental conditions throughout the DOE complex. For this 1998 calendar year (CY98) report, significant environmental program achievements are highlighted, as well as noting any areas of noncompliance, corrective actions, or other areas of ongoing improvements. Audit results from all external appraisals conducted in 1998 are briefly described.

SNL/NM is managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation. The site is located on the 80-square-mile Kirtland Air Force Base (KAFB) military complex, which includes 22,500 acres withdrawn from the U.S. Forest Service for various remote testing activities conducted by DOE, SNL, and the U.S. Air Force (USAF). The complex is situated adjacent to and southeast of Albuquerque, New Mexico.

The primary mission of SNL/NM is to conduct research and development for nuclear weapon system components and to ensure the integrity and reliability of the nation's nuclear defense systems. This mission has greatly expanded in recent years to focus on the development of non-

weapon-specific technology such as microelectronics, micro-machines, computer technology, waste treatment technologies, accelerator and pulsed power energy research, robotics, and biomedical engineering. The Environment, Safety and Health (ES&H) Center within SNL/NM supports the corporate mission by providing compliance support to SNL line organization activities. SNL/NM's operations primarily take place within five technical areas (TA-1 through TA-V) and the Coyote Test Field (CTF).

The major environmental programs and activities conducted at SNL/NM during 1998 are as follows:

- Waste management
- Pollution Prevention (P2) and waste minimization
- Environmental Restoration (ER)
- Terrestrial surveillance
- Water quality for effluents and runoff
- Groundwater monitoring
- Air quality compliance and monitoring
- National Environmental Policy Act (NEPA) activities
- Environmental occurrence reporting
- Environmental audit tracking

WASTE MANAGEMENT, POLLUTION PREVENTION (P2), AND WASTE MINIMIZATION

Waste management at SNL/NM is conducted at three primary waste handling areas: the Hazardous Waste Management Facility (HWMF), the Radioactive and Mixed Waste Management Facility (RMWMF), and the Solid Waste Transfer Facility (SWTF). In addition, representatives from SNL/NM's waste minimization and P2 programs confer with SNL/NM's line organizations to implement waste minimization technologies and recycling, wherever feasible.

- **HWMF** – The HWMF operates under a Resource Conservation and Recovery Act (RCRA) Part B Permit. All nonradioactive, nonexplosive, hazardous chemical wastes, including RCRA waste, asbestos, polychlorinated biphenyls (PCBs), and biohazardous waste, are handled at this facility. Recycling is also carried out for various material categories that include used oil, specific metals, batteries, and PCBs. The HWMF is responsible for verifying, labeling, packaging, storing, and shipping waste to permitted facilities for disposal. A total of 21,513 individual items were collected and cataloged at the HWMF in 1998. The HWMF shipped out the following waste categories:

<i>Weight (kg)</i>	<i>Category</i>
73,446	RCRA Waste
31,523	Asbestos
2,141	PCBs (recycled & waste)
19,572	ER Waste (non-rad)
2,574	Biohazardous Waste
170,087	Other Recycled and Chemical Waste
299,343	Total Shipped

The New Mexico Environment Department (NMED) conducted an audit in June 1998 of SNL/NM's hazardous waste management activities including waste generator sites. This was a thorough "wall to wall" audit of significantly greater scrutiny than the normal annual audit. Nine draft findings were identified. All were insignificant and immediately corrected.

- **RMWMF** – The RMWMF currently handles low-level waste (LLW), mixed waste (MW), transuranic waste (TRU), and TRU/MW. In 1998, SNL/NM managed:

<i>Weight (kg)</i>	<i>Category</i>
861,590	LLW
10,143	MW
22,089	TRU
44.5	TRU/MW
893,866.5	Total

SNL/NM is in compliance with the Federal Facilities Compliance Act (FFCA), which acknowledges and makes provisions for the national lack of MW treatment capabilities for Federal facilities. However, compliance with RCRA continues to be an issue since the hazardous component of MW is being stored for longer than the mandated one-year time frame. MW treatment technologies have been developed, and shipments of MW have begun, however, it will be several years before all the onsite MW can be shipped to treatment and/or storage facilities. A total of 749,487 kg of LLW and 5,518 kg of MW were shipped offsite in 1998.

- **SWTF** – The SWTF accepts non-hazardous solid waste generated from SNL/NM's offices and laboratories. The waste is screened for acceptance criteria and then compacted, baled, and stored for shipment to recycling centers or area landfills. Recyclable material handling makes up a large portion of the facility's activities. In 1998, a total of 1,330,013 kg of solid waste was received at the facility and an additional 728,227 kg of paper and cardboard were recycled. Plans to expand the recycling effort to include other categories are under way.
- **Pollution Prevention (P2)** – Waste minimization and P2 efforts at SNL/NM take on several forms. Pollution Prevention Opportunity Assessments (PPOAs) are used to identify areas of waste production that can be reasonably reduced through modification of existing processes and/or equipment. PPOAs may be used to identify potential Return-on-Investment (ROI) projects, which are funded by DOE. ROIs are initiated for projects that can show a waste management cost-savings over two years by modification of the existing methods. There were nine projects proposed for ROI funding in 1998.

There is also a Generator Set-Aside Fee (GSAF) Program piloted by the DOE. A small fee is collected from waste generators based on their waste quantity and used for P2 project funding. For example, GSAF money was used to replace light fixtures with low energy alternatives and purchase launderable personal protective equipment (PPE).

ENVIRONMENTAL RESTORATION (ER) PROJECT ACTIVITIES

The assessment and remediation of potential release sites identified by the ER Project at SNL/NM are being regulated by the NMED as provided for by the Hazardous and Solid Waste Amendments of 1984 (HSWA) Module IV of the RCRA Part B Operating Permit. At the close of fiscal year 1998 (FY98), there were 146 sites remaining to be addressed. Many of these sites will require no further action due to the completion of voluntary cleanup measures or because any contamination present is below regulatory action levels. Cleanup of the Chemical Waste Landfill (CWL) in TA-III, the most significant ER project remaining, was started in 1998. Remedial action at all SNL/NM ER sites should be completed by the year 2003. SNL is continuing to pursue closure of the 16 ER sites proposed for No Further Action (NFA) in 1997. These sites have been proposed for NFA either because of insignificant contamination present or because voluntary cleanup measures have already been completed. The sites remain on the ER list until NMED has approved the closures in writing.

TERRESTRIAL SURVEILLANCE

SNL/NM conducts terrestrial surveillance as required by DOE Order 5400.1 (DOE 1990). Soil, sediment, vegetation, and surface water samples are collected from onsite, perimeter, and offsite locations. Sample locations are in areas of known contamination or in areas where contamination, if present, would be expected to accumulate. The surveillance sampling objectives are to detect any potential releases and/or migration of contaminated material to offsite locations as well as to determine if pollutants are migrating from offsite to onsite.

Results are put into four categories. A Category 1 location—of which SNL/NM has none—would be a site which showed higher than offsite or perimeter values and an increasing trend. At the other end of the scale, Category 4 locations would show no statistical differences between onsite and offsite/perimeter sampling locations. Results in 1998 identified several locations with higher than offsite values (Category 2) in areas of known contamination. Results were similar to past years. Tritium contamination at levels higher than offsite is present in TA-II and near the Mixed Waste Landfill (MWL) in TA-III. Cesium-137 has been found higher than offsite in four areas near and within the KAFB land withdrawal, including near the Burn Site and at the north end of Manzano Base. High levels of metals have been found at perimeter locations north of KAFB including cobalt, magnesium, iron, manganese, and potassium. Near the Air Force Skeet Range, lead and cadmium are elevated. Category 3 locations, which identify areas of increasing trends but with levels remaining below offsite values, were identified at 28 routine sampling sites.

The Terrestrial Surveillance Program conducted its annual wildlife monitoring survey in 1998 to ascertain the presence of contaminants in rodent populations and to augment baseline data for general species information on small mammals, birds, and vegetation.

WATER QUALITY MONITORING

Water quality programs include wastewater effluents, surface discharges, storm water runoff, and groundwater monitoring.

- **Sewer System Discharges** – Wastewater from SNL/NM is discharged directly to the public sewer line through four general outfall stations. Additionally, there are two pretreatment stations upstream of the general outfalls for the Advanced

Manufacturing Process Laboratory (AMPL) and the Microelectronics Development Laboratory (MDL). The AMPL station has been a zero discharge location for the last two years. Monitoring is conducted to ensure that wastewater discharges meet the standards of the Albuquerque's Southside Water Reclamation Plant. Treated water is discharged to the Rio Grande under the City's National Pollutant Discharge Elimination System (NPDES) permit. SNL had only one exceedence in a wastewater sample in 1998. Molybdenum slightly above standards was caused from disposal of contaminated mop water. Cleaning procedures were changed.

- **Surface Discharges** – All water to be discharged to the ground surface, either directly or to lined containments, must meet State surface discharge standards. There were 23 requests made for individual discharges to the ground surface. Two were not approved and sent to the sanitary sewer authority for disposal. Additionally, routine surface discharges are made to the evaporation lagoons servicing the Pulsed Power Facility under an existing discharge permit. All permit requirements were met in 1998 for this facility. There were two instances of inadvertent discharges to the surface in 1998: a small diesel spill (several gallons) and 350 lb of sodium hydroxide that fell off of a forklift.
- **Storm Water Runoff** – In 1998 only one storm water event met the criteria for sampling. Aluminum, iron, magnesium, nitrates, and total suspended solids were detected above established standards. The source of the apparent contaminants was not located. However, since one data point is inconclusive, future monitoring will attempt to gather more representative samples. If results continue to be high for these or other parameters, further investigations to determine the source will be carried out.

- **Groundwater Monitoring** – Groundwater monitoring activities reported are those associated with SNL/NM's ER Project and the Groundwater Protection Program (GWPP).

In 1998, the Groundwater Surveillance Task of the GWPP sampled 13 wells and one spring. Water quality data showed several metals slightly exceeded the maximum contaminant limits (MCLs) set for drinking water standards. These included chromium, nickel, radium-226 and 228, and uranium-234. Elevated nickel is likely a result of deteriorating well screens. Uranium is expected higher than average due to erosion from the Manzano Mountains, which is an igneous/metamorphic complex. No significant environmental impacts were found.

ER results were divided into five areas: Chemical Waste Landfill (CWL), Mixed Waste Landfill MWL), TA-V, Sandia North (near TA-I and TA-II), and the Burn Site. In 1998, water quality samples taken at ER sites, as required by the RCRA permit, showed elevated levels of known contaminants similar to past years. This includes trichloroethylene (TCE) at the CWL, TA-V, and Sandia North. The concentrations of TCE are at relatively low levels with the highest level being 21 micrograms/liter ($\mu\text{g/L}$) at TA-V, as compared to the drinking water MCL of 5 $\mu\text{g/L}$. The MWL showed elevated levels of chromium (0.326 mg/L) as compared to the 0.1 mg/L standard. Nickel was elevated at the CWL, however, elevated nickel in most wells is due to well screen corrosion. Nitrates are also present at Sandia North, TA-V, and the Burn Site. Sandia North has the more significant nitrate contamination of the three sites, but is only about two times higher than the drinking water standards. There is no indication that contaminants are migrating from any of SNL/NM's ER sites.

Water levels were also recorded in 102 wells to determine the potentiometric surface (subsurface water table levels and general flow directions). Water levels are continuing to drop at a rate of 1 to 2 ft per year in wells west of the Tijeras fault complex, in the Santa Fe Group aquifer. Water level declines are the result of pumping from City of Albuquerque (COA) and KAFB water supply wells.

AIR QUALITY COMPLIANCE AND MONITORING

- **Ambient Air Monitoring** – SNL/NM measures ambient air quality at six stations throughout the site to compare to the National Ambient Air Quality Standards (NAAQS) and local ambient air standards implemented by New Mexico regulations. The network includes one Criteria Pollutant Monitoring Station (CPMS)—which measures sulfur dioxide (SO_2), nitrous oxides (NO_x), particulate lead, ozone (O_3), and carbon monoxide (CO)—and five air monitoring stations that measure volatile organic compounds (VOCs) and particulate matter (PM). There were no exceedences in ambient air quality at any of SNL/NM's six stations.
- **Title V Requirements** – In accordance with the new requirements of the Clean Air Act Amendments (CAAA), SNL/NM has applied for a Title V Operating Permit. SNL/NM is a major source (>100 tons per year [tpy]) for nitrous oxides (NO_x). The permit will include many of the current individually permitted sources under a site-wide comprehensive permit. The Title V permit application was submitted on March 1, 1996 but a permit has yet to be issued by the City.

- **Meteorological Monitoring** – SNL/NM maintains a network of eight meteorological towers to supply onsite data in support of SNL projects, such as determining locations for air monitoring station locations. The data also serves to provide current meteorological data for emergency response information in the event of a spill or other hazardous release. The towers are instrumented at various levels to record wind speed and direction, standard deviation of horizontal wind speed (sigma theta), temperature, relative humidity, precipitation, and barometric pressure.
- **National Emission Standards for Hazardous Air Pollutants (NESHAP) Compliance** – In 1998, there were 17 facilities reporting NESHAP-regulated emissions. Six routine sources and the Chemical Waste Landfill (CWL) were used in CAP-88 dose assessment modeling. Primary radionuclides released included tritium, nitrogen-13, oxygen-15, and argon-41.

The NESHAP calculated effective dose equivalent (EDE) to the maximally exposed individual (MEI) onsite was determined to be again located at the USAF Kirtland Underground Munitions Storage Complex (KUMSC) facility. The EDE calculated for this location was 0.000798 millirem per year (mrem/yr). The offsite MEI receptor, located at the KAFB Eubank Gate, was 0.00061 mrem/yr. Results were several magnitudes less than the EPA's dose limit of 10 mrem/yr (approximately 100,000 times less). The total population dose for the 80-kilometer radius surrounding SNL/NM was calculated to be 0.0297 person-rem. By comparison, the population received more than 57,000 person-rem from natural background radiation. SNL/NM was in full compliance with NESHAP regulations in 1998.

NEPA ACTIVITIES

SNL/NM's NEPA activities are coordinated with the DOE/Kirtland Area Office (DOE/KAO). On April 16, 1999, the final draft Site-Wide Environmental Impact Statement (SWEIS) was available to the public.

In 1998, a total of 86 NEPA Checklists were sent to DOE/KAO for determination of further NEPA action. Two Environmental Assessments (EAs) were also completed, each of which was issued a Finding of No Significant Impact (FONSI). One was an Air Force EA for the construction of the bypass road around the Chemical Waste Landfill (CWL) remediation project. The other was for the Rapid Reactivation Project, which will increase the production of neutron generators. A programmatic EIS was also prepared for SNL's radioactive and hazardous waste management activities.

OCCURRENCE REPORTING

There were only four reportable environmental occurrences in 1998, a significant reduction compared to previous years. Three were for past year's incidences that came to resolution in 1998; including (1) a compliance order issued in response to audit findings from 1997, (2) the discovery of an unregistered underground storage tank (UST), and (3) the discovery of old oil-contaminated soil found during an excavation project. Only one occurrence involved a release to the environment that occurred in 1998. A forklift carrying several containers of sodium hydroxide, hit a depression and lost its load, resulting in 350 lb of sodium hydroxide being released to the ground. The spill was cleaned up and there were no detrimental environmental consequences.

ENVIRONMENTAL AUDIT RESULTS

There were six environmental audits conducted by external agencies in 1998. These included several DOE agencies, Lockheed Martin, and New Mexico Environment Department (NMED). The hazardous waste management

audit was particularly successful; NMED said they were very pleased with the low number of findings, all of which were insignificant. The DOE Contractor Performance Assessment Program (CPAP) audit identified functional areas at SNL in a sweeping assessment. All corrective actions resulting from this audit have either been completed, or are on schedule.

Early View of Sandia National Laboratories

*This July 11, 1945, aerial view looking toward the east indicates the isolation of Sandia at the time.
In the center foreground is Kirtland Airfield and in the background is Sandia (Oxnard Field)*

Introduction

This Annual Site Environmental Report (ASER) has been compiled to characterize the state of the environment in and around Sandia National Laboratories/New Mexico (SNL/NM) for the calendar year 1998 (CY98). The ASER summarizes SNL/NM's operations and describes all environmental programs in place to support SNL's mission. The primary purpose of this report is to encapsulate environmental compliance status with respect to applicable Federal, State, and local laws. Some of the specific areas covered in this report include the performance and compliance status of air and water quality programs, waste management, recycling, Environmental Restoration (ER), environmental surveillance, chemical inventory tracking, and adherence to the National Environmental Policy Act (NEPA).

The ASER represents a collective effort by many SNL organizations, which are responsible for the various components of SNL/NM's total site environmental management performance. Individuals who have supplied program information for this report are named in the front section of this report. Within each program area, significant efforts and successes are highlighted, as well as indicated areas where improvement or corrective actions are ongoing.

DOE Orders

The major U.S. Department of Energy (DOE) environmental safeguard requirements applicable in this report are embodied in the following two orders:

- DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990)

- DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993)

The production of a site environmental report is a requirement for all large DOE facilities that have the potential to impact the environment through their activities. This report represents a key component of the DOE's effort to keep the public informed about environmental conditions at DOE sites.

1.1 BACKGROUND

The Mission of Sandia National Laboratories

SNL/NM is a multi-program national security laboratory operated for DOE by Sandia Corporation, a Lockheed Martin Corporation. It is one of three national laboratories in DOE's nuclear weapons complex. The primary mission of the Labs is centered on defense technology, developing nuclear and non-nuclear weapons and performing environmental testing on new weapon designs. Specifically, SNL/NM designs all non-nuclear components for the nation's nuclear weapons stockpile, conducts energy research projects, and responds to national security threats—both military and economic. Current defense work conducted at SNL/NM includes the weaponization of nuclear explosives (for example, the design of arming, fusing, and firing systems); safe transport and storage of radioactive materials; pulsed power

and accelerator research; and arms control and non-proliferation.

Remaining Vigilant

Although the nuclear danger is greatly reduced in the wake of the Cold War, the United States continues to rely on nuclear weapons as a vital military deterrent. Emerging nations from the former Soviet Union with nuclear technology present an area of instability with regards to safeguarding nuclear materials and technology. Sandia Lab scientists are actively involved in helping these new countries to improve safeguards and security in this area. Other major threats exist with politically unstable or unfriendly countries who either have nuclear technology or are actively pursuing a nuclear weapons program. Therefore, the primary mission of SNL/NM remains to ensure the integrity and reliability of nuclear weapon systems and to maintain stewardship of our nation's nuclear weapons stockpile.

Center for National Security and Arms Control

In 1997, Sandia Labs opened the Center for National Security and Arms Control (CNSAC) in Technical Area I (TA-I). This state-of-the-art center was designed to allow scientists and dignitaries from the United States and abroad to tackle the complex challenges related to national and global security including non-proliferation, treaty verification, and national security. The Center is the largest secure information-management facility of its kind in the DOE complex.

Non-Defense Technologies

Although SNL's primary mission remains defense oriented, many non-military technologies have been developed at SNL—oftentimes as direct spin-offs of defense related work.

CORPORATE MISSION STATEMENT

As a DOE national laboratory, Sandia works in partnership with universities and industry to enhance the security, prosperity, and well-being of the nation. We provide scientific and engineering solutions to meet national needs in nuclear weapons and related defense systems, energy security, and environmental integrity, and to address emerging national challenges for both government and industry.

These new developments have provided tremendous advances in areas such as computer technology, biochemical and medical research, energy sciences, industrial processes, microelectronics, robotics, and environmental remediation technologies. SNL/NM conducts work under two primary categories: Lab Directed Research and Development (LDRD) and Cooperative Research and Development Agreements (CRADA). SNL/NM encourages technical teaming with U.S. industries and universities. Many new exciting technologies have been developed for outside customers. Some of these are listed in the inset "Recent Developments From Sandia Labs" in this chapter.

SNL Facilities and Locations

Sandia National Laboratories has two locations: the main lab in Albuquerque, New Mexico (SNL/NM) (Figure 1-1) and a second lab located in Livermore, California (SNL/CA). SNL also conducts operations at the Tonopah Test Range (TTR) in Nevada, the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, and the Kauai Test Facility (KTF) in Hawaii. A separate ASER is prepared for the KTF and is included in this report as Appendix B. ASERs for SNL in

FIGURE 1-1. Facilities Located on KAFB Military Complex Showing SNL Technical Areas, and the U.S. Forest Service Land Withdrawal

SNL EXTERNAL WEBSITE

Additional information on Sandia Labs can be found at the following internet address:

<http://www.sandia.gov/>

Livermore and for operations at TTR are published as stand-alone documents.

Sandia National Laboratories, Albuquerque, New Mexico

SNL/NM's operations are located on the Kirtland Air Force Base (KAFB) Military Complex, an 80-square mile base, which includes 22,500 acres withdrawn through agreement with the U.S. Forest Service (Figure 1-1). The land is jointly used by the USAF, DOE, and SNL/NM. SNL/NM's facilities cover about 2,842 acres within five technical areas and 15,003 acres in various remote test areas.

Historical Perspective on SNL/NM

Sandia National Laboratories came into existence in 1945 and was known as the "Z Division." It was originally an extensional facility for the early work being done at Los Alamos National Laboratories (LANL) to secretly develop the atomic bomb under the Manhattan Project during World War II. In 1948, it was named Sandia Laboratories, as a separate branch of LANL.

Sandia Lab's first mission was to design, test, and assemble ordnance. The original buildings were located on Sandia Base (now KAFB) because of the proximity to the airfield and the opportunity to work in close partnership with the military. This was a very remote location in the late 1940s with the city limits of Albuquerque very far from the base boundaries.

In 1949, President Harry Truman wrote a letter to the American Telephone and Telegraph Company (AT&T) President, Leroy Wilson, offering the company "an opportunity to render an exceptional service in the national interest" by managing Sandia Laboratories. AT&T accepted, formally separating from LANL. AT&T managed the

Laboratories for nearly 44 years until it was taken over by Martin Marietta in 1993. In 1995, Martin Marietta joined with Lockheed to become Lockheed Martin. Today Truman's words remain SNL's creed:

"Exceptional Service in the National Interest"

How Environment, Safety and Health (ES&H) Evolved at SNL/NM

During the crunch of the war years when the primary concern was to manufacture components for the nation's defense, very little consideration was given to the environmental impacts resulting from research and development. Even after the war ended, environmental stewardship still took a back seat in priority over mission-driven activities. It was not until 1989, after a DOE report identified significant environmental problems at the Labs, that serious changes in environmental management were made at SNL/NM. The report identified environmental problems that included diesel fuel leaks, contaminated landfills, and various chemical discharge sites. In a ranking of DOE sites, however, SNL/NM was one of the least contaminated facilities in DOE's complex.

As environmental awareness came to the forefront across the nation with tougher laws promulgated by the U.S. Environmental Protection Agency (EPA), DOE significantly increased its ES&H activities across the DOE Complex. SNL/NM infused environmental management into its corporate culture to ensure that environmental compliance was met, and by 1990, ES&H programs were raised to the highest administrative levels (Johnson 1997).

Both hazardous and radioactive waste has been generated and disposed of in various landfills at SNL/NM over the years. However, most contaminants at the site are related to hazardous and not radioactive waste. SNL has actually produced very little radioactive waste, because

its main mission has been to design weapon ordnance rather than work with the nuclear materials (package) in weapons. Still, SNL does operate nuclear reactors, accelerators, and routinely works with various radioactive sources in its research and development activities.

Tiger Teams

In 1991, DOE sent "Tiger Teams" to conduct rigorous ES&H appraisals at SNL/NM. The teams assessed every aspect of ES&H compliance at the Labs over a six week period and in the final audit report, documented 371 deficiencies. Findings included areas in waste management and recycling, groundwater monitoring, Environmental Restoration (ER) activities, and underground storage tank (UST) management. SNL closed out the last of the Tiger Team findings in 1996.

1.2 SANDIA NATIONAL LABORATORIES OPERATIONAL AREAS

Technical Area I

TA-I is the center for SNL/NM's administration and site support activities and the main area for research, design, manufacturing, and production of weapon system components. The following bullets highlight some of the notable facilities located within TA-I and describe the major work performed.

- **Microelectronics Development Laboratory (MDL)** – This facility provides state-of-the-art research and development in microelectronic technology. Work conducted here includes scanning electron microscopy, integrated circuit fabrication, silicon wafer testing, photo-lithography, etching, computer modeling and simulations, and device inspection (Figure 1-2).

FIGURE 1-2. Technician Stephanie Reel with Plenum of One of Several Metal Deposition Systems at the MDL.
(Photo by Randy Montoya)

- **Advanced Manufacturing Process Laboratory (AMPL)** – The primary capabilities of the AMPL include specialized production of weapon hardware, development of new manufacturing processes, and design and manufacturing of unique parts and equipment using innovative materials.
- **Photovoltaic Device Fabrication Laboratory** – Photovoltaic cells concentrate and store solar energy. The mission of this lab is to increase the cost effectiveness of solar cell technology.
- **Energy and Environment Facility** – This complex comprises a multitude of labs located in Bldg. 823. Research areas include material sciences, geophysics, chemical engineering, wind turbine testing, and instrument analysis.

Recent Developments From Sandia Labs

Landmine Detecting Bees - Sandia chemists working with entomologists at the University of Montana are working to see if they can train foraging bees to detect buried landmines. Landmines have been called the worst form of pollution on earth, injuring or killing about 60 people every day. The Red Cross estimates that there are 80 to 120 million landmines currently deployed in 70 countries worldwide, with an average 40,000 new landmines deployed each week. In many developing countries, thousands of acres of land lie unused because farmers are afraid to work their fields. Visit the following web sites to learn more:

- University of Montana, Missoula "Bee Alert!"
<http://biology.dbs.umt.edu/bees/default.htm>
- Sandia's "Minebees":
<http://www.sandia.gov/media/minebees.htm>

A beekeeper holds honeybees being used to potentially detect landmines. Two unfused anti-tank mines are shown in the foreground. (Photo by Randy Montoya)

Anti-Terrorist Biochemical Foam - Sandia Labs has developed a new foam that can be rapidly deployed to neutralize dangerous chemical and biological agents in minutes, such as anthrax bacteria, the toughest known biological agent. (The foam was successful on killing a simulant of anthrax.) The new foam, which could be dispersed from fire trucks, sprinkler systems, and extinguishers, is made from common inexpensive materials and is not harmful to people or the environment. Its developers think the decontaminating foam may soon be the best first response available in the event of a biochemical terrorist attack.

Improving School Security - Jeff Bingaman, New Mexico Senator, named SNL/NM to head a new national center of expertise on school security technologies and approaches. Efforts to improve security on the nation's school grounds have intensified since the fatal shootings at several schools across the nation. Specific technology is being developed to solve such on-campus problems as violent crime, theft, vandalism, and drug and alcohol use.

Chem Lab on a Chip - Sandia Labs is developing tiny acoustic wave chemical sensors for tiny chemical detection systems, commonly called "chem lab on a chip." The microsensors, each about the size of a grain of rice, would be able to detect the presence of chemicals in the environment alerting people to potential hazards. A direct application of this technology would be to detect chemicals in a terrorist attack.

Steve Casalnuovo shows a large computer printout of the design of the acoustic wave sensor. (Photo by Randy Montoya)

Cracking the Unabomber Case - During his visit to Albuquerque on February 3, 1998, President Clinton gave public recognition and thanks to Chris Cherry and Rod Owenby (both of 9322) for their involvement in resolving the Unabomber case. Under Chris' direction, a team of experts spent several days surgically dismantling the last of the Unabomber's explosive devices, at Theodore Kaczynski's cabin in Montana.

Robot Painters for F-117 Stealth Fighters - Engineers in the Intelligent Systems and Robotics Center (ISRC) have designed and built the largest most complex Labs robot ever delivered to an outside customer. The huge "BOT" with two 10,000-lb rail-mounted robotic arms and one floor-mounted arm will automatically spray a precisely thin radar-absorbent coating onto the skin of each of the nation's active F-17 Nighthawks. The new precise coatings will radically improve the radar absorbing effectiveness, which along with the aircraft's angular body design, give it its "stealthiness." All original coatings on the F-117s will be replaced by the new system.

Robots, Robots Everywhere! - Sandia robotics engineers developing a wide array of new intelligent systems, predict a robotics revolution by the year 2020. Robots will be common place in performing many of the functions done manually today. Microscale robots with the ability to crawl, fly, and swim will work together to perform monitoring, surveillance, medical, and intelligence operations. Larger robots will clean up radioactive and hazardous chemical spills, removing humans from dangerous situations. Still others will assemble weapons components that are now tediously built in clean rooms by people using microscopes and tweezers.

Making Buildings Stronger - Sandia Labs is developing a portable building tester, called an Autonomous Structural Event Recorder, to determine exactly how a building fails and collapses. The first application of this instrument will be to monitor buildings subjected to hurricanes. Later uses will be to monitor other destructive forces like earthquakes, bomb blasts, floods, tornadoes, and fires. If engineers can determine the exact cause-and-effect relationship that occurs when a building is put under severe stresses, such as wind shear, projectile impacts, and pressure differentials, then better building codes can be developed.

Detonation Assurance - Sandia Labs has developed an extremely tiny lock, called the "Micro Guardian," made up of micromachines, micro-optics, and microelectronics for nuclear weapon trajectory safety subsystems. This safety subsystem is the portion of a nuclear weapon that ensures it does not detonate unless a series of events occur that indicate triggering action is appropriate. The lock is one of the most complicated micro-systems Sandia has ever built. The trajectory system will fit on the tip of a pencil eraser.

Monitoring Global Climate Changes - Sandia Labs has installed a new station as part of DOE's Atmospheric Radiation Measurement (ARM) Program to gather atmospheric data from the tiny Pacific island of Nauru about 1,300 miles northwest of Papua, New Guinea. Sandia scientists are studying the Earth's atmosphere to determine if our planet is undergoing long-term global climate change. Specifically, scientists seek to understand how sunlight and infrared radiation interact with clouds, and if varying levels of atmospheric moisture could permanently influence the Earth's radiative heat budget. Clouds can reflect incoming radiation contributing to global cooling but they can also absorb radiation reflecting from the earth causing global warming, or what is known as the "greenhouse effect."

- **Neutron Generator Facility (NGF)** – The NGF fabricates war reserve neutron generators. Neutron generators produce a pulse of neutrons that initiate nuclear fission in nuclear weapons or physics tests. Neutron generators previously were manufactured at the Pinellas Plant in Florida, but in 1992 DOE formally decided to consolidate production at SNL/NM in accordance with the Arms Agreement between Russia and the United States.
- **Lightning Simulation Facility** – Simulated lightning is generated at this facility to test weapon components, communication equipment, and other materials and structures.
- **Teraflops Computer** – The teraflops (which stands for one trillion floating point operations per second) is made up of 76 actual computer cabinets with 9,072 Pentium Pro processors and nearly 600 billion bytes of memory. The computer, which was built in partnership with Intel Corporation, covers about 1,600 sq ft.
- **Integrated Materials Research Laboratory (IMRL)** – Research at the IMRL focuses on studying the relationship between the atomic structure of materials and their physical and mechanical properties. Based on this research, Lab scientists have developed innovative and superior materials such as alloys, ceramics, adhesives, organic polymers, and optical and dielectric materials.
- **Ion Beam Materials Research Lab** – The mission at this facility is to research and establish theories and models in the areas of material science, solid state physics, and accelerator physics. The 6 MeV TANDEM Van de Graaff Generator at this facility can be used for producing and accelerating ion beams of most elements.
- **Steam Plant** – The steam plant was built in 1949 and has operated non-stop 24 hours a day since then. The plant produces hot water and steam to heat facilities on the east side of KAFB including most of TA-I and SNL's Coronado Club. A vast underground system of piping delivers steam and returns condensate to and from the plant. The plant operates five boilers, which run primarily on natural gas but can also burn diesel.
- **Rock Mechanics Lab** – This lab performs geomechanical studies to characterize natural fracture systems, identify and model rock deformation and failure processes, and determine thermomechanical and transport properties of competent rock and natural fractures. Research in geomechanics can be directly applied to underground construction, mining, and oil and gas production/reservoir management.
- **Robotic Manufacturing Science and Engineering Lab (RMSEL)** – This facility is home to the Intelligent Systems and Robotics Center (ISRC). The center encourages industry and academic partners in developing a wide range of robotic and intelligent system applications (Figure 1-3). Robots are developed for surveillance and reconnaissance, accident response,

FIGURE 1-3. Virtual Welding Using an Intelligent System Developed at the ISRC

environmental sensing, weapons delivery, security monitoring and testing, and hazardous material handling. Advanced robots are self-learning and self-directed.

- **Center for Security Systems** – This Center conducts research and development of systems and technologies to understand, identify, and solve the nation's security problems. The Center conducts field tests at the Robotic Vehicle Range (RVR) and within TA-III. Physical security systems developed and tested include sensors, video, image processing, alarm communications and display, and entry control contraband detection. Developments are being applied to improve security at our nation's schools.
- **Engineering Sciences Experimental Facility (ESEF)** – Various labs within this complex include large-scale experimental facilities for aerosciences, including the Hypersonic and Trisonic Wind Tunnels, the High Altitude Chamber, and the Parachute Fabrication/ Development Facility.

Technical Area II

TA-II is located adjacent to and south of TA-I. The following bullets highlight and describe some of the facilities located there.

- **Explosive Components Facility (ECF)** – A number activities are conducted at this facility related to handling, testing, and evaluating energetic components, such as explosives research, neutron generator assembly and testing, and battery research (Figure 1-4).
- **Hazardous Waste Management Facility (HWMF)** – This facility is the centralized location for the collection, packaging, shipping, and recycling (as applicable) of regulated and non-regulated chemical waste.

- **Solid Waste Transfer Facility (SWTF)** – This is the centralized receiving center for most non-hazardous solid waste produced at SNL/NM. A major effort at the SWTF includes recycling materials—primarily paper and cardboard.
- **Landfills** – There are two landfills within TA-II: the Classified Waste Landfill (CIWL) and the Radioactive Waste Landfill (RWL). Both landfills are closed and are being remediated under the ER Project.

FIGURE 1-4. An Explosive Chamber Used at the ECF for Conducting Research on Energetic Materials

Technical Area III

TA-III is the largest of SNL/NM's technical areas and is primarily used for large-scale environmental effects testing. Tests conducted include high-speed impacts on sled tracks, electromagnetic field effects testing, explosive testing, and drop testing. Test facilities may be equipped with various data acquisition devices such as ultra-high-speed cameras, mobile laser trackers, high-speed x-rays, filmless real-time radiography, and holography. Some of the notable facilities in TA-III are highlighted in the following bullets. The first four listed are the primary testing facilities.

- **Centrifuge Complex** – There are two centrifuges in the complex: a 29-ft indoor (underground) centrifuge and a 35-ft outdoor centrifuge. The smaller radius centrifuge is the most powerful with the capability of accelerating up to 16,000 lb at a force of 100Gs (lighter objects can be subjected to 240Gs). Objects tested include weapon components, satellite systems, reentry vehicles, and rocket motors.
- **Drop/Impact Complex** – This multi-tower facility is used for hard surface impacts, water impacts, and underwater testing of weapon systems. The 85-ft tower is used to drop objects to a hard surface. The 300-ft tower is used to drop objects into a 50-ft deep pool. Aerial cables at the facility can be used for pull-down tests for added velocity.
- **Sled Track Complex** – The 10,000-ft sled track is used to test high speed impacts for various weapon systems, including the use of full-scale aircraft.
- **Terminal Ballistic Facility** – Various ballistic studies using many types of firearms are tested at this facility. Solid fuel rocket motor tests are also performed.
- **Classified Destruction Facility** – Classified documents, computer tapes, and microfilms are safely rendered to unreadable residue at this facility. Equipment used includes a hammermill paper pulverizer and a plastics shredder.
- **Radiant Heat Facility** – Intense heat testing is performed on various components using an array of electrically powered heat lamps to simulate fire temperatures.
- **Thermal Treatment Facility (TTF)** – The TTF is a small part of the previously operational Light Initiated High Explosive Facility (LIHE). Small amounts of

explosive waste (several kilograms per year) are treated for safe disposal at this facility.

- **Radioactive and Mixed Waste Management Facility (RMWMF)** – The RMWMF is located in the southeast corner of TA-III. Radioactive waste produced by SNL/NM is received through this facility for handling, packaging, storage, and shipment to offsite disposal facilities. Some waste may also be characterized and treated, as necessary.
- **Liquid Metal Processing Facility** – This facility contains an array of furnaces for research in metals and solidification processes.
- **Landfills** – Two landfills are located in TA-III: the Chemical Waste Landfill (CWL), which is undergoing remediation, and the Mixed Waste Landfill (MWL), which is scheduled for remediation in the near future. Both landfills are closed and managed under the ER Project.

Technical Area IV

TA-IV is the center for pulsed power research and is where all of SNL's major pulsed power accelerators are located. Other activities conducted within TA-IV include research in computer science, flight dynamics, radiation transport, satellite processing, and robotics.

TA-IV commenced with the construction of its first accelerator in support of the Inertial Confinement Fusion Program. A pulsed power accelerator is a device that electromagnetically accelerates atomic sized particles, such as ions, protons, and electrons, into energetic beams. The beams are directed at various targets for electromagnetic analysis and fusion studies. Pulsed power is used to test nuclear weapon component survivability by subjecting components to extreme magnetic fields and x-ray sources. Other applications for pulsed

power include radiation hardening of materials, sterilization of medical waste, and food purification.

The following bullets highlight the primary accelerator facilities located within TA-IV:

- **Z Machine** – The Z Machine (formally the PBFA-II) is the most powerful pulsed power x-ray source in the world. The pulse that drives the Z accelerator lasts less than ten billionths of a second—20,000 times faster than a lightning bolt—but delivers 1,000 times the electrical current in a typical lightning bolt. The pulse produces as much as 290 trillion watts (terawatts) of x-ray power and an x-ray energy of 1.9 million joules (Figure 1-5).

FIGURE 1-5. The Z Machine Accelerator
The tank enclosing Z is 6 m (20 ft)
high and 33 m (108 ft) in diameter.

- **High Energy Radiation Megavolt Electron Source (HERMES III)** – HERMES-III is housed in the Simulation Technology Laboratory. It is a third generation gamma ray accelerator used to simulate the gamma rays produced by nuclear weapons. Testing is conducted on various systems such as electronic components.
- **SATURN** – This accelerator produces x-rays to simulate radiation bursts on

electronic subsystems and material components.

- **Short Pulse High Intensity Nanosecond X-Radiator (SPHINX)** – This is an x-ray source for small area exposures primarily used for thermostructural response testing.
- **Sandia Accelerator & Beam Research Experiment (SABRE)** – This accelerator produces electron beams or x-rays for moderate exposures that support the Inertial Confinement Fusion Program.
- **Repetitive High Energy Pulsed Power (RHEPP) I** – This is one of two repetitive pulsed power accelerators. The RHEPP-I produces pulses of ions to create x-rays.
- **RHEPP II** – The RHEPP II produces an electron beam or x-rays.
- **TESLA** – Short x-ray bursts produced by this accelerator are used to test plasma opening switches.
- **High Power Microwave Lab** – Several accelerators in this lab are capable of producing high-energy electron beams used to drive microwave generating devices.

Technical Area V

TA-V is located adjacent to and on the northeast end of TA-III. This high-security facility primarily conducts reactor operations used in testing weapon components. High security is required because it uses Category 1 special nuclear materials. The reactors produce high neutron doses and are used for irradiating various targets and testing survivability of materials, electronic subsystems, and components in a hostile environment. Notable facilities in TA-V are highlighted in the following bullets.

- **Annular Core Research Reactor (ACRR)** – The ACRR is located in a deep water-filled tank with cylindrical fuel elements around a central experimental cavity. It provides neutron and sustained gamma pulsed environments. The reactor can be configured in one of two modes: Defense Program (DP) mode and medical isotope production (Mo-99) mode. The DP mode is used to test various weapon component survivabilities and in-pile experiments for reactor safety research (simulating reactor accident scenarios). In 1998, the ACRR was undergoing conversion to the medical isotope mode for a proposed project to produce molybdenum-99 (Mo-99).
- **Sandia Pulse Reactor III (SPR III)** – This is a fast burst reactor (pronounced “spur”) used to create intense neutron bursts. It produces a near-fission spectrum radiation environment and is used for effects testing on material components and electronic subsystems.
- **Gamma Irradiation Facility (GIF)** – This facility provides cobalt-60 gamma ray sources for simulating irradiation environments. A new GIF is expected to be constructed before 2003.
- **Hot Cell Facility (HCF)** – The Hot Cell has full capability to handle and analyze radioactive materials. It is primarily an isotope production facility where isotopes produced in the ACRR are extracted in the cell. The Hot Cell is also undergoing conversion to support the Mo-99 project.
- **Radiation Metrology Laboratory (RML)** – This lab provides radiation measurement services for SNL’s reactors, isotopic sources, and accelerator facilities.

Coyote Test Field and Manzano Base

Operations in remote test areas include large-scale testing within the Coyote Test Field (CTF), and waste storage handling at Manzano Base.

Manzano Waste Storage Facility Bunkers

The Manzano Base area is a secure area owned and maintained by the Air Force. The base surrounds KAFB’s four prominent peaks (Four Hills) just west of the withdrawal boundary (Figure 1-1). The mountains have been extensively tunneled into, to create secure storage bunkers. The bunkers were originally constructed in the 1940s for storing explosives, but are now used for storing a variety of materials. SNL leases bunker space from the Air Force to store low-level waste (LLW), transuranic waste (TRU), and mixed waste (MW) under its Resource Conservation and Recovery Act (RCRA) Part A Interim status permit. LLW is shipped periodically to disposal facilities. SNL also uses the bunkers to store archived records.

Coyote Test Field

The CTF actually describes several remote test areas on KAFB that are not necessarily contiguous. It includes secluded areas within the canyons and foothills of the Manzanita Mountains on the land withdrawal, and locations to the south and east of TA-III. Most test activities within the CTF are on Air Force-owned land. SNL holds lease agreements with the Air Force to use these areas. Test activities include violent physics experiments on weapon system components, transport containers, and other assemblies. Test facilities include sled tracks, aerial cables, and drop towers for conducting impact and shock tests. There is also a Burn Facility Complex to fire test components. The following bullets highlight some of the notable CTF facilities located both on and off of the land withdrawal.

CTF Facilities Within the Land Withdrawal

- ***Aerial Cable Facility Complex***— This facility has several cables spanning the 5,000-ft wide Sol Se Mete Canyon. The cables are used to guide full scale, air-deliverable weapon systems to simulate realistic target engagement scenarios. Transportation packages are also impact tested here. A rocket sled track allows pull-down tests to achieve accelerated velocities.
- ***Lurance Canyon Burn Site*** — This 220-acre complex has several fire test pools including an outdoor concrete pool (30 x 60 ft in area and 3 ft deep) and a steel pool (20 ft square). The SWISH (Small WInd Shield), is an enclosed facility which reduces smoke and improves combustion. The FLAME (Fire Laboratory used for the Authentication of Models and Experiments) is used to fire test objects on one side.

CTF Facilities on KAFB West

- ***Thunder Range Complex*** — This range originated in 1963 as an explosive testing area. SNL no longer conducts explosive testing on the range. It is primarily used for disassembly and evaluation of special items and for radar studies.
- ***Robotic Vehicle Range (RVR)*** — The 226-acre RVR is an outdoor test area is used for testing robots over varied terrain. The Mobile Robotics Department operates the range as a branch of the ISRC.
- ***Containment Technology Test Facility*** — There are two scale models (1:4 and 1:10) of reactor containment buildings at this facility. The models are used to support reactor containment research and development (accident scenarios).
- ***National Solar Thermal Test Facility (NSTTF)*** — This is a 115-acre test facility devoted to the development of solar energy.

The facility includes solar furnaces, parabolic dishes and troughs, and a field of 222 computer controlled heliostats that reflect concentrated sunlight onto a 200-ft receiving tower. The Solar Tower can concentrate the sun's energy up to 5,000 times its normal intensity.

1.3 FUTURE DIRECTIONS AT SNL

Sandia Science and Technology Park

SNL/NM is working with the City of Albuquerque (COA) and several landowners to plan a 240+ acre, campus-style technology center—the Sandia Science and Technology Park (SS&TP). The complex is located adjacent to the Labs on the northeast boundary of KAFB, along Eubank Blvd.

SNL's vision is to develop a high-technology industrial cluster in New Mexico. The plan is to encourage close partnerships with the private industrial technical sector, with over 300 companies expected to participate in the park. In addition to SNL/NM, other local research facility resources include the University of New Mexico, the Air Force Research Laboratory, the Lovelace Respiratory Research Institute (LRRRI), and Intel Corporation. Similar to other parts of the country, geographical clusters of high-tech industries, universities, and government laboratories have proven to be engines of innovation and regional economic growth.

1.4 SITE SETTING AND DEMOGRAPHICS

KAFB Topography and Layout

KAFB has widely varied topography from rugged mountains on the east to near flat plains on the west. As shown in Figure 1-1, KAFB backs up to and encompasses a portion of the Manzano and Manzanita Mountains (Cibola National Forest) on its eastern boundary. Mountainous terrain on KAFB lies almost entirely within the U.S. Forest Service land withdrawal area (with the exception of Four Hills). The remainder of KAFB is situated on gently west sloping foothill terrain that grades to widespread flat areas upon which the majority of Air Force and SNL facilities are built. The Albuquerque International Airport on the far west side of the base shares the runway with KAFB.

The Mountains

The most prominent topographic feature in the Albuquerque area is the impressive west face of the Sandia Mountains east of the city (Figure 1-6). The Sandias form a 21-kilometer (13-mile) long escarpment distinguished by steep cliffs, pinnacles, and narrow canyons. The name Sandia means “watermelon” in Spanish and was given for the brilliant pink color of the Sandia granite at sunset. Sandia Crest at 3,254 m (10,678 ft), is the highest point in the region. The Sandia Peak Aerial Tramway (the world’s longest freespan cable car at 2.5 miles) runs to the top of the mountains near Sandia Crest.

To the south of the Sandias—and separated by Tijeras Canyon—are the Manzano Mountains and the slightly smaller Manzanita Mountains, which lie east of and adjacent to KAFB. The maximum elevation within KAFB’s boundary is 2,434 m (7,988 ft). Sediments transported from the canyons and draws of these mountains have formed coalescing alluvial fans called bajadas. These broad alluvial plains slope west across KAFB and are dissected by Tijeras Arroyo, and smaller arroyos and washes, draining the area. The flat areas of KAFB are mostly devoid of

trees, except where landscaped around facilities and homes.

Tijeras Arroyo

Tijeras Arroyo forms a significant topographic feature on KAFB (Figure 1-1). It is up to 1,300 m (4,264 ft) wide and 33 m (108 ft) deep. It is dry except during heavy downpours and can cause significant flash flooding. The arroyo originates out of Tijeras Canyon running coincident with the Tijeras fault briefly before deviating to the west and emptying into the Rio Grande. The watershed drained by Tijeras Arroyo includes the southern Sandia Mountains and the north end of the Manzanita and Manzano Mountains.

FIGURE 1-6. A View of the Sandia Needle Looking Out Over Albuquerque to the West

The Rio Grande

The Rio Grande, meaning “Great River,” is 2,896 km (1,800 mi) long, extending from Stony Pass in the San Juan Mountains of Colorado to the Gulf of Mexico. In North America, it is second only in length to the Mississippi/Missouri River combination.

The Rio Grande, which used to have natural flood cycles, has since been managed and contained by the construction of the Cochiti Dam and an extensive system of flood control ditches built by the U.S. Army Corps of Engineers (ACE 1979). Although a great improvement for residents, flood control has impacted the cottonwood growth cycle, which depend on flooding for seedling propagation. The largest stand of cottonwoods in the world grow along the Rio Grande. Today, water from the Rio Grande is primarily used for agricultural irrigation. However, plans are being developed to use treated river water to supplement Albuquerque's drinking water supply, which currently is derived solely from deep groundwater wells.

Regional Elevations

Elevations in the Albuquerque metropolitan area range from 1,493 m (4,900 ft) at the Rio Grande, near the intersection of Interstate-40 (I-40) and I-25 to approximately 1,767 m (5,800 ft) at the base of the Sandia Mountains. Albuquerque's average elevation of 1,619 m (5,311 ft) makes it the highest large metropolitan city in America (AED 1999). The KAFB military reservation (excluding the more mountainous withdrawal area) has a mean elevation of 1,641 m (5,384 ft).

Counties and Population

New Mexico is the fifth largest state in the union with 121,666 sq mi and a total population of approximately 1.5 million residents. A recent count of the population within an 80-kilometer (50-mile) radius of SNL/NM has been estimated at 695,406 residents (DOC 1998). There are nine counties contained in all or part of this radius (Figure 1-7 and Table 1-1).

TABLE 1-1. Counties Within a 80 km (50-mile) Radius of SNL/NM

County	Primary Population Centers
Bernalillo	Albuquerque, KAFB, and east mountain residents (Sandia and Manzano Mountains areas)
Sandoval	Corrales, Rio Rancho, Bernalillo, and several Indian Pueblos
Valencia	Bosque Farms, Los Lunas, and Belen
Santa Fe	Edgewood, Madrid, and suburbs of Santa Fe
Torrance	Moriarty and small villages east of the Manzano Mountains
McKinley	Sparsely populated northwest edge of the county
San Miguel	Sparsely populated southwest edge of the county
Cibola	Laguna Pueblo
Socorro	Several small villages on the north edge of county

Regional Economics

The City of Albuquerque and its neighboring communities are the main economic center for the State. The top 10 employers, as reported by Albuquerque Economic Development, Inc. (AED 1999), are listed below. SNL/NM is the fifth largest employer in the area.

Employer	Employees
Albuquerque Public Schools	17,500
University of New Mexico	15,475
KAFB (Civilian)	12,830
City of Albuquerque	9,000
Sandia National Laboratories	8,500
Presbyterian Healthcare Services	5,800
KAFB (Military)	5,650
Intel Corporation	5,200
State of New Mexico	4,870
Lovelace Medical Center	3,225

NEW MEXICO

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FIGURE 1-7. New Mexico Satellite Map

The overlay shows major roads, cities, county lines, and the 80 km (50-mile) radius from SNL/NM facilities (dashed circle).

1.5 GEOLOGY

Regional Setting

The regional geologic setting in which Sandia Labs and KAFB are situated, is an area that has been subjected to relatively recent episodes of volcanism and ongoing intercontinental rifting. The Rio Grande rift, or trough, is an area of regional extension running 450 mi from Leadville, Colorado to southern New Mexico, forming one of the greatest troughs on Earth. The rift represents the surface expression of an area where the earth's lithosphere is being pulled apart. The thinning crust has produced normal faulting, down dropped basins, and volcanoes. In recent geologic times, mafic magmas have been extruded in vast sheets. This rifting has formed a series of connected down-dropped basins where vast amounts of sediments have been deposited.

It is thought that the Rio Grande rift is a part of the Basin and Range deformational event (NMGS 1984). Similar to the Basin and Range, the rift is characterized by large crustal blocks separated by steeply dipping normal faults. The Rio Grande rift differs, however, in that it is a much broader and deeper basin than the grabens of the Basin and Range, which extend from California to New Mexico.

Albuquerque Basin

The Albuquerque Basin is one of several the north-south trending sediment filled basins formed by the Rio Grande rift. This major structural feature is approximately 48 km (30 mi) wide and 161 km (100 mi) long and 3,000 sq mi in area (Grant 1982) (Figure 1-8). The basin is drained by two south-flowing rivers: the Rio Puerco to the west and the Rio Grande to the east. On the east, the basin is bounded by uplifted fault blocks, reflected by the Sandia, Manzanita, and Manzano Mountains. The

western side of the basin is bounded by the Lucero uplift to the south, the Rio Puerco fault belt, and the Nacimiento uplift at the northern end. There is relatively little topographic relief along the Rio Puerco fault belt on the northwestern side of the basin.

Basin Filling Formations

During the Miocene and Pliocene epochs, the basin filled with as much as 4,560 m (15,000 ft) of sediments derived from the erosion of the surrounding highlands, as well as material transported into the basin by the ancestral Rio Grande from sources to the north. This sequence of unconsolidated sediments (primarily the Santa Fe Group) thins toward the edge of the basin and is truncated by normal faults at the bounding uplifts.

The Santa Fe Group is overlain in places by Pliocene Ortiz gravel and Rio Grande fluvial deposits, which are interbedded with Tertiary and Quaternary basaltic and pyroclastic materials. Basin-fill sediments of the Santa Fe Group consist of channel, debris flow, and floodplain deposits, and include eolian and playa deposits towards the center of the basin (in the lower unit of the Santa Fe Group). Most of the bedding is thought to be lenticular with limited areal extent, although buried channels or debris flows can extend for great distances (miles). These subsurface features are of major importance in controlling the movement of groundwater within the basin.

Fault Systems

The geology underlying the eastern section of KAFB includes major faulting (Figure 1-9). The east-west trending Tijeras Canyon, which divides the Sandia and Manzano Mountains, was formed by preferential erosion along the Tijeras fault. The Tijeras fault is a strike-slip fault of Paleozoic (and younger) age expressed by southwesterly movement of the northern block (left lateral). The fault has been traced at least as far north as Madrid, New Mexico, and trends

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FIGURE 1-8. The Albuquerque Basin, North Central New Mexico, Showing Bounding Faults and Uplifts

FIGURE 1-9. Generalized Geology in the Vicinity of SNL/NM and KAFB

southwesterly through Tijeras Canyon, along Four Hills, and across KAFB. The system of faults associated with the Tijeras fault is collectively referred to as the Tijeras fault complex, part of which marks a distinct geologic boundary between the mountains and the regional basin.

Other faults on KAFB are the Tertiary age Hubbell Springs and Sandia faults. These are north-south trending, down-to-the-west, en-echelon normal faults (Lozinsky et al. 1991; Woodward 1982; Kelley and Northrop 1975). The Hubbell Springs fault extends northward from Socorro County, New Mexico, into the southern portion of KAFB. The Hubbell Bench (south of KAFB) is one of the most easily recognizable fault scarps in the basin, with offsets of 5–30 m (15–100 ft) (Machette et al. 1982). The Sandia fault is thought to be the primary boundary between the Sandia Mountains and the Albuquerque Basin and shows evidence of Quaternary motion (Kelley 1977). The Tijeras, Sandia, and Hubbell Springs faults converge in the vicinity of the Chemical Waste Landfill (CWL) in Technical Area III (TA-III).

Regional Geologic History

The Precambrian granite, gneiss, schist, quartzite, and greenstone exposed in the Sandia Mountains today represent the mountain roots of an ancient system formed 1.5 billion years ago (Kelly 1977). Over the eons, this ancestral Sandia range was eroded to a broad level peneplain forming the "Great Unconformity" that marks the stratigraphic bottom of all sedimentary rocks in the region.

Beginning about 500 million years ago (Ordovician) and continuing through the Cretaceous, the entire regional area (most of New Mexico and west Texas) was inundated by episodic (advancing and retreating) shallow seas, which laid down great thicknesses of marine limestone, sandstone, and shale. In this region, however, most of the earlier Paleozoic section is missing, most likely because

previously deposited beds were eroded and removed from the geologic record.

During the Pennsylvanian period, a shallow sea advanced into most of New Mexico along great seaways separated by narrow mountainous islands. Corals, brachiopods, crinoids, and bryozoans inhabited the near-shore waters and accumulated on the sea floor. The Pennsylvanian age Sandia Formation and Madera Group limestones, capping the Sandia granite, are rich with fossils of these animals. At the close of the Paleozoic, the red beds (from oxidized iron minerals) of the Abo Formation were deposited in a vast flood-plain valley.

By mid-Jurassic (170 million years ago), the seas retreated again. Sand dunes developed over the Mancos Shale forming the Entrada Sandstone. By late-Jurassic, the climate became wetter and vast lakes and floodplains covered the area depositing the Morrison Formation; dinosaurs flourished during this period as indicated by numerous fossils found in this formation. During the Cretaceous, the seas returned and regional subsidence accelerated resulting in huge thicknesses of sandstone and shale forming a deposit nearly as great as the combined thickness of all the sedimentary rocks below it.

Coal Beds

In the late Cretaceous (100 to 65 million years ago), another major sea advanced across New Mexico leaving thick marine shales and terrestrial flood plain deposits. Inland areas formed swamps and lagoons where great volumes of decaying vegetation accumulated, forming rich coal beds. The Tijeras Coal Basin is one such deposit. At the close of Mesozoic era (65 million years ago) the seas retreated for the last time.

Jemez Volcanics

By the mid-Tertiary (25 to 40 million years ago), the Albuquerque regional area became tectonically active. Volcanoes formed, such as Mt. Taylor near Grants and Valley Grande near Los Alamos. Valley Grande, a 22-mile wide

caldera, is the centerpiece of the Jemez volcanic field. Approximately 2,000 cubic kilometers (km³) of material were ejected from this volcano over several million years of activity that began in the Miocene (Wood and Kienle 1990). Mt. Taylor, with an elevation of 3,444 m (11,301 ft) began erupting about 4 million years ago producing successive lava and ash flows over a period of 2 million years. The earliest flows were andesite and dacite; the most recent flows were basaltic. The mountain has been quiescent for the last 2 million years.

Mountain Building and Rift Formation

Volcanic activity was followed by tremendous faulting and uplift, and marked the beginning of the Rio Grande rift and mountain building that formed the current Sandia, Manzanita, and Manzano Mountains. The majority of the uplift has occurred during the last 5 to 10 million years and continues today. The uplift exposed the ancient precambrian granite and metamorphics in the Sandia and Manzano Mountains. The Albuquerque Basin formed by the rift, represents an enormous offset in vertical displacement. The equivalent stratigraphic sequence that is exposed on the crest of the Sandia Mountains today (limestone cap rock) is located at the bottom of the basin, with a total offset of approximately 8 km (5 mi).

Recent Volcanism

In recent geologic time (the last one million years) a small string of 18 volcanoes formed along the western fissure of the Rio Grande rift, known as the Albuquerque Volcanoes. Basaltic lava, extruded from deep within the earth's crust, spread in large sheets over the western Rio Grande Valley. The uneroded remains of this volcanic flow are exposed in the low profile cliffs along the west mesa and comprise the rocks of Petroglyph National Park.

1.6 HYDROLOGICAL SETTING

Understanding the groundwater hydrology at KAFB is complicated by the structurally complex terrain. In general, hydrogeological characterization is divided into two areas separated by the Tijeras fault complex, marking a distinct structural boundary relative to subsurface characteristics. To the east of this fault zone complex, the geology is characterized by fractured and faulted bedrock, a thin alluvium cover, and shallow groundwater (50–100 ft below the surface). On the west side of the complex—where most SNL/NM facilities are located—groundwater levels occur from 90–150 m (300–500 ft) below the surface.

The vadose (unsaturated) zone in the KAFB area represents an important feature of the hydrologic system. As in most semi-arid climates, the thickness of this zone is quite large resulting in a significant distance that any surface contaminants must travel before reaching the groundwater system.

Two perennial springs, Coyote Springs and Sol se Mete Spring, are present on KAFB. Hubbell Spring, also perennial, is located immediately south of the KAFB boundary on Isleta Indian lands.

Groundwater Yields

The primary water-yielding zones are in the basin within the upper unit and, to a lesser degree, the middle unit of the Santa Fe Group. Most of the City of Albuquerque's water supply wells are located on the east side of the Rio Grande and west of the eastern extent of the ancestral river channel deposits. The highest yield wells are screened in the sediments associated with the ancestral river channel.

Prior to extensive urban development in the Albuquerque area beginning in the 1950s, the direction of groundwater flow was primarily to the southwest in the vicinity of Albuquerque and KAFB. However, as a result of pumping, the water table in the regional Santa Fe Group aquifer has dropped by as much as 43 m (140 ft) (Thorn et al. 1993). Relative to KAFB, groundwater currently flows north-northwest towards the City's well fields, being influenced by the depression in the water table.

1.7 ECOLOGICAL SETTING

The regional area within an 80 km (50 mi) radius of SNL/NM facilities is situated at the junction of four major physiographic provinces:

- **Great Plains Grassland Prairie** (east of the Rocky Mountains)
- **Great Basin Desert** (west of the Rocky Mountains)
- **Chihuahuan Desert** (South of Albuquerque)
- **Rocky Mountains** (the Sandia and Manzano Mountains form the southern extension of the Rockies)

This section discusses each influencing province, noting the typical landforms, flora, and fauna predominant within each biome. (Biomes are large ecological communities characterized by a distinctive climate and vegetation type.) Typical vegetation found on KAFB is shown in Figure 1-10.

Desert Influence

Although the word "desert" has several possible definitions, it can generally be defined as a place where more water is lost through evaporation than is gained from precipitation. Some definitions consider a desert to be a place where the average annual precipitation is less than 10 in. per year. In the Albuquerque area, excluding the higher elevations in the mountains, the average precipitation is about 8 in. per year. The

landscape, however, is lush along the Rio Grande (bosque) and in the surrounding higher elevations. Irrigated farmland also lines the river.

1.7.1 Great Plains Grasslands Prairie

East of the Sandia and Manzano Mountains, the regional area generally falls under the influence of the Great Plains Grassland Prairie. Short grass grows in the rain shadow of the Rocky Mountain system where the average rainfall is about 15 in. per year—favoring grasses over trees. In New Mexico, most of this land is used to graze cattle. This biome is distinctive in the counties of Santa Fe and Torrance near the communities of Edgewood and Moriarty.

Vegetation – The short grass prairie region is dominated by drought tolerant plants that generally grow no more than 6-12 in. high. Blue grama and buffalo grasses dominant. Other common plants include sagebrush, sunflowers, and locoweed. Succulents and cacti, such as cholla and prickly pear, are numerous. In the spring, grasslands support an abundant variety of wildflowers.

Wildlife – Large mammals in this area include pronghorn antelope on the plains, and mule deer and white tail deer common where brush cover is available. Coyote, jackrabbit, and desert cottontail are ubiquitous. Prairie dogs, ground squirrels, and other small rodents thrive here. Common birds include western meadow lark, quail, ravens, and many raptors, such as hawks, falcons, and owls. The roadrunner, New Mexico's State bird, makes its nest in cholla bushes and hunts rodents, lizards, insects, and small birds (Figure 1-11).

FIGURE 1-10. Local Vegetation Found on KAFB

FIGURE 1-11. The Roadrunner, New Mexico's State Bird

1.7.2 The Great Basin Desert

The Great Basin Desert is located within much of the Basin and Range Province, which stretches from the east side of the Sierra Nevada Mountains in California to the west side of the Rocky Mountains. The region is comprised of a series of down-dropped basins and uplifted ranges produced by normal faulting. Each range typically has a steep slope on one side and a gentle slope on the other (as do the Sandia and Manzano Mountains, which have a gentle east slope). The Great Basin is a "cold desert" due to its more northern latitude, as well as higher elevations (at least 3,000 ft, but more commonly 4,000–6,500 ft). Precipitation is generally 7–12 in. annually and winter precipitation often falls as snow. Though not a true part of the Great Basin Desert, the Albuquerque region, is heavily influenced by this ecosystem.

Vegetation – Great Basin Desert vegetation consists of many shrubby plants such as sagebrush, blackbrush, shadscale, Mormon-tea and greasewood. Yucca and cactus occur only occasionally.

Wildlife – Typical desert animals in this region include bighorn sheep, pronghorn antelope,

jackrabbit, small rodents, and numerous species of snakes and lizards.

1.7.3 Chihuahuan Desert

The Chihuahuan Desert is present in almost all of Mexico, and parts of Arizona, Texas, and southern New Mexico. In the Albuquerque regional area, a small northern finger of this desert biome stretches to Socorro, New Mexico. Elevations are generally between 3,000–5,000 ft. Winter temperatures are cool, and summer temperatures are extremely hot.

Vegetation – Indicator plants include Chihuahuan shrubs such as creosotebush, mesquite, yucca, agave, and ocotillo. Lechugilla, a type of agave, is endemic to the Chihuahuan Desert.

Wildlife – Pronghorn antelope and mule deer are the most widely distributed large game animals. Other common mammals are black-tailed jackrabbit (Figure 1-12), coyote, bobcat, desert cottontail, kangaroo rat, wood rat, and numerous smaller rodents. Birds include the black-throated sparrow, quail, bobwhite, great horned owl, red tailed hawk, greater roadrunner, curve-billed thrasher, and Chihuahuan raven. Reptiles are abundant.

1.7.4 'Rocky Mountain' Life Zones

The Sandia and Manzano Mountains form the southern extension of the Rocky Mountains. This section discusses the mountain biomes by life zones (elevation ranges).

RAPTOR MIGRATION IN THE MANZANOS

Raptors—or birds of prey—include eagles, hawks, owls, falcons, and vultures. The Manzano Mountains are an important flyway for many raptor species. Common sightings include the sharp-shinned hawk, cooper's hawk, American kestrel, and red-tailed hawk. Other migrating raptors noted include the golden and bald eagle, turkey vulture, osprey, northern harrier, broad-winged and zone-tailed hawk, merlin, peregrine and prairie falcon, and northern goshawk.

During fall migration, raptors in New Mexico tend to funnel down from the Jemez and Sangre de Cristo Mountain ranges toward the Manzanos. The Manzano Site has been designated by the raptor research and conservation organization, HawkWatch International Inc., as a "fall migration site." Some stations count an average of 150 birds per day during the fall migration. In a typical year, about 4,000 raptors are counted at the Manzano Site.

The Canadian Life Zone — This alpine zone occurs above 8,000 ft; the highest elevations in the Sandia and Manzano Mountains are just over 10,000 ft. The Canadian zone is marked by mixed conifer forests of spruce, fir, and aspen. Large animals include bighorn sheep, black bear, deer, and elk. Smaller animals include rabbits, squirrels, and bobcat. The crest of the mountains in this area serve as an important flyway for migrating birds, including numerous raptor species (see inset). Birds use updrafts from the mountain ridges to gain lift and conserve energy.

Ponderosa Pine Transition Zone — This life zone occurs in the higher elevations of the withdrawal land on KAFB. In the Albuquerque region, the ponderosa zone generally occurs between 6,500–8,500 ft. Common trees are ponderosa, white fir, Douglas fir, spruce, scrub oak, pinon, and juniper.

FIGURE 1-12. Black-tailed Jackrabbit

Wildflowers include penstemon, indian paintbrush, wild iris, Mexican hat cone flower, and skyrocket. Typical animals found here are big horn sheep, black bear, mountain lion, bobcat, mule deer, squirrels, skunk, porcupine, and rabbits. Towhee, flicker, hummingbirds, blue jay, and Steller's Jay are common birds.

Pinion Juniper Zone — This zone generally occurs from 5,500–6,500 ft. This elevation makes up most of the rolling terrain located on the KAFB land withdrawal. The dominant trees are pinon pine and junipers, which are interspersed with mountain mahogany, sumac, soapweed (yucca), cholla, prickly pear cactus, and short grasses. Canyon areas may support riparian habitat along ephemeral creeks and arroyos. Mule deer, rock squirrel, pinon mouse, skunks, rattlesnakes, fence lizards, and horned lizards are common. Typical birds include warblers, nutcrackers, woodpeckers, siskins, and towhees.

Aluvial Fans - Scrubby semi-desert vegetation occurs on alluvial fan slopes that grade into flat sandy areas of KAFB (generally below at 6,000 ft). The primary vegetation is grama grasses, snake-weed, sage, winter fat, and various cacti including cholla, and prickly pear. This type of terrain is abundant with coyote, jackrabbit, lizards, and rattlesnakes, as well as many burrowing animals — ground squirrel, prairie dogs, and field mice. Birds include hawks, quail, and roadrunners.

1.7.5 Rio Grande and Bosque

The Rio Grande is approximately 14 km (8.7 mi) from SNL facilities. Storm water draining the east side of KAFB is channeled to the Tijeras Arroyo, which empties directly to the river. In the Albuquerque area, the Rio Grande is wide and meandering and braided with sand bars in low areas. Some portions of the river may be completely dry and run underground, especially when irrigation use is high. In general, most of the channel is less than one foot deep. Bulrushes, sedges, watercress, duckweed, milfoil, stonewort, and cattails grow along the margin in some areas.

Bosque, the term for the heavy forest and vegetation along the river, includes mature cottonwood stands, willows, russian olive, and tamarisk (salt cedar)—the latter two being introduced species. The bosque provides habitat for mule deer, raccoons, muskrats, beavers, porcupine, rabbits, coyotes, small rodents, and various reptiles and amphibians. Like the mountains, the Rio Grande provides an important flyway and habitat for migrating birds. Snow geese, sandhill cranes, and the very rare whooping crane winter along the Rio Grande. Other birds include the wild turkey, pheasant, red winged blackbird, warbler, and migrating songbirds and hummingbirds.

1.8 REGIONAL CLIMATE

The climate of the Albuquerque Basin is characterized by wide diurnal temperature extremes, seasonal brief heavy rain showers, and frequent drying winds. The general region also has one of the highest incidences of thunderstorms and lightning strikes in the U.S.

Temperature and Humidity

Air temperatures are characteristic of high-altitude, dry continental climates. Winter daytime high temperatures average 9.6 degrees Celsius (°C) (49.2 degrees Fahrenheit [°F]), while the lows average -4.6 °C (23.7 °F). Summer daytime temperatures average 32.7 °C (90.8 °F), while daily lows average 16.6 °C (61.8 °F) (NOAA 1994). The monthly average relative humidity varies from a low of 30 percent in early summer to 56 percent in early winter.

Wind

While the regional climate is described by the atmospheric state variables of temperature and humidity, site-specific meteorology at SNL/NM is influenced by the proximity to topographic features such as mountains, canyons, and arroyos. These features influence local wind patterns across the site; canyons and arroyos tend to channel or funnel wind, whereas mountains create upslope-downslope diurnal (day/night) wind flows. Winds tend to blow toward the mountains during the day (as the ground heats up the air) and blows back down the mountains at night. These topographically induced wind flows can be enhanced or negated by synoptic (regional) weather systems that move across the southwest part of the United States. The strongest winds occur in the spring when monthly wind speeds

average 4.6 meters per second (m/s) (10.3 miles per hour [mph]). Wind gust can commonly reach up to 50 mph.

Precipitation

Annual precipitation, most of which occurs between July and October, averages approximately 21 cm (8.2 in.) on KAFB. In the higher elevations of the Sandia and Manzano Mountains, annual precipitation is between 12–35 in. The winter season is typically dry with less than 4.0 cm (1.6 in.) of precipitation recorded.

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Compliance Summary

SNL/NM complies with Federal, State, and local environmental laws, regulations, and statutes, and specific rulings contained in Executive Orders (EOs). As a prime contractor to DOE, SNL/NM conducts its operations under the guidance contained in DOE orders. SNL/NM strives to meet 100 percent regulatory compliance standards—both in letter and spirit—with all applicable environmental laws and internal Environment, Safety and Health (ES&H) requirements.

This chapter summarizes compliance with the major environmental laws and statutes applicable to SNL/NM operations. A summary of ongoing issues and actions, occurrences, release reporting, permit status, and the results of external audits and assessments are discussed at the end of the chapter. The individual environmental programs responsible for supporting compliance activities are discussed more fully in the remaining chapters.

2.1 COMPLIANCE STATUS

2.1.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA, commonly known as “Superfund,” provides cleanup funds and/or assessment requirements for inactive waste sites at all Federal facilities. CERCLA requirements are

implemented under 40 CFR 302, “Designation, Reportable Quantities, and Notification.”

A Preliminary Assessment/Site Inspection (PA/SI), as required by the Superfund Amendments and Reauthorization Act (SARA) Section 120(c), was performed at SNL/NM in 1988. This inspection confirmed that SNL/NM does not own any sites that would qualify for listing on the National Priorities List (NPL), a listing of high priority cleanup sites. Therefore, with respect to inactive waste sites, SNL/NM has no CERCLA reporting requirements. SNL/NM was in full compliance with CERCLA and SARA in 1998.

Other CERCLA reporting requirements defined under SARA, are discussed in the following section.

2.1.2 Superfund Amendments and Reauthorization Act (SARA) Title III

SARA Title III, also known as the “Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA),” establishes emergency planning requirements for Federal, State, and local governments and industry. The act is implemented by:

- 40 CFR 355 – “Emergency Planning and Notification” (EPCRA, Section 302-304)

- 40 CFR 370 – “Hazardous Chemical Reporting: Community Right-to-Know” (EPCRA, Section 311-312)
- 40 CFR 372 – “Toxic Chemical Release Reporting: Community Right-to-Know” (EPCRA, Section 313)

EPCRA applies to all facilities in which there is present a threshold quantity of extremely hazardous substances (EHSs) equal to or greater than the threshold planning quantities, or in specifically designated amounts as determined by the local community. Additionally, EO 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention*, signed by President Clinton on August 3, 1993, directed all Federal agencies to comply with EPCRA.

SARA Title III requires the community to be informed of potential hazards such as the type and location of large quantities of toxic chemicals used and stored by facilities in the community. EPCRA specifically mandates that chemical information will be made available to local emergency response organizations such as fire departments and hospitals. Any releases that do occur, must be reported to appropriate State and local authorities, and all subsequent reports must be made easily accessible to the public. The four major reporting requirements designated by specific sections of SARA Title III are shown in Table 2-1.

The EPA web site address for EPCRA is:
<http://www.epa.gov/swercepp/crtk.html>

Reportable quantities (RQs) are defined as the amount of any extremely hazardous chemical listed in CERCLA or in EPCRA's list of EHSs, in quantities greater than or equal to the stated reportable thresholds. SNL/NM had no reportable releases under EPCRA or CERCLA in 1998.

Emergency Preparedness at SNL/NM

Planning notification was designed to facilitate emergency response and preparedness

capabilities through better coordination and planning with State and local communities. SNL has never had a “General Emergency” in which offsite areas and the public have been potentially threatened from an onsite release. However, as required by DOE, SNL routinely plans for various emergency scenarios including the release of toxic chemicals.

To prepare for emergencies, routine full-scale drills are conducted to simulate the release of hazardous substances. Drills are conducted through the Emergency Operations Center (EOC) under SNL's Environmental and Emergency Management Department. These drills test the EOC's ability to quickly coordinate a response and function efficiently with other emergency response agencies such as the KAFB Fire Department, SNL's Hazardous Materials (HAZMAT) Response Team, SNL Medical, and local hospitals and ambulance services. Other important interface functions tested in emergency drills are the ability to make proper notifications in a timely manner to DOE emergency personnel and to DOE Headquarters, various affected Indian tribe leaders, the State of New Mexico, and the City of Albuquerque. The ability to disseminate accurate and timely news reports to local media are handled by the Joint Information Center (JIC). In the event of a “General Emergency,” the JIC would be responsible for keeping the public informed with timely and accurate news release updates.

Toxic Release Inventory (TRI) Reporting

SARA Title III reporting requirements under Section 313 require an annual TRI report to be submitted to the U.S. Environmental Protection Agency (EPA) if chemicals used onsite are above the reporting threshold (10,000 lb). For the last three years, SNL has not been required to submit a TRI report due to a change in the regulations, which delisted certain chemical types. Because of this, SNL's chemical use has not been over the reporting threshold. SNL does, however, continue to compile an annual chemical purchase inventory information report.

The *Supporting Documentation for the Hazardous Chemical Purchase Inventory, 1998 Reporting Year* (SNL 1999a) provides 1998 chemical purchase information for all TRI listed chemicals and describes the facilities that use the bulk of the chemicals and for what purposes. SNL was in full compliance with SARA Title III in 1998.

New Directions in Reporting

SNL/NM is preparing for additional reporting requirements under SARA Title III, which will address Persistent-Biochemical Toxics (PBTs). EPA is expected to promulgate the new regulation by 2001.

2.1.3 Resource Conservation and Recovery Act (RCRA)

RCRA regulates the generation, treatment, storage, and disposal of hazardous chemical waste, non-hazardous solid waste, and

hazardous or petroleum products stored in underground storage tanks (USTs).

The Hazardous Waste Program at SNL/NM is under the compliance authority of the New Mexico Environment Department (NMED), which regulates both hazardous waste and the hazardous component in radioactive mixed waste (MW).

The following bullets describe the status of SNL/NM's compliance with applicable RCRA requirements in 1998.

- **Hazardous Waste** – Hazardous waste is regulated under RCRA "Subtitle C" (implemented by 40 CFR 260–268, 270–272, and 279). Hazardous waste at SNL/NM is handled by the Hazardous Waste Management Facility (HWMF) in TA-II and is included on the RCRA Part B Operating Permit as shown in Table 2-3. The facility also manages any non-hazardous waste that does not meet the waste

TABLE 2-1. 1998 SARA Title III Reporting Requirements (also known as EPCRA) for SNL/NM

Section #	SARA Title III Section	Yes	No	N/R	Explanation
302 - 303	Planning Notification	✓			SNL has submitted a planning report to State and local emergency response authorities detailing its notification procedures and other facility notification responsibilities.
304	Emergency Release Notification			✓	No reportable quantity (RQ) releases of an extremely hazardous substance (EHS), or as defined under CERCLA, occurred in 1998.
311-312	Material Safety Data Sheets (MSDSs) and Chemical Inventory	✓			There are two "Community Right-to-Know" reporting requirements: (a) an inventory report listing all hazardous chemicals onsite (above threshold levels) must be submitted annually to State and local emergency response groups and fire departments; (b) all MSDS ¹ information must be made available to local emergency organizations. SNL submitted Tier 1 and 2 reports in March 1999.
313	Toxic Release Inventory (TRI) Reporting			✓	SNL was below the reporting threshold in 1998 was not required to submit a TRI report.

NOTE: ¹Material Safety Data Sheets (MSDSs) give relevant chemical information.
N/R = not required.

acceptance criteria at the Solid Waste Transfer Facility (SWTF), or any waste that is prohibited from normal landfill disposal. In 1998, the HWMF shipped a total of 84,739 kg of RCRA-regulated hazardous waste.

- **Solid Waste** – Non-hazardous solid waste is regulated under RCRA “Subtitle D.” The SWTF in TA-II screens, bales, and ships most non-hazardous solid waste generated at SNL/NM. The SWTF does not accept construction debris, liquids, food service garbage, hazardous waste, or chemical waste. The SWTF also serves as SNL/NM’s central recycling center (primarily paper and cardboard). In 1998, the facility handled 1,330,013 kg of solid waste and 728,227 kg of recycled paper and cardboard. About 60 percent of the total recyclables were received from outside agencies: DOE, Los Alamos National Laboratory (LANL), and KAFB. The facility was in full compliance with all New Mexico Solid Waste Regulations in 1998.
- **Environmental Restoration (ER) Sites** – By the end of fiscal year 1998 (FY98), 146 ER sites remained to be addressed at the SNL/NM site. All ER sites are regulated under the RCRA Part B Operating Permit issued by NMED on August 26, 1993. ER sites are being assessed and remediated as required by the Hazardous and Solid Waste Amendments (HSWA) module to RCRA, Section 3004(u) “Continuing Releases at Permitted Facilities.” Corrective Actions (CAs) for continuing releases from Solid Waste Management Units (SWMUs)—whether active or inactive—are stipulated in the requirements of the permit. The ER project generated 11,293 kg of RCRA-hazardous ER waste in 1998. SNL/NM met all RCRA permit conditions for ER sites in 1998.
- **Underground Storage Tanks (USTs)** – USTs are regulated under RCRA “Subtitle

I,” codified as 40 CFR 280 and 40 CFR 281. SNL/NM also must meet State of New Mexico regulations that are consonant with Federal UST standards. The State standards are written in 20 NMAC 5 “UST Regulations.”

In 1998, SNL/NM operated five registered tanks; although two of these tanks (Bldg. 6523 and 983) were taken out of service and later closed. The Bldg. 983 tank was closed after it was discovered to be unregistered during an inspection by the State UST Bureau in 1997. The Bureau issued a field Notice of Violation (NOV) for the tank being both unregistered and without proper UST monitoring equipment. SNL responded to the violation by registering the tank in October 1998 and then closing it in place several months later. The tank was filled with inert materials (grout) in accordance to UST closure regulations.

- **Mixed Waste (MW)** – MW is dually regulated under RCRA and the Atomic Energy Act (AEA) of 1954. Onsite treatment of newly generated MW began in late summer of 1997. In 1998, SNL/NM managed 10,143 kg of MW and shipped out 5,518 kg. The total volume of MW shipped for offsite treatment and disposal was 19.6 m³. (Volume is a better way to track outgoing waste since the weight of the MW containers is significant.)
- **Explosive Waste Disposal** – In 1998, 2.12 kg of explosive waste was treated at SNL’s Thermal Treatment Facility (TTF). Another 303.3 kg of explosive waste was treated at the KAFB’s Explosive Ordnance Disposal (EOD) site. Offsite shipments of explosive waste were sent to the following two facilities:

Safety Kleen (Louisiana).....	8.9 kg
Thiokol (Utah).....	6,356 kg

- **Corrective Action Management Unit (CAMU)** – The CAMU was designed to store, treat, and dispose of contaminated ER soils generated from SNL/NM onsite remediation projects. Currently, the CAMU is only used for storage; soil treatment and limited disposal will start later.) The CAMU is located next to the Radioactive and Mixed Waste Management Facility (RMWMF) and the Chemical Waste Landfill (CWL). Most of the waste that will be handled at the CAMU will originate from remediation of the CWL. Part of the CAMU consists of a row of soil storage units constructed with three-sided concrete walls that keep the contaminated soils from being blown away. Other soil containment areas at the CAMU are housed in tent structures. The CAMU received its initial waste on January 6, 1999. Soil that meets required standards will be disposed of onsite. The CAMU will greatly facilitate the completion of all ER waste treatment by the year 2001.

NOTE TO READER: A Temporary Unit (TU), was originally permitted to store waste for up to a year during the completion of the CAMU. However, this option was never used.

2.1.4 Federal Facility Compliance Act (FFCAct)

On October 6, 1992, the FFCAct was passed into law, amending RCRA and the Hazardous and Solid Waste Act (HSWA). The Act established requirements for all Federal facilities with respect to treatment and storage of mixed waste (MW). Where by previously, Federal facilities had been granted sovereign immunity from MW compliance, the FFCAct required DOE to meet RCRA's Land Disposal Restrictions (LDRs) for MW and onsite storage limitations. The Act did, however, grant a three-year grace period (1992-1995) for Federal

facilities to come into compliance. LDRs require the treatment of hazardous waste to reduce the toxicity, volume, and likelihood of contaminant migration. Only waste that meets the required LDR standards can be legally disposed.

On October 4, 1995, the Federal Facility Compliance Order was signed by the State of New Mexico, the DOE, and Sandia Corporation. The Order is an agreement between all parties that details the specific actions required with regard to MW management. The agreement stipulated the development of a site treatment plan with identified treatment technologies and milestones. To meet these requirements, SNL/NM will incorporate both onsite and offsite treatment technologies. The first MW shipment was made to Perma-Fix/DSSI in September 1996. In 1998, MW was sent to the Waste Experimental Reduction Facility (WERF) at the Idaho National Engineering and Environmental Laboratories (INEEL) for treatment.

2.1.5 National Environmental Policy Act (NEPA)

NEPA law applies to Federal government agencies; and any private entities that are performing Federally-sponsored projects. NEPA requires Federal agencies, including DOE, to analyze the potential impacts to the environment from their proposed actions. If the proposed action is potentially "significant," the agency would be required to prepare an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) before the project could be started. Although, a major intention of NEPA is to preserve the environment for future generations, the law does not mandate environmental protection per se—it only ensures that Federal agencies make an informed decision and are aware of the environmental impacts of their projects before

proceeding. NEPA does mandate that the decision process be open for public review.

1998 NEPA Documentation

During 1998, SNL/NM submitted 86 SNL/NM NEPA Checklists (summarizing potential environmental impacts) to DOE/KAO for review and approval. In addition, 18 Air Force Environmental Checklists (AF-813 forms) were submitted for projects on Air Force land that required NEPA determination. The following EAs were under development or completed in 1998:

- **Rapid Reactivation Project** (DOE/EA-1264) – This project provided for an increase in manufacturing of neutron generators at the Neutron Generator Facility (NGF). The EA was under preparation in 1998 and completed in April 1999 (DOE 1999a). A Finding of No Significant Impact (FONSI) was issued on February 11, 1999.
- **Chemical Waste Landfill (CWL) Bypass Road Project** (AF 98-012) – In early 1998, an Air Force EA was prepared to allow for temporary road construction on Air Force land for construction near the CWL. A FONSI was issued on April 11, 1998 (USAF 1998).
- **Programmatic EIS for Radioactive and Hazardous Waste Management** (DOE/EIS-0200-f) – DOE Headquarters prepared this EIS for SNL's Waste Management Programs. A FONSI was issued on May 29, 1998 (DOE 1998b).

Site-Wide EIS (SWEIS)

DOE/AL, in coordination with SNL/NM and support contractors, continued the preparation of the Site-Wide Environmental Impact Statement (SWEIS) for SNL/NM. The final draft of the document was available for public review and comment on April 16, 1999.

Historical Value of TA-II Buildings Assessed

In 1998, several buildings in TA-II, slated for demolition, were researched to determine if they were protected under the National Historic Preservation Act. The SNL NEPA team collaborated with SNL's Facilities Management, Planning, and Project Development Department, and with the Recorded Information Management Department, to prepare a report documenting the history of these buildings. The report, *Tech Area II: A History* was submitted by DOE to the State Historic Preservation Officer (SHPO) and Advisory Council on Historic Preservation, along with supporting documentation (Ullrich 1998). The State determined that SNL could continue with its plan to tear down the structures.

2.1.6 Clean Air Act (CAA) and CAA Amendments (CAAA) of 1990

The objectives of the CAA and the CAAA are to protect and enhance the quality of the nation's air. The EPA is responsible for describing and regulating air pollutants from stationary and mobile sources, as well as setting ambient air quality standards. The City of Albuquerque locally administers these standards as well as specific air emission permits and registrations as shown in Table 2-3.

Ambient Air Quality

The City of Albuquerque announces air quality alerts requesting voluntary or mandatory compliance. Yellow alerts request voluntary cooperation to limit driving and burning. Red alerts are mandatory "No-Burn Periods," and request voluntary "non-driving day" cooperation. SNL/NM honors these notices by not performing any open burns or detonations during yellow or red alerts. The City had 100 percent compliance with the CAAA in 1998, noting no recorded exceedences in the ambient air quality standards. In 1998, SNL/NM also recorded no exceedences in air quality standards at any of its six ambient air quality monitoring

stations. A pollution index listing criteria pollutants and local pollen counts is published routinely in the Albuquerque Journal newspaper.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

As it applies to SNL/NM, NESHAP compliance relates to 40 CFR 61, Subpart H, which regulates radionuclide emissions, other than radon, from DOE facilities. As required by this regulation, SNL performs an annual dose assessment to evaluate radioactive air emissions with respect to potentially exposed members of the public. The regulation requires that SNL determine the maximum possible dose that could be received for both onsite and offsite receptors. A receptor, called the "maximally exposed individual" (MEI), is assumed to be an individual that resides at the location 24 hours-per-day to receive the highest concentration. The MEI dose for 1998 was again located at the Kirtland Underground Munitions Storage Complex (KUMSC) north of Technical Area V (TA-V). The dose received at this location was 0.000798 millirem/year (mrem/yr) or 0.00000798 millisievert/year (mSv/yr). The offsite MEI was located at the KAFB Eubank Gate with a dose of 0.00061 mrem/yr (0.0000061 mSv/yr). This is minute compared to EPA's established limit of 10 mrem/yr. SNL/NM was in full compliance with NESHAP air quality requirements in 1998.

Hazardous Chemical Inventory

A hazardous chemical purchase inventory is conducted annually to determine SNL/NM's hazardous chemical use onsite. The assumption is that chemicals purchased equals chemicals used, although the actual inventory will be slightly different than the purchase inventory. This inventory is required by:

- Title V of the CAAA (implemented by 40 CFR 70-71 and 20 NMAC 11.42)
- SARA Title III, Toxic Release Inventory (TRI) reporting requirements (Section 313)

Inventory reports are created from both an inventory of purchased chemicals and Material Safety Data Sheets (MSDSs). MSDSs give pertinent chemical information and are available wherever chemicals are used or stored.

Although a TRI report was not required in 1998 since SNL's chemical use was under the reporting threshold, a hazardous chemical inventory report was published that described SNL/NM's chemical purchases and inventory in 1998 (SNL 1999a).

Table 2-2 presents the results of the 1998 hazardous chemical inventory and compares them to last year's purchase inventory totals. The list published in last year's ASER included all chemical purchases over 1,000 lb. The list for 1998 includes only chemicals purchases over 1,000 lb that are listed under SARA Title III Toxic Chemical List.

2.1.7 Clean Water Act (CWA)

The CWA sets forth goals to protect U.S. waters by controlling discharged pollutants. As it pertains to SNL/NM, the CWA applies to sanitary and septic system wastewater effluents, storm water runoff, and surface water discharges. The CWA is implemented through local, State, and Federal water quality standards: the City of Albuquerque administers sanitary sewer discharges based on Federal pretreatment standards; the New Mexico Environment Department (NMED) administers regulations concerning surface discharges; and the EPA retains oversight of storm water discharges and mandates requirements for oil storage. Oil storage requirements are outlined in an Oil Spill Prevention Control and Countermeasures (SPCC) Plan (CDM 1995).

COA Sewer Discharge Regulations

There are six wastewater monitoring stations at SNL/NM that are subject to the City's "Sewer

Use and Wastewater Control Ordinance.” Four of these stations discharge directly to the City sewer; two are categorical pretreatment stations upstream of a general outfall. In 1998, there was one instance in which a wastewater sample was found to exceed established standards. Molybdenum was found elevated at Station WW011 in a sample taken by the City on September 8, 1998. The source was determined to be from mop water, which had been used to clean an area where molybdenum dust had accumulated. Cleaning procedures were changed to prevent a reoccurrence.

National Pollutant Discharge Elimination System (NPDES)

NPDES implements requirements specific to discharges made to waters of the United States as defined in the CWA. At SNL/NM, this is applicable to surface storm water runoff (SNL/NM does not require a separate NPDES permit for process water—all process water is discharged through the sanitary sewer authority). Due to low precipitation in 1998, only one storm water event could be sampled. Several metals were found elevated over permit standards, however, meaningful conclusions cannot be derived from a single measurement. (See Section 6.3 for discussion.)

A State Pollutant Discharge Elimination System (SPDES) permit, required in some states, is not required in New Mexico.

Surface Water Discharge

Surface discharges made to the ground or to containments must be first evaluated for compliance with regulations implemented through the New Mexico Water Quality Control Commission (NMWQCC). There were 21 approved surface discharge requests in 1998. In addition, SNL holds permits for two surface discharge lagoons in TA-IV, which are used to routinely discharge accumulated storm water from oil containment areas. All permit conditions for these lagoons were met in 1998.

In 1998, there were two surface discharge violations as discussed in Section 6.2.2.

2.1.8 Safe Drinking Water Act (SDWA)

The SDWA, passed in 1974, and revised in 1986 and 1996, sets national standards for drinking water for both groundwater and surface water sources. These standards are designed to protect

TABLE 2-2. 1998 Summary of SNL/NM's SARA Title III Toxic Chemical Purchases in Quantities Greater than 1,000 lb

Chemical Name	CAS Number	1997 Usage (lb/yr)	1998 Usage (lb/yr)
Acetone	67-64-1	6,405	6,800
Aluminum oxide (fibrous forms)	1344-28-1	none	2,325
Catechol (pyrocatechol)	120-80-9	none	1,332
Dichloromethane (methylene chloride)	75-09-2	none	1,025
Ethylene glycol	107-21-1	2,493	2,691
Hydrogen chloride	7647-01-0	55,309	1,035
Isopropyl alcohol	67-63-0	4,566	4,479
Methanol	67-56-1	2,461	1,855
Nitric acid	7697-37-2	5,117	5,423
N-Methyl-2-pyrrolidone	872-50-4	3,897	2,999
Phosphoric acid	7664-38-2	1,542	1,600
Sulfuric acid (liquid)	7664-93-9	24,589	19,228
TOTAL		106,379	50,792

NOTE: CAS = Chemical Abstract System

human health by regulating the allowable amount of chemicals, metals, radionuclides, bacteria, and other potential pollutants in the water. Discharges from residential, municipal, and industrial sources are closely monitored and regulated to prevent contamination of drinking water sources. All drinking water systems in the United States must routinely test to ensure that the water they are providing meets EPA's National Drinking Water Standards.

The SDWA addresses three areas:

- Maximum contaminant levels (MCLs)
- Treatment techniques to remove certain contaminants
- Monitoring and reporting requirements

SNL/NM's Drinking Water Supply

Potable water on KAFB is provided by the KAFB Water System, which is derived from several groundwater wells. KAFB's water utility operates under EPA identification number NM3567701 and serves approximately 30,000 people who live and work on the base. KAFB routinely samples its water for trihalomethanes, coliforms, volatile organic compounds (VOCs), gross alpha and gross beta radioactivity, and other specifically listed inorganic chemicals. The water system at KAFB has an almost perfect compliance history with respect to the SDWA. The only reported violation in the last 10 years was in 1993 when lead and copper contaminants were found over the standards. This information is located at EPA's SDWA web site, which details the compliance status for all drinking water systems in the U.S. The site address is:

http://www.epa.gov/enviro/html/sdwis/sdwis_query.html#geography

SNL's Remote Drinking Water Systems

There are several remote water delivery systems used by SNL/NM to supply water to remote test areas in Coyote Canyon and the 6000 Igloo Complex. This system has been classified as a Non-Transient, Non-Community (NTNC) water

system. SNL's system is regulated separately by NMED, and its sampling plan for the system has been approved. SNL/NM samples for coliform, lead, and copper. SNL was in full compliance with drinking water regulations in 1998.

2.1.9 Toxic Substances Control Act (TSCA)

TSCA addresses the import, export, use, and disposal of specifically listed toxic chemicals. As it applies to SNL/NM, compliance with TSCA primarily involves the handling and disposal of polychlorinated biphenyls (PCBs) and asbestos waste. All TSCA waste and recyclables are handled and shipped by the Hazardous Waste Management Facility (HWMF). In 1998, the HWMF received 968 kg of PCB waste, 1,173 kg of recyclable PCBs, and 31,523 kg of asbestos waste. All wastes were disposed of or recycled at permitted offsite facilities. SNL/NM was in full compliance with TSCA regulations in 1998.

2.1.10 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

SNL/NM's Biological Control Activity includes oversight of pesticide use at SNL to ensure compliance with FIFRA as implemented by the EPA. Pesticides used at SNL include herbicides for weed control, insecticides for control of insect pests, and rodenticides for the control of mice and other unwanted rodents. SNL has contracts with commercial certified pesticide applicators to apply herbicides, insecticides, and rodenticides where they are needed. Restricted-use pesticides are applied only by the commercial certified pesticide applicators, and all pesticide products used at SNL are EPA-approved.

2.1.11 Endangered Species Act (ESA)

ESA applies to both private individuals and Federal agencies. At SNL/NM, ESA is addressed under the NEPA Program. Section 7 of ESA specifically applies to Federal agencies. The law ensures that any action authorized, funded, or carried out by a Federal agency will not jeopardize the continued existence of a "threatened or endangered species," or result in adverse modifications to its habitat.

Sensitive Species

The term "sensitive species" has a much broader connotation for NEPA compliance purposes than "threatened or endangered." It includes Federally-listed and State-listed "threatened or endangered species," "candidate species" for listing, species listed by other Federal agencies, species protected under other laws and regulations, and any species perceived by the public as "sensitive."

Prior to SNL/NM beginning any proposed action that may potentially affect sensitive species or habitats, a National Environmental Policy Act (NEPA) Checklist must be submitted to DOE/KAO for a determination. As it is applicable, DOE must confer with the following agencies:

- U.S. Fish and Wildlife Service
- New Mexico Game and Fish Department
- New Mexico Energy, Minerals, and Natural Resources Department
- U.S. Forest Service

If potentially significant impacts to "sensitive" species or habitat could result from the an agency's proposed action, an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) must be prepared.

Animals

There are several Federally-listed threatened, endangered, and sensitive species that have the *potential* to occur on the KAFB complex. The peregrine falcon (*Falco peregrinus*)—also a

State-listed Endangered Group 1 species—is the only endangered species that has been observed on KAFB. However, no nesting activity of this species has been observed and only marginal habitat exists for nesting. Three other endangered species occur in Bernalillo County, but are not found within KAFB. These are the whooping crane (*Grus americana*), the willow flycatcher (*Empidonax traillii extimus*), and the Rio Grande silvery minnow (*Hybognathus amarus*). Two threatened species, occurring in Bernalillo County, but not observed on KAFB, are the bald eagle (*Haliaeetus leucocephalus*) and the Mexican spotted owl (*Strix occidentalis lucida*). The burrowing owl, which inhabits prairie dog towns on KAFB, is a Federally-listed "species of concern."

Plants

There are no plant species that are currently listed as endangered by the New Mexico Forestry and Resource Conservation Division that are known to occur on KAFB. Only one sensitive (List 2) plant species, the Santa Fe milkvetch (*Astragalus feensis*), has been recorded.

For more information on sensitive plants and animals in New Mexico, visit the New Mexico State Wildlife Agency web site address at:

<http://www.gmfsh.state.nm.us/>

The *SNL/NM Environmental Baseline Update* (SNL 1996a) includes a section on biological resources. The management of sensitive species areas is also discussed in the *ES&H Manual*, "NEPA, Sensitive Species, and Historic Properties" (SNL 1999b).

2.1.12 Cultural Resources Acts

As it applies to SNL/NM, the three primary cultural resources acts are:

- National Historic Preservation Act (NHPA)
- Archaeological Resources Protection Act (ARPA)
- American Indian Religious Freedom Act (AIRFA)

At SNL, cultural resources are managed under the NEPA Program. As with sensitive species compliance, locations that could adversely affect cultural resources are initially analyzed in a NEPA Checklist. It is DOE policy that NEPA review must be performed for all DOE actions potentially affecting the environment; thus, even actions that are classified as Categorical Exclusions are reviewed for impacts to cultural resources.

Historical properties (as defined by NHPA and implementing regulations) include archeological sites and historic buildings and structures. SNL/NM activities are usually planned to avoid potential impact to such sites. There are no known archeological sites located on DOE property. Historic buildings and structures may include those dating from the World War II and Cold War eras. SNL and DOE have begun assessments of potentially historic buildings and structures from these periods. Several buildings in TA-II were recently assessed for potential historical value before they could be approved for demolition.

The *SNL/NM Environmental Baseline Update* (SNL 1996a) provides information on the affected environment that must be addressed in the NEPA process. Cultural resources are also discussed in the *ES&H Manual*, "NEPA, Sensitive Species, and Historic Properties" (SNL 1999b).

2.1.13 Executive Orders (EOs)

There are two EOs germane to NEPA compliance at SNL/NM. They address wetlands and floodplains.

Floodplain Management, EO 11988

This order has minimal impact for SNL/NM. All active SNL/NM facilities are located outside the 500-year floodplain as described by the U.S. Army Corps of Engineers for both the Tijeras Arroyo and Arroyo del Coyote (ACE 1979). The SNL/NM boundary of the 100-year flood plain does occur along the arroyo boundaries as described in the *SNL/NM Environmental Baseline Update* (SNL 1996a).

Protection of Wetlands, EO 11990

Wetlands are those areas inundated by surface or groundwater with a frequency to support a prevalence of aquatic plant and/or animal life. Wetlands generally include swamps, bogs, potholes, ponds, mudflats, and areas around natural springs. There are several natural springs on KAFB with a limited wetland setting. These areas are managed with care by the U.S. Air Force and the U.S. Forest Service to preserve an important source of drinking water for wildlife as well as to preserve the biological niche created by the presence of water in an otherwise arid habitat. Any activity proposed by SNL/NM that could potentially impact wetlands, must receive NEPA review.

2.2 SUMMARY OF ENVIRONMENTAL PERMITS

Table 2-3 lists all environmental permits and registrations that were in effect in 1998. This includes permit applications that are pending and are under review by various agencies.

TABLE 2-3. Summary of Environmental Permits and Registrations in Effect During 1998

Permit Type and/or Facility Name	Location/Building	Permit Number	Issue Date	Expiration Date	Regulatory Agency
SEWER WASTEWATER					
General	WW001 Station Manhole, south of TA-IV at Tijeras Arroyo	2069 A-3	7/1/97	6/30/99	COA
General	WW006 Station Manhole, at Pennsylvania Ave.	2069 F-3	7/1/97	7/31/99	COA
Microelectronics Development Laboratory (MDL)	WW007 Station Manhole, Bldg. 858 in TA-I	2069 G-4	7/1/98	5/31/02	COA
Advanced Manufacturing Process Laboratory (AMPL)	WW009 Station Manhole, Bldg. 878 in TA-I	2069 H-3	7/1/97	8/31/99	COA
General	WW008 Station Manhole, south of TA-II at Tijeras Arroyo	2069 I-2	7/1/97	9/30/99	COA
General	WW011 Station Manhole, north of TA-III (includes TA-III, TA-V, and Coyote Test Field sewer lines)	2069 K-3	7/1/98	2/28/02	COA
SURFACE DISCHARGE					
Pulsed Power Development Facilities (Discharge Plan) (first issue -1988)	TA-IV, Lagoons I and II	DP-530	2/24/95	2/24/00	NMED
UNDERGROUND STORAGE TANKS					
7,000 gal hydraulic oil, Centrifuge Facility	Bldg. 6523 (closed in 1998)	06382	10/15/98	10/15/99	NMED, UST Bur.
9,730 gal emergency generator fuel	Bldg. 862	06383	9/24/98	9/24/99	NMED, UST Bur.
20,000 gal oil storage tank	Bldg. 888	06384	9/24/98	9/24/99	NMED, UST Bur.
20,000 gal oil storage tank	Bldg. 888	06385	9/24/98	9/24/99	NMED, UST Bur.
1,500 gal ethylene glycol	Bldg. 983 (closed in 1999)	06386	10/15/98	10/15/99	NMED, UST Bur.
STORM WATER					
National Pollution Discharge Elimination System (NPDES) "Multi-sector General" Permit	Storm water discharges from Stations 4 and 5	NMR05A181	8/97	9/1/01	EPA
NPDES Construction Permit	TA-I, Processing and Environmental Technology Laboratory (PETL)	NMR10B434	Notice of Intent submitted 5/14/98	4/30/00	EPA

NOTE: COA = City of Albuquerque
 NMED = New Mexico Environment Department
 EPA = U.S. Environmental Protection Agency

TABLE 2-3. Summary of Environmental Permits and Registrations in Effect During 1998 (Continued)

Permit Type and/or Facility Name	Location/Building	Permit Number	Issue Date	Expiration Date	Regulatory Agency
RCRA					
Hazardous Waste Management Facility (HWMF) Module I, II, III	TA-II, Bldgs. 958 and 959	NM5890110518-1	8/6/92	08/06/02	NMED
Thermal Treatment Facility (TTF)	TA-III, Bldg. 6715	NM5890110518-2	12/4/94	12/4/04	NMED
Resource Conservation and Recovery Act (RCRA) - Hazardous and Solid Waste Amendments (HSWA)-Module IV	ER sites	NM5890110518-1	8/26/93	9/20/02	NMED/EPA
Resource Conservation and Recovery Act (RCRA) - Temporary Unit (TU) (permit/modification to HSWA module)	TA-III	Part of CAMU permit	9/97	6/99	NMED
Resource Conservation and Recovery Act (RCRA) - Corrective Action Management Unit (CAMU) - proposed modification	TA-III	NM5890110518	9/97	6/03	NMED
RCRA Part A and B Permit Applications for the RCRA component in mixed waste (MW) stored at Hazardous Waste Management Units	- Radioactive and Mixed Waste Management Facility (RMWMF), Bldg. 6920 - 7 Manzano Bunkers - Interim Storage Site (ISS), TA-III, Bldg. 6921 - High Bay TA-V, Bldg. 6586	NM5890110518	Interim status first submitted 8/90; Rev. 3, 11/96	Pending Review*	NMED/EPA
Open Burn Permits					
Thermal Treatment Facility (permit must be submitted within 30 days of receipt)	Bldg. 6715	76-OB-2-1999	12/10/98	12/30/99	COA
Fire Extinguisher Fire Training	Off 9 th Street	76-OB-4-1999	12/11/98	12/30/99	COA
Burn Site (8 Open Pool Events)	Open Pool	76-OB-1-1999	12/10/98	12/30/99	COA
Burn Site (Bldg. 9830)	Igloo 9830	76-OB-3-1999	12/11/98	12/30/99	COA
Burn Site - Wood Crib Fire No. 1	Open Ring	76-OB-1-1998	1/12/98	1/30/98	COA
Sled Track Explosive Testing	10,000 Track	76-OB-2-1998	1/12/98	12/30/98	COA
Fire Extinguisher Fire Training	Off 9 th Street	76-OB-3-1998	1/12/98	12/30/98	COA
Thermal Treatment Facility (TTF)	Bldg. 6715	76-OB-4-1998	1/12/98	12/31/98	COA
Burn Site - Wood Crib Fire No. 2	Open Ring	76-OB-5-1998	1/27/98	2/28/98	COA
Burn Site - Wood Crib Fire No. 3	Open Ring	76-OB-6-1998	2/9/98	2/28/98	COA
Burn Site - VULCAN	Open Pool	76-OB-7-1998	3/1/98	9/1/98	COA
Burn Site (Bldg. 9830)	Igloo 9830	76-OB-8-1998	3/1/98	12/31/98	COA
Burn Site Onsite Container	Open Pool	76-OB-9-1998	3/1/98	6/30/98	COA
Burn Site HALFPAC	Open Pool	76-OB-10-1998	3/1/98	6/30/98	COA
Burn Site - Wood Crib Fire No. 4, 5, 6	Open Pool	76-OB-11-1998	4/1/98	7/30/98	COA
Sled Track Weed Maintenance	10,000 Track	76-OB-12-1998	4/12/98	6/30/98	COA
Sled Track 1,000 lb Detonation	800 South	76-OB-13-1998	8/11/98	6/30/98	COA

NOTE: * Submitted and awaiting agency review.

TABLE 2-3. Summary of Environmental Permits and Registrations in Effect During 1998 (Concluded)

Permit Type and/or Facility Name	Location/Building	Permit Number	Issue Date	Expiration Date	Regulatory Agency
ECOLOGICAL					
New Mexico Department of Game and Fish for Scientific/Educational Purposes Authorization for Taking of Protected Wildlife	Site-Wide Ecological Monitoring Activity	2931	1/1/98	12/31/98	New Mexico Department of Game and Fish
AIR (Permits & Registrations)					
Hammermill Facility	TA-III, Bldg. 6583	144	08/28/85	Biennial update	COA
Fire Laboratory used for the Authentication of Modeling and Experiments (FLAME)	Burn Site	196	5/19/88	Registration†	COA
Neutron Generator Facility (NGF)	TA-I, Bldg. 870	374	09/23/94	Registration†	COA
Standby diesel generators	TA-I, Bldg. 862	402 (150 old)	05/07/96	Biennial update	COA
Radioactive & Mixed Waste Management Facility (RMWMF)	TA-III, Bldg. 6920	415	05/07/96	Registration†	COA
Isotope Production Facility	TA-V, Bldg. 6580	428	07/08/96	Biennial update	COA
Title V Operating Permit	Site-Wide	515 (pending)	Submitted* 3/1/96	Pending (5 year renewal)	COA
Classified Waste Landfill (CIWL)	TA-II, Landfill	560	12/17/96	Biennial update	COA
Advanced Manufacturing Processes Laboratory (AMPL)	TA-I, Bldg. 878	646	1/23/97	Biennial update	COA
Portable Burn Pools	Burn Site	647	5/5/97	Biennial update	COA
Radiological Waste Landfill (RWL)	TA-II, RWL	NESHAP	12/15/95	Approval††	EPA, Region VI
Chemical Waste Landfill -Voluntary Corrective Measure (VCM)	TA-III, CWL	648	5/23/97	Registration†	COA
Processing and Environmental Technology Laboratory (PETL)	TA-I, Bldg. 701	925	Submitted*	Pending	COA
Emergency Generator	TA-I, Bldg. 870B	924	Submitted*	Biennial update	COA

NOTE: †Registration = Certificate, no permit required.

†† Approval = EPA does not issue a permit.

* Submitted and awaiting agency review.

2.3 CURRENT COMPLIANCE ISSUES AND ACTIONS

Environmental issues and actions of concern or interest to SNL/NM for 1998 are discussed below.

Air Quality Issues

- **20 NMAC 11.42, Operating Permits** – The City of Albuquerque implements the CAAA Title V regulations under its Operating Permit Program, which encompasses Albuquerque and the rest of Bernalillo County. The program received interim approval by the EPA on March 13, 1995, requiring all existing “major sources” to apply for an operating permit by March 13, 1996. A major source is defined as a facility that emits, or has the potential to emit:

- 100 tons per year (tpy) of any criteria pollutant
- 10 tpy of any single Hazardous Air Pollutant (HAP), or
- 25 tpy of any combination of HAPs.

Based on the actual emissions from the Steam Plant and the inventory of all boilers, heaters, and standby generators, SNL/NM is a major source for nitrous oxides (NO_x). Additionally, SNL/NM has the potential to emit more than 100 tpy of carbon monoxide (CO).

DOE submitted SNL/NM's Title V permit application (Volume I) on March 1, 1996; the application was deemed complete on May 1, 1996. The City of Albuquerque had planned to issue the Title V Operating Permit on or before March 13, 1998;

however, as of June 1999, it had not been issued.

- **20 NMAC 11.02, Permit Fees** – Since 1994, when Title V of the CAAA became effective, SNL/NM has been required to pay air emission fees. Most of the fees result from SNL's Steam Plant emissions, which produces nitrogen oxide (NO_x). The fee was calculated based on an “emission factor” of 550 lb of NO_x emitted for every 1,000,000 standard cubic feet (scf) of natural gas burned. Initially, SNL paid a per ton emission fee based on its annual *maximum* potential to emit air emissions (a much higher estimate than actual operating conditions). Later, the City allowed emission fees to be calculated based on the *actual* volume of fuel used. This gave SNL a substantial cost savings. Although, this was negated in part due to the City raising the per ton rate at the same time. However in 1998, the EPA lowered the “emission factor” from 550 lb to 280 lb per 1,000,000 scf. This action increased the potential cost savings on emission fees since SNL will now be paying less per ton for its NO_x emissions.
- **40 CFR 68, Subpart G, Risk Management Plan (RMP)** – Section 112r of the CAAA directed the EPA to promulgate regulations for managing highly hazardous materials and preventing accidental releases. In response, the EPA promulgated the Risk Management Program rule in 40 CFR 68 on May 24, 1996. The rule requires sources to develop and implement risk management programs that incorporate three elements:
- Hazard Assessment
 - Prevention Program
 - Emergency Response Program

These programs are to be summarized in an RMP that will be made available to State and local government agencies and the public. The rule requires subject facilities to develop and submit a RMP to regulatory authorities by June 21, 1999. SNL is currently evaluating the ruling to determine if it applies to its operations.

- **One Hour Ozone Standard Revoked by EPA** – On May 27, 1998, EPA revoked the NAAQS one-hour ozone standard in 2,901 counties nationwide, including Bernalillo County. (The old rule stated that the hourly average ozone concentration was not to exceed 0.12 ppm more than once a year.) The counties chosen were selected based on the fact that there had been no measured violation of the old one-hour rule. The revocation of the one-hour standard in these areas became effective upon publication of the Federal Register on July 15, 1998. This action assisted in the phasing out of the one-hour standard since the 1997 promulgation of the 8-hour standard, which is now in effect.

Waste Management Issues

- **Mixed Waste (MW) Compliance** – Although, SNL is in compliance with the Federal Facility Compliance Act (FFCA), the issue of compliance with regard to RCRA's Land Disposal Restrictions (LDRs) (RCRA 3004j) remains. The Federal Facilities Compliance Order acknowledges the lack of treatment capacity for MW and allows MW to be stored onsite past the normal one-year time frame mandated by RCRA. As required by the Order, SNL/NM has developed MW treatment technologies and has initiated shipments of MW for offsite disposal and offsite treatment (if not already treated by SNL). In 1998, 19.6 m³ of MW was shipped for disposal, however, it will be several years before all of the

accumulated MW remaining onsite is sent for permanent offsite disposal.

2.4 1998 AUDITS AND APPRAISALS

Operations at SNL/NM are routinely subjected to audits by external regulatory agencies. Additionally, DOE and internal independent SNL organizations conduct appraisals and assessments. Audits and appraisals conducted by external agencies in 1998 are listed in Table 2-4.

Audits identify issues that may be positive or negative. These are reported as either "findings," "observations," or "noteworthy practices." Findings denote non-compliance and require corrective actions. Observations may be either positive or negative and may or may not require a follow-up action. Noteworthy practices identify positive conditions. Addressing negative issues resulting from audits and appraisals is the responsibility of each program area.

The *ES&H Manual* provides requirements for addressing and tracking corrective actions (SNL 1998a).

2.5 1998 RELEASES AND ENVIRONMENTAL OCCURRENCES

SNL/NM had a significant reduction in occurrences in 1998 as compared to previous years and only one was the result of a release. The other three were relatively minor: a discovery of buried oil contamination, a failure to register an existing UST, and results from the previous year's audit.

TABLE 2-4. Audits and Appraisals Conducted by External Agencies in 1998

Appraising Agency	Title	1998 Audit Period	Summary
DOE/AL	Evaluation of ES&H Policies and Procedures for SNL Laboratory Directed Research and Development (LDRD) Projects	Jan to Mar	Results noted that LDRD projects follow ES&H policies and procedures, but recommended that projects involving multiple organizations be reviewed by associated organizations for ES&H concerns to better effect communication between teaming parties on ES&H issues.
DOE-EH 23 DOE-DP 23 DOE-NN 60	Emergency Management Assessment	Mar 30 to Apr 3	Validated plans and procedures for SNL emergency response to a planned event (exercise scenario). A number of command and control issues were identified for improvement. Noteworthy practices included the SNL Family Assistance Center and the coordination of medical and community resources.
New Mexico Environment Department (NMED)	Hazardous Waste Management "Wall-to-Wall" Audit	May	Nine draft findings were identified and immediately addressed by SNL, although all were relatively insignificant. NMED stated that they were impressed with the low number of findings given the high scrutiny level of the audit.
DOE/KAO DOE/AL	Contractor Performance Assessment Program (CPAP) of SNL/NM	Jun 22 to Jul 2	This assessment focused on 11 functional areas at SNL. Results included 27 findings, 18 noteworthy practices, and five best management practices. All corrective actions were completed or are on schedule.
Lockheed Martin, Corporate	Environmental Safety & Health (ES&H) Audit	Nov to Dec	A total of 17 program areas were deemed to meet all regulatory, corporate, and company requirements. Results included: seven findings (five safety and health and two environmental); nine positive observations and 12 areas for improvement. All findings were addressed.
DOE ISMS Verification	Integrated Safety Management System (ISMS) Implementation Verification Phase I & II	Oct 27 to Nov 20	SNL's ISMS description was approved. There were nine opportunities for improvement and 11 noteworthy practices were identified.

Details of these occurrences are described at the end of this section.

Occurrence Tracking

An occurrence is a problem, concern, failure, malfunction, or deficiency in equipment, process, procedure, or program. It is also any condition or event that adversely affects, or may adversely affect, DOE or contractor personnel, the public, property, the environment, or DOE's mission, security, or operations. This section describes occurrences that can affect the environment.

Occurrence reporting is tracked by the ES&H Centralized Services/Feedback and Improvement Department. All SNL/NM occurrences are entered into the Occurrence Reporting Processing System (ORPS) database. Corrective actions are also tracked through the database, although final responsibility for completing corrective actions rests with each affected organization. Table 2-5 presents a five year history of SNL/NM's occurrence reporting status.

DOE Order 232.1a, *Occurrence Reporting and Processing of Operations Information* (DOE 1997a) establishes a DOE system for identification, categorization, notification, analysis, reporting, follow-up, and close-out of occurrences. DOE notifies appropriate agencies based on the nature of each occurrence.

The *ES&H Manual* chapter on occurrence reporting was recently updated to improve guidance for determining what constitutes an occurrence and the proper reporting procedures (SNL 1999c).

Occurrence Categories

There are three types of environmental occurrences, each of which is determined by the severity of the event. An occurrence can also be incurred as the result of an audit finding or other break in permit compliance and/or official agreement. The following defines the three types of environmental occurrences tracked by SNL/NM.

- ***"Emergency Occurrence"*** – Any actual or potential release of material that would put communities or wildlife in great harm. The Emergency and Environmental Management Department stages routine mock emergencies to test the Incident Command System (ICS) and SNL/NM's ability to respond and coordinate with other agencies in the event of an actual emergency. There are three levels within this category that are dependent on the potential offsite impact. A "General Emergency" would be the most severe level. All releases in this category would be reportable to outside State or Federal agencies and DOE immediately after the occurrence has been categorized. SNL/NM has never had an "Emergency Occurrence" at any level.

TABLE 2-5. Summary of Environmental Occurrences Over the Past Five Years

Year	Number of Waste Management-Related Releases	Number of Water Quality-Related Releases	Number of Air Quality-Related Releases	Total Reportable Releases to the Environment
1998	4	0	0	4
1997	7 (6)	5 (3)	1	13 (10)
1996	0	3	0	3
1995	2	2	2	6
1994	4	7	0	11

NOTE: The number in parentheses for 1997 represents the incidences for which an occurrence report was prepared.

- **"Unusual Occurrence"** – Includes CERCLA reportable quantity (RQ) releases and other more significant events based on quantities released or damage incurred. All releases in this category are reported to outside State or Federal agencies and DOE. DOE must be notified as soon as practical but within two hours of categorization.
- **"Off-Normal Occurrence"** – An unplanned release that adversely affects the environment but does not exceed Federal limits, involve personal injury, or result from the violation of safety and operational rules.

1998 Occurrences

The following list summarizes the four incidences in 1998 for which occurrence reports were prepared. All were classified as "off-normal occurrences."

1. **Hazardous Waste** – On January 5, 1998 SNL received a compliance order from NMED for seven violations of hazardous waste management regulations from an audit the year before (June 27-July 1, 1997). Violations included failure in identifying a hazardous waste, several improper labeling violations, inadequate containment, and failure to document the start accumulation date on a container.
2. **UST Found Unregistered** – On February 5, 1998, a Notice of Violation (NOV) was received from the NMED for failure to register a UST. During an inspection by the UST Bureau, a UST at Bldg. 983 was found to be unregistered and without the required UST monitoring equipment. The tank had been part of a chilled water system for the air conditioner to Bldg. 983. SNL responded to the notice by registering the tank and then closing it in place with filled grout. All UST requirements were met.
3. **Chemical Spill** – On January 26, 1998, a spill at the Microelectronic Development

Laboratory (MDL) released 350 lb of sodium hydroxide (NaOH) and water ("caustic soda," a 50 percent NaOH solution). The accident occurred when a forklift carrying four 55-gal drums hit a depression in the ground and lost the load. One drum was punctured on impact and spilled approximately half its contents; a second drum developed a small leak at the cap. The material was contained and the area was cleaned up. Notifications were made to State and local agencies.

4. **Old Contaminated Soil** – On June 12, 1998, during a construction project for a foundation, an area of contaminated soil was discovered. The excavation into a 21 ft hole unearthed dark, odorous soil apparently contaminated with oil. The find was reported. There was no significant impact to the environment as a result of the discovery.

2.6 SUMMARY OF REPORTING REQUIREMENTS

This section briefly describes the reporting requirements necessary for both non-routine and routine releases of pollutants or hazardous substances. Release information may be used to evaluate facility operation compliance, waste handling programs, and emergency response programs.

The following four release reporting documents are required by external organizations other than DOE.

- **Reportable Quantity (RQ) Accidental Release Reporting** – RQ release reporting is required by CERCLA and SARA Title III. CERCLA requires that any release to the environment (in any 24-hour period) of any pollutant or hazardous substance in a quantity greater than or equal to the RQ, must be reported immediately to the

National Response Center (NRC) (telephone number 800-424-8802). However, if the release is "Federally permitted" under CERCLA Section 101(10)H, it is exempted from CERCLA reporting. This reporting exemption also applies to any "Federally permitted" release under SARA Title III. In 1998, no release exceeding the RQ occurred at SNL/NM.

- **Radioactive Effluent Information System/Onsite Discharge Information System (EIS/ODIS) Annual Report** – SNL/NM is no longer required to submit this report per DOE Order 231.1 (DOE 1996e).
- **National Emission Standards for Hazardous Air Pollutants (NESHAP) Annual Report** – Subpart H of 40 CFR 61, NESHAP, "Radionuclide Releases from DOE Facilities Other than Radon," requires that an annual dose assessment report be submitted to the EPA, for all DOE facilities that produce radioactive emissions. DOE must submit the report to the EPA by June 30th following the reporting year. The report includes the calculated effective dose equivalent (EDE) in millirem per year (mrem/yr) for the maximally exposed individual (MEI). The annual NESHAP report also gives the population dose in person-rem/yr (SNL 1999d). Section 5.4 of this site environmental report presents results of the dose assessment to the public from SNL/NM operations in 1998.
- **Toxic Release Inventory (TRI) Report** – The Emergency Planning and Community Right-to-Know Act (EPCRA), Section 313, (40 CFR 372) requires that any facility with a Standard Industrial Code (SIC) 20 through 39, and which uses listed toxic chemicals over a threshold value must submit a TRI report. A TRI report is also required by EPCRA EO 12856, *Federal Agency Compliance with Right-to-Know Laws and Pollution Prevention Requirements*. The

threshold value, for chemical use in which a TRI report is required, would be for any listed chemical that is processed or manufactured in quantities greater than 25,000 lb, or otherwise used in quantities greater than 10,000 lb. At SNL, only one chemical—sulfuric acid—was purchased in quantities greater than 10,000 lb. However, only aerosol forms of this acid over 25,000 lb are subject to TRI reporting. SNL/NM has been filing TRI reports with DOE and the EPA since 1991. Due to a change in the regulations concerning the threshold for aerosol acids, SNL/NM has been below the reporting threshold limit, and, therefore, has not filed a TRI report since 1995.

Environmental Programs Information

Environmental monitoring began at SNL/NM in 1959 at which time the principal objective was to monitor radioactive effluents and determine any associated environmental impacts. Since then, environmental programs, along with other Environment, Safety and Health (ES&H) activities, have greatly expanded at SNL/NM. The Tiger Team investigations, initiated by DOE in 1990, provided further impetus to continue development and expansion of ES&H programs to meet DOE objectives.

Environmental program areas covered in this chapter include the Environmental Restoration (ER) Project, waste management programs, the Pollution Prevention (P2) Program, the Oil Storage and Spill Containment Program, and the National Environmental Policy Act (NEPA) Program. Environmental monitoring programs covered in subsequent chapters of this report include the Terrestrial Surveillance Program, air quality programs, water quality programs, and groundwater monitoring and protection programs (Chapters 4, 5, 6, and 7, respectively).

Environmental progress at SNL/NM is tracked through performance measures and indicators, including annual summaries such as this report. Trends in compliance status and/or other significant program results over the past five years are given where appropriate, and awards and commendations are highlighted, where available.

SNL/NM has established and implemented environmental management programs to meet or exceed the requirements of Federal, State, and local environmental regulations, Executive Orders (EOs), and DOE Orders. Besides

meeting basic regulatory compliance requirements, other environmental investigations are ongoing to verify that contamination is not accumulating in the ambient environment or to identify potential concerns where they exist.

SNL/NM's policy is to minimize risks to the public and the environment to "as low as reasonably achievable" (ALARA) levels. DOE Order 5400.1, *General Environmental Protection Program*, and DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, are the primary orders that drive SNL's environmental programs including those that are not externally regulated (DOE 1990, DOE 1993).

3.1 ENVIRONMENTAL RESTORATION (ER) PROJECT

The ER Project is a phased DOE project to identify, assess, and remediate contaminated DOE facilities from past spill, release, and disposal activities. The DOE Kirtland Area Office (DOE/KAO) has oversight over SNL/NM's ER sites. The ER Project is administered under four departments within the Geoscience and Environment Center.

ER work was initiated in 1990 to implement assessment and remediation of past release sites at SNL/NM, SNL/CA, the Kauai Test Facility (KTF), as well as any other locations under DOE/KAO's jurisdiction. ER remediation at SNL/NM is projected to be completed ahead of

most other installations in the DOE complex, by the end of 2003.

The ER Project received an outstanding programmatic performance in the DOE/SNL appraisal system in 1995, 1996, 1997, and 1998.

Regulatory Authority

All ER sites are regulated by the Resource Conservation and Recovery Act (RCRA) as applied to SNL/NM under the Hazardous and Solid Waste Amendments Act of 1984 (HSWA), and specified in Module IV of the RCRA Part B Operating Permit. The New Mexico Environment Department (NMED) implements RCRA regulations and issues all applicable permits. SNL/NM remains in compliance with permit conditions and is currently ahead of schedule for assessment and cleanup activities.

Solid Waste Management Units (SWMUs)

The HSWA Permit and RCRA regulations refer to ER sites as Solid Waste Management Units (SWMUs) (40 CFR 264.90 and 40 CFR 270.14d). RCRA defines a SWMU (including interim status sites) as any unit "from which hazardous constituents might migrate, irrespective of whether the units were intended for the management of solid and or hazardous waste."

SNL/NM ER Site Historical Status

The initial identification of ER sites at SNL/NM was completed in 1987. At that time, 117 sites were identified in the initial *Comprehensive Environmental Assessment and Response Program (CEARP) Phase I: Installation Assessment* (DOE 1987). This and other ER documents are listed in Table 3-1. By 1992, the year SNL/NM's ER Program was initiated, a total of 172 sites were identified. By the end of fiscal year 1992 (FY92), the number of identified sites reached 219. Between 1992 and 1998, a total of 500 individual sites, potential sites, or individual historical activities had been identified for investigation. These sites and activities were located both at SNL/NM and at other offsite areas where SNL performs work, such as the Tonopah Test Range (TTR) and the

Kauai Test Facility (KTF). As of 1998, all offsite locations had been investigated or transferred to other agencies, and what remains is only at SNL/NM and one site at SNL/CA. Many of these sites were proposed for No Further Action (NFA) based on insignificant contamination present or after remediation had already been accomplished. From 1993 to 1996, 152 sites at SNL/NM and offsite locations were investigated and proposed for NFA after assessment and/or remediation. Table 3-2 shows the ER Project status since 1992.

1998 Activities and Future Plans

During 1997, 16 sites were proposed for NFA. SNL/NM will continue to actively pursue the closure of remaining proposed NFA sites by working with the NMED to provide adequate and/or further verification, as necessary, for a successful determination.

ER remediation technologies have made great strides in recent years. Some of the methods being developed include advanced applications for electrokinetics, in-situ reduction/stabilization using innovative grouting materials and techniques, natural attenuation processes, next generation reactive barriers, and unexploded ordnance/landmine remediation.

Examples of ER Site Remedial Actions

During the 1950s depleted uranium (DU) was buried near the Tijeras Arroyo and left undisturbed for some 40 years. DU is commonly used to replace fissile material in nuclear components for environmental stress testing. Because DU is bright yellow, the bigger pieces were easily found and disposed of at the time of the tests. However, the residue DU was buried onsite and large concrete pads were poured over the area to stabilize the contamination in place. This was effective for containing the DU until 1997 when a large thunderstorm washed out a portion of a buried site along the arroyo, exposing DU contaminated soil.

FIGURE 3-1. Fran Nimick and Anh Lai Discuss the Cleanup of a Depleted Uranium (DU) Contaminated Site in the Tijeras Arroyo Flood Plain
The Thermo Nuclear rig, seen in the background, detects and separates "hot" soil from normal soil.

Figure 3-1 shows ER Project personnel at the site. The Thermo Nuclear rig will separate out the radioactive soil, reducing the contaminated soil volume to between 95 and 99 percent.

Other ER sites awaiting cleanup or under going current remediation are the Classified Waste Landfill (CIWL) in TA-II, various sites along

Tijeras Arroyo, the Canyons Test Areas, and groundwater contamination in Technical Areas I, II, III, and V. The Chemical Waste Landfill (CWL) is the most significant cleanup project to be addressed by the ER Project. Remediation at the CWL began in September 1998.

TABLE 3-1. Important Documents for the ER Project

Program Document	Reference
<i>Program Implementation Plan for Albuquerque Potential Release Sites</i>	SNL 1995a
<i>Environmental Restoration (ER) Site Atlas</i>	SNL 1996b
<i>The Chemical Waste Landfill Final Closure Plan and Postclosure Permit Application</i> (including "Sampling and Analysis Plan for Groundwater Assessment Monitoring at the Chemical Waste Landfill")	SNL 1992
<i>Comprehensive Environmental Assessment and Response Program (CEARP) Phase I: Installation Assessment</i>	DOE 1987
<i>Environmental Assessment of the ER Project at SNL/NM</i>	DOE 1996a
<i>Workbook: Future Use Management Area 1</i>	DOE 1995a
<i>Workbook: Future Use Management Area 2</i>	DOE 1995b
<i>Workbook: Future Use Management Area 3, 4, 5, and 6</i>	DOE 1996b
<i>Workbook: Future Use Management Area 7</i>	DOE 1996c

TABLE 3-2. Summary of ER Project Status Since the Program's Inception in 1992

Year	Total ER Sites at Start of FY*	ER Sites Proposed for NFA in FY*	Sites Approved for NFA in FY*	Corrective Actions Completed by End of FY*	New ER Sites Identified During FY*	Total ER Sites at End of FY*
1998	146	16	0	0	0	146
1997	153	30	7	4	0	146
1996	155	35	2	29	0	153
1995	191	61	36	34	0	155
1994	219	48	28	3	0	191
1993	219	0	0	0	0	219
1992	172	0	0	0	47	219

NOTE: *FY = October 1 to September 30
NFA = No Further Action

3.2 WASTE MANAGEMENT PROGRAMS

Waste management at SNL/NM is conducted under two departments: the Solid and Hazardous Waste and P2 Department and the Radioactive and Mixed Waste Department. In addition to site-generated waste, waste and recycled materials may be received from offsite sources including SNL/CA, LANL, other DOE sites, and KAFB. Waste handled at SNL/NM falls into four primary categories:

- Sanitary solid waste
- Hazardous waste (RCRA and other chemical waste)
- Low-level radioactive waste (LLW)
- Mixed waste (MW) (radioactive and hazardous constituents)
- Transuranic (TRU) and TRU/MW

Depending on the waste category, waste management may include characterization, treatment, recycling, packaging, storing, and transportation to offsite disposal facilities. The layout and operations at each of SNL/NM's three waste handling facilities is briefly described below:

FIGURE 3-2. The Hazardous Waste Management Facility
The larger building left of center is the Waste Storage Building.

- **Hazardous Waste Management Facility (HWMF)** – The HWMF receives, segregates, packages, stores, and ships waste to offsite recycling, treatment, or disposal facilities (Figure 3-2). All hazardous waste produced at SNL/NM is brought from the generator sites to the HWMF for handling. The facility has two primary buildings: the Waste Packaging Building and the Waste Storage Building.

All hazardous waste categories are recycled where possible. Waste is also stored in transportainers and covered areas. As shown in the upper left corner of the photo, the HWMF has a catchment pond to collect storm water runoff.

- **Radioactive and Mixed Waste Management Facility (RMWMF)** – Located in the southeast corner of TA-III, the RMWMF is within an enclosed compound with an administration trailer just outside the main gate. The primary waste handling building at the RMWMF is equipped with a main control room for monitoring activities and controlling air flow throughout the facility. Handling bays, sorting rooms, and various waste storage areas operate under negative air flow to ensure that all emissions are channeled through the facility's stack. The RMWMF's radionuclide emissions are regulated under National Emission Standards for Hazardous Air Pollutants (NESHAP). The Waste Assay Facility Building is currently set up for laboratory and waste treatment activities. Incoming waste is staged in Bldg. 6925. Bldg. 6926 is used to stage waste that is ready for offsite shipment and disposal. The RMWMF handles low-level radioactive waste (LLW), mixed waste (MW), transuranic (TRU) waste, and TRU/MW.
- **Solid Waste Transfer Facility (SWTF)** – The SWTF handles non-hazardous sanitary solid waste consisting primarily of office trash and recyclable paper and cardboard. It does not handle food service garbage, construction debris, liquids, pressurized cans, light bulbs, and any waste with hazardous characteristics. The purpose of this facility is to screen all solid waste streams to ensure compliance with solid waste regulations and to increase the quantity of materials being recycled. The primary waste handling building houses a multi-story industrial compactor/baler. Bales of compacted trash and recycled

material are produced weighing up to 1 ton each. The disposal process at the facility begins with initial waste screening; all waste or recyclable material is dumped directly onto the bay floor for inspection and sorting (screening). After segregation, a front-end loader pushes the material onto the baler's conveyer belt and the material is compressed into bales approximately 6 x 4 x 4 ft.

SNL/NM's individual waste management programs are described in the following sections. Documents relevant to waste management programs are listed at the end of Section 3.3 in Table 3-11.

3.2.1 Hazardous Waste Management

Regulations

SNL/NM is classified as a large-quantity generator with respect to RCRA-hazardous waste. The HWMF operates under SNL/NM's RCRA Part B Operating Permit but handles various hazardous waste regulated under other statutes. This facility also complies with the provisions of the Toxic Substances Control Act (TSCA) for asbestos waste (40 CFR 763) and PCB waste (40 CFR 761). Used oil is recycled in accordance with 40 CFR 279. The State of New Mexico regulates infectious waste under 20 NMAC 9.1.

Cradle to Grave Tracking

Hazardous waste is tracked from the point of generation to final disposal through meticulous documentation at each waste-handling step. Each generator at SNL/NM initiates the "cradle to grave" tracking process by filling out a Disposal Request Form describing the quantity and type of waste requested for pickup. Generators characterize their own waste by either process knowledge or, if necessary, sampling and analysis. Each individual hazardous waste item is labeled with a bar code for tracking at the generator site before pickup.

An individually coded waste item typically is a bottle, plastic bag, or other small item that contains toxic materials. The Disposal Request Form is sent to the HWMF for evaluation where it is assigned a U.S. Department of Transportation (DOT) hazard class and RCRA code, if applicable.

Once the waste is received at the HWMF it is unpacked for verification. Waste is sorted by DOT hazard class and placed in temporary containment bays by DOT class. Each bay is isolated to ensure segregation of incompatible waste types. All bays are equipped to contain any accidental spill. Shelving is also designed to absorb shaking from low-level seismic activity.

When enough individual items have been accumulated within a DOT class, the bar coded items are packaged for shipment into 5- to 55-gal containers. Each container is also bar coded and moved to storage areas until it is shipped to an offsite treatment, recycling, or disposal facility. In this way, every waste item's location can be tracked from "cradle to grave." In 1998, 21,513 items were collected at the facility and a total of 2,898 waste containers were shipped for disposal.

Hazardous Waste Recycling

In 1998, the HWMF received and redistributed 11,767 kg of lead to be reprocessed through the lead bank. The lead is recast and used for other applications at SNL/NM. A total of 14,156 kg of RCRA hazardous material and 80,700 gal of used oil was recycled. "Other Recycled" categories (34,109 kg) included PCB capacitors, cadmium compounds, various oils, nickel and silver oxide batteries, mercury, and halogen, fluorescent, and sodium lamps/bulbs.

The HWMF prepares weekly, monthly, and annual reports. Shipment schedules of hazardous waste, waste carriers, waste disposal facilities, and material recycling facilities are documented in the *Hazardous Waste Management Facility (HWMF) Annual Report*

and the *Biennial Hazardous Waste Disposal Report*. Both reports are submitted to NMED.

Table 3-3 presents a 5-year summary of waste handling activities at the HWMF. Table 3-4 details the waste categories received at the HWMF in 1998.

Hazardous Waste Onsite Treatment

SNL treats some of its hazardous waste onsite at: (1) the Thermal Treatment Facility (TTF), (2) several generator sites that conduct elementary neutralization, and (3) the RMWMF, which has started treatment of some mixed waste (MW).

Thermal Treatment Facility (TTF)

The TTF is a small active component of the original Light Initiated High Explosives (LIHE) Facility. Small amounts of explosive wastes, generated from research and development experiments, are thermally deactivated. In 1998, 2.1 kg of residual explosive wastes were treated at the TTF. This represents only a small fraction of the explosive waste generated at SNL/NM; another 303.3 kg of explosive waste was treated at the KAFB Explosive Ordnance Disposal (EOD) site, 8.9 kg at Safety Kleen in Louisiana, and 6,356 kg at Thiokol, Utah.

3.2.2 Radioactive Waste Management

Regulations

Radioactive waste management is conducted in accordance with the following drivers:

- DOE Order 5820.2a, *Radioactive Waste Management* (DOE 1988)
- DOE Order 5400.5 *Radiation Protection of the Public and the Environment* (DOE 1993)
- 40 CFR 260-82, RCRA, as it concerns the hazardous component in MW

TABLE 3-3. Five-Year Summary of Waste Handling at the HWMF

Year	ER Wastes (Soils etc.) (kg)	Routinely Recycled* (kg)	Non-Routinely Recycled (kg)	RCRA Non-ER (kg)	Other Hazardous (kg)	Total Waste & Recyclables (kg)
1998	19,572	17,040	124,865	59,290	78,576	299,343
1997	344,334	15,227	73,121	50,153	231,011	713,846
1996	5,517	14,082	81,027	51,549	181,405	333,580
1995	303,966	46,806	67,484	91,876	287,729	797,861
1994	541,090	18,220	24,794	102,545	140,408	827,057

NOTE: *Routinely recycled materials include nickel-cadmium batteries and lead acid batteries.

RCRA = Resource Conservation and Recovery Act

ER = Environmental Restoration

TABLE 3-4. Breakdown of Hazardous Waste Handled by the HWMF in 1998.

1997 figures are shown for comparison.

Waste Categories Handled at the HWMF	1997 Waste Shipped (kg)	1998 Waste Shipped (kg)
Resource Conservation and Recovery Act (RCRA) Waste (except ER)		
• RCRA Regulated Waste	49,564	59,290
• RCRA Recycled Waste (nickel-cadmium batteries, silver compounds, mercury compounds, silver oxide batteries, mercury batteries, lamps, and capacitors)	589	14,156
Total RCRA Waste**	50,153	73,446
Environmental Restoration (ER) Waste		
• RCRA**	343,290	11,293
• Non-RCRA	1,044	8,279
Total ER Waste	344,334	19,572
Toxic Substances Control Act (TSCA) Waste		
• Asbestos	155,951	31,523
• Polychlorinated Biphenyl (PCB)	13,560	968
• PCB Recycled Waste	15,031	1,173
Total TSCA Waste	184,542	33,664
Biohazardous Waste		
Infectious Waste	2,355	2,574
Total Biohazardous Waste		
"Other" Waste		
• Chemical Waste	16,398	37,212
• Non-hazardous Solid Waste (RCRA Subtitle D) *	4,728	6,299
• Recycled Oil	36,242	80,700
• Recycled Lead	16,647	11,767
• Recycled (Other) – (Routine) lead acid batteries, fluorescent lamps, other oil, batteries (nickel metal hydride), and non-PCB (ballasts, capacitors, and oils)	58,447	34,109
Total "Other" Waste	132,462	170,087
Total Waste Handled	713,846	299,343

NOTE: *Non-hazardous waste that does not meet waste acceptance criteria at the Solid Waste Transfer Facility (SWTF).

**The HWMF shipped a total of 84,739 kg of RCRA waste and RCRA recyclables from all sources including ER.

- 10 CFR 61 (Disposal Requirements)
- 10 CFR 835, "Occupational Radiation Protection" (Price Anderson Act)
- DOT 49 CFR 100-199 (Department of Transportation requirements)
- NESHAP, regulates emissions from radioactive waste handling operations

1998 Activities

In 1998, the Radioactive and Mixed Waste Management Facility (RMWMF) handled LLW, MW, TRU, and TRU/MW. LLW was shipped to either Envirocare™ in Utah or the Nevada Test Site (NTS). MW was shipped to the Waste Experimental Reduction Facility (WERF) at INEEL and to Permafix/DSSI in Florida. Four containers of generic radioactive waste was received from SNL/CA in 1998.

Although SNL operates nuclear reactors, it has yet to produce any spent fuel (the original fuel rods are still viable). Further more, because SNL is not a power-producing utility, any spent fuel that would eventually be removed from the research reactors will not be classified as HLW.

There was a significant increase in ER waste in 1998. Most was the result of cleanup activities at the Classified Waste Landfill (CIWL). Also a large increase was produced due to the conversion of the Annular Core Research Reactor (ACRR) and the Hot Cell to accommodate the Medical Isotope Production Project (MIPP). The MIPP will produce the medical radioisotope, molybdenem-99. Due to these waste increases, activity at the RMWMF was accelerated. In 1998, the RMWMF exceeded shipment goals by 558 percent for LLW and 133 percent for MW.

Table 3-5 presents a 5-year summary of waste handling activities at the RMWMF.

Radioactive Waste Storage

Presently, all newly generated radioactive waste is temporarily stored at three onsite locations: at the RMWMF, at TA-V in Bldg. 6596, and at the

Manzano Bunkers. Most TRU waste is stored at the bunkers. Eventually, TRU waste will be routed through LANL for final disposal at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico. WIPP received its first shipment of TRU waste from LANL in March 1998. The Interim Storage Site (ISS) in TA-III is no longer used for waste storage and will be taken off the permit.

Waste Descriptions

LLW – The bulk volume of the LLW handled at the RMWMF in 1998 consisted of contaminated soils excavated from ER sites. Other wastes sources came from demolition and decontamination (D&D) projects, personal protective equipment (PPE), and lab waste. The primary radioisotope inventory contained in LLW waste handled at the RMWMF in 1998 included tritium, mixed fusion products, and isotopes of strontium, plutonium, cobalt, americium, cesium, thorium, and uranium. (Plutonium and americium in LLW is below the activity level designated for TRU waste.)

MW – Most MW is comprised of the same material as LLW, except that it is also contaminated with hazardous RCRA-regulated chemical contaminants.

TRU and TRU/MW – The Hot Cell conversion resulted in a large increase in generated TRU waste (22,089 kg) as shown in Table 3-5.

Sorting at the RMWMF

Sorting is performed on all waste that is not already characterized. Some waste may bypass handling at the RMWMF, if it is known and sealed. Such waste is accepted directly into storage and later shipped offsite. Sorting of waste continued to be modified in 1998. Sorting levels for radioactive waste handled at SNL are as follows:

- **Level 1** – Radioactive waste that has already been characterized and is in a sealed container. Level D PPE (coveralls and work gloves) is all that is required for handling.

- **Level 2** – This waste has very low radiation and/or chemical hazards associated with it and can be handled by using proper ventilation controls in the work area in addition to Level D PPE. Waste may be physically segregated such as removing known hazardous chemical components that would otherwise classify the waste as MW.
- **Level 3** – Higher hazards associated with this waste require workers to wear fully contained suits and respiratory protection.
- **Level 4** – This is the highest waste hazard level handled. All waste is contacted through a glove box with full containment PPE. Any waste that has not been previously characterized, such as legacy waste, must be assessed at this level.

3.2.3 Mixed Waste (MW) Management

MW Inventory Description

The majority of MW now being stored onsite consists of very low-level radioactive sludges from septic tank system close-outs, organic debris (mostly PPE), paper and plastic contaminated with radionuclides and solvents, and radioactive metallic objects with RCRA metals. In 1998, a new type of MW category was added to account for mixed transuranic waste (TRU/MW).

TABLE 3-5. Five-Year Summary of Radioactive Waste Managed at SNL/NM

Mass values in this table can be very misleading since a 2,000 lb container may contain only 40 lb of waste.

Year	Managed				Shipped	
	LLW	MW	TRU	TRU/MW	LLW	MW
1998	861,590 kg	10,143 kg	22,089 kg	44.5 kg	749,487 kg	5,518 kg
	41,454 ft ³	436 ft ³	625 ft ³	7 ft ³	30,066 ft ³	1,137 ft ³
1997	332,731 kg	8.04 m ³	0.45 kg	--	322,736 kg	0
	12,582 ft ³	284 ft ³	0.12 ft ³		10,520 ft ³	
1996	511,298 kg	138 m ³	390 kg	--	469,165 kg	267 kg
	22,730 ft ³	4,880 ft ³	155 ft ³		14,510 ft ³	7 ft ³
1995	12,431 kg	19.3 m ³	3,789 kg [‡]	--	3,327 kg	0
	1,924 ft ³	682 ft ³	170 ft ³		688 ft ³	
1994	not avail	1.67 m ³	0	--	0	--
	1886 ft ³	59 ft ³				560 ft ³

NOTE: LLW = Low-level radioactive waste MW = Mixed waste TRU = Transuranic waste
[‡] = In 1995, all TRU waste originated from the Inhalation Toxicology Research Institute (ITRI).

The radioactive component in SNL/NM's current MW inventory results primarily from tritium, and isotopes of cesium, strontium, plutonium, americium, and uranium. The hazardous component results primarily from solvents, heavy metals, and toxic or corrosive chemicals.

Information on MW management at SNL is given in SNL's *Site Treatment Plan for MW FY98 Update* (SNL 1999e). Table 3-6 lists the current MW categories and the currently preferred treatment options.

MW Part A and B Permit Status

SNL is in compliance with the Federal Facility Compliance Act (FFCA), which allows for storage of MW onsite past the usual one year time frame set by RCRA. SNL/NM continues to operate under Interim RCRA status with regard to MW management. The Part A and B RCRA Permit application currently allows MW to be managed at the following facilities:

- Manzano Bunkers,
- RMWMF
- High Bay Storage Facility (Bldg. 6586),
in TA-V

The Interim Storage Site (ISS) is still listed on the permit, although a closure plan for this location is in progress. New MW is stored at the RMWMF.

Mixed Waste Treatment

SNL/NM continues to pursue several options for treating MW: onsite treatment, commercial offsite treatment, and treatment at DOE incinerators.

Treatment of MW began at SNL/NM in 1997. In 1998, SNL/NM made shipments of MW totaling 19.6 m³. The waste was shipped for incineration. The first shipment was made in February (18.5 m³) and the second one in September (1.1 m³). Other MW was removed

from SNL's inventory in 1998 through onsite treatment or re-characterization.

Onsite treatment is performed at the RMWMF in Bldgs. 6920 and 6921. Deactivation, neutralization, and stabilization/solidification are the three most important treatments being used at this time. The other primary treatments are macroencapsulation, and mechanical processing (physical sorting and separation). Macroencapsulation, although not done in 1998, was demonstrated on some high-activity reactor material. Due to the classified materials being handled, this process needs to be performed onsite. Macroencapsulation at a commercial site may be used in 1999 for non-classified waste.

SNL's MW inventory can change based on three ways that MW may be removed from the inventory:

- (1) MW is shipped offsite for treatment and/or disposal.
- (2) MW may be treated onsite.
- (3) MW is re-characterized and proven to not be MW at all—(it may be only radioactive or only hazardous waste).

Treatment Technologies

There are 11 onsite treatment processes described in the current Part B RCRA permit application. The first five on the list are the treatments that have been used onsite:

- **Deactivation**
- **Solidification/Stabilization**
- **Macroencapsulation**
- **Mechanical Processing**
- **pH Neutralization**
- Amalgamation
- Chemical Oxidation
- Flocculation/Centrifugation
- Packed Bed Reactor/ Silent Discharge Plasma (PBR/SDP) (*not funded by DOE*)
- Reverse Osmosis
- Thermal Desorption (*not funded by DOE*)

Management for Newly Generated MW

Currently, MW generators are required to complete a request form describing the proposed waste characteristics before generating MW. This practice ensures that waste can be properly characterized and sorted into the correct treatability groups. Process knowledge and direct sampling, as needed, is used to characterize the waste. By the summer of 1997, newly-generated waste was being sorted into treatability groups upon arrival at the RMWMF.

SNL/NM's Compliance History for MW

SNL/NM's history leading up to the treatment and shipment of MW is described below.

1. MW became an issue after amendments to RCRA and HSWA in 1984 enforced LDRs. MW inventory continued to accumulate onsite due to the national lack of treatment capacity needed to meet the LDRs.
2. In August 1990, SNL/NM submitted a RCRA Part A Interim Status Permit application for MW storage. Later revisions to the permit made various corrections and added new proposed MW treatment processes.
3. On October 6, 1992, the FFCAct was passed requiring DOE to submit a site treatment plan for MW. The FFCAct made allowance for the storage of MW over the one-year maximum, acknowledging the nation-wide lack of treatment capacity. Although noncompliance with RCRA continued to be an issue, DOE and SNL/NM remained in compliance with the FFCAct while treatment technologies were developed. The FFCAct was implemented by the NMED (20 NMAC 4.1) under the New Mexico Hazardous Waste Act.
4. On December 30, 1992, the EPA issued a Notification of Noncompliance (NON) for storage of RCRA-regulated waste (MW) over the one-year maximum period.
5. In October 1993, DOE submitted to NMED a *Conceptual Site Treatment Plan for Mixed Waste* (SNL1993); other drafts followed.
6. On March 31, 1995, DOE submitted its final *Site Treatment Plan for Mixed Waste* to NMED for SNL/NM waste (SNL 1995b).
7. In June 1995, the Historical Disposal Requests Validation (HDRV) Project was initiated to characterize legacy MW and to sort it into treatability groups. Some MW generated through September 30, 1995 was sorted.
8. On October 6, 1995, the NMED issued a Compliance Order enforcing SNL/NM's Site Treatment Plan (SNL 1995b).
9. In September 1996, the first MW shipment was made to Perma-Fix/DSSI.
10. In November 1996, SNL re-submitted the Part A and B permit application, to reflect revisions to its proposed treatment methods (Amendment 3). This remains the current permit application in effect.
11. In 1997, characterization related to the HDRV Project continued. Some waste was staged and ready for shipment by the end of the year. At that time, the HDRV effort was discontinued and replaced with new sorting procedures.
12. In December 1997, onsite treatment of MW began at the RMWMF in Bldg. 6920. Additionally, Bldg. 6921 was converted to a laboratory for the treatment of certain types of MW. Procedures for the treatment of TG5, TG13, and TG15 were prepared and approved.

TABLE 3-6. Mixed Waste Treatment Categories and the Current Preferred Treatment Options
Volumes are current through September 30, 1998.

Category	Estimated FY98 Volume	Constituents	Preferred Treatment
TG-1	0 m ³	Inorganic Debris with Explosive Component (e.g., neutron generator disassembly)	Deactivation
TG-2	0.03 m ³	Inorganic Debris with Water Reactive Component	Deactivation
TG-3	0.02 m ³	Reactive Metals	Deactivation
TG-4	0.14 m ³	Elemental Lead (some onsite treatment by SNL)	Macroencapsulation
TG-5	0.01 m ³	Aqueous Liquids (corrosive)	Neutralization Followed by Stabilization
TG-6	0 ml	Elemental Mercury	Amalgamation
TG-7	0.1 m ³	Organic Liquids I	Incineration
TG-8	17.5 m ³	Organic Debris with Organic Contaminants	Thermal Desorption
TG-9	28.1 m ³	Inorganic Debris with TCLP Metals	Macroencapsulation
TG-10	4.0 m ³	Heterogeneous Debris	Sorting Followed by Reclassification
TG-11	3.6 m ³	Organic Liquids II	Hydrothermal Processing
TG-12	2.0 m ³	Organic Debris with TCLP Metals	Macroencapsulation
TG-13	0.1 m ³	Oxidizers	Deactivation Followed by Stabilization
TG-14	0 m ³	Aqueous Liquids with Organic Contaminants	Evaporative Oxidation
TG-15	11.9 m ³	Soils <50% Debris and Particulates with TCLP Metals	Stabilization
TG-16	0 m ³	Cyanide Waste	Oxidation
TG-17	41.5 m ³	Liquid/Solid with Organic and/or Metal Contaminants	Incineration Followed by Stabilization
TG-18	0.22 m ³	Particulates with Organic Contaminants	Incineration
TRU/MW	0.0034 m ³	Transuranic Contaminants with Hazardous Components	To Be Determined (treatment technology in development)

NOTE: Treatments are detailed in the *Mixed Waste Site Treatment Plan, Compliance Plan Volume Background Volume* (SNL 1998b) and the *Site Treatment Plan for MW FY98 Update* (SNL 1999e).
TCLP = toxicity characteristic leaching procedure

13. In January 1998, the *Mixed Waste Site Treatment Plan, Compliance Plan Volume Background Volume* was updated to include the current treatment technologies and proposed schedules (SNL 1998b). The new plan also detailed storage areas, construction of treatment facilities, and transportation options to offsite disposal or treatment facilities. Each year the Site Treatment Plan is updated as required by the Compliance Order (SNL 1999e).
14. In February 1998, 18.5 cubic meters (m³) of waste was shipped to the Idaho National Engineering and Environmental Laboratories (INEEL) for incineration at their Waste Experimental Reduction Facility (WERF).
15. In September 1998, SNL/NM shipped 1.1 m³ MW for commercially available treatment at Perma-Fix/DSSI (incineration).

3.2.4 Solid Waste Management

Drivers

SNL/NM's sanitary solid waste is regulated under RCRA "Subtitle D" and New Mexico's Solid Waste Management Regulations. The State driver is 20 NMAC 9.1 and is administered by the New Mexico Solid Waste Bureau. Additionally, Executive Order (EO) 12780, *Federal Agency Recycling*, mandates the level of recycling expected from government agencies.

SWTF Activities

The Solid Waste Transfer Facility (SWTF) screens, bales, stores, and ships solid waste and recyclables generated from SNL/NM as well as recyclables from other agencies. All solid waste that is accepted at this facility must be non-hazardous. Any waste with hazardous characteristics received by the SWTF is re-manifested to the HWMF for handling. The SWTF does not accept food service garbage or

construction debris; this waste is collected and transported directly to landfills. Currently, solid waste that is processed at the SWTF is disposed at the Rio Rancho Industrial Landfill.

Paper and Cardboard Recycling

The SWTF is the center for recycling paper and cardboard generated from SNL/NM and other cooperating outside agencies. Paper and cardboard are accepted from LANL, KAFB, and DOE field offices. Recycled material contributed from KAFB increased about 87 percent from 1997 figures, when they first joined SNL's recycling program.

Currently, only recyclable paper and cardboard are source segregated. Large piles of paper or cardboard are spread onto the floor and hand sorted as best as practical into quality levels. Paper is sorted by "White," "Office," and "Mixed" paper categories. "White" paper is the highest quality and contains less than one percent non-white paper in the bales. "Office" paper may contain up to 30 percent mixed paper, and "Mixed" paper contains mostly colored paper, newspaper, and magazines. The recycled paper and cardboard bales are sold to recycling companies. Profits are split among the cooperating agencies.

Table 3-7 presents a summary of solid waste management in 1998. Table 3-8 details the amounts of recycled materials from all cooperating agencies in 1998.

NMED Audit

The NMED conducted an audit of SNL's waste facilities in 1998. There were no compliance issues found at the SWTF.

The SWTF works closely with Pollution Prevention (P2) and Waste Minimization Program staff to implement existing and new recycling activities. In 1998, the SWTF received two awards for its waste minimization efforts:

- DOE National Award for Pollution Prevention
- SNL's President's Quality Award, Silver

3.2.5 The Asbestos Program

Asbestos is regulated under the Toxic Substances Control Act (TSCA) and implemented by 40 CFR 763. Asbestos is also regulated as a hazardous air pollutant under NESHAP 40 CFR 61, Subpart M, and under New Mexico Solid Waste Management Regulations found in 20 NMAC 9.1.

At SNL/NM, the abatement of asbestos-containing equipment and building materials is ongoing. However, asbestos removal is only performed if the material presents an inhalation hazard, or if the building is to be torn down or renovated. Typical building materials containing asbestos include floor, ceiling, and roofing tiles, certain types of insulation, and other fire retardant construction materials. Similarly, in instances where laboratory equipment has asbestos-containing material in a non-friable form and there is no risk of particle inhalation, the item is allowed to remain in service or is redistributed through the property reapplication program. Typical asbestos waste generated from equipment abatement consists of gloves, fume hoods, cable insulation, and ovens.

The Facilities Department is responsible for the removal and waste packaging of asbestos waste generated from the demolition of old buildings. All other asbestos waste is managed by the Solid and Hazardous Waste Department and is handled and stored at the HWMF until shipment. Larger asbestos-contaminated items may be stored at the maintenance yard located across from the HWMF. In general, asbestos waste is shipped offsite within a few days or weeks of being received. The waste is disposed at a New Mexico landfill permitted to accept friable asbestos waste.

TABLE 3-7. SWTF Activity Summary for 1998
"Total Solid Waste" and "Total Recyclables" are two separate figures.

Category	Weight lb (kg)	Volume (yd ³)	Bales (each)
Total Solid Waste	2,926,030 lb (1,330,013 kg)	3,332.5	1,747
Recyclables			
White Paper	755,112 lb (343,233 kg)	965.2	508
Office Paper	322,218 lb (146,463 kg)	410.4	216
Mixed Paper	84,182 lb (38,265 kg)	93.10	49
Cardboard	416,428 lb (189,285 kg)	606.1	319
Phone Books	24,160 lb (10,982 kg)	40	N/A
Total Recyclables	1,602,100 lb (728,227 kg)	2,114.8	1,092

NOTE: The SWTF reports weight in pounds.
 Conversions have been made to kilograms.
 N/A = not available

TABLE 3-8. Detailed Breakdown of Recyclable Materials Received from All Agencies in 1998

Location	Weight (lb)	Weight (kg)	Bales (each)
White Paper (up to 1% non-white)			
SNL	323,620	147,100	216
DOE	17,850	8,113	12
LANL	208,518	94,781	139
KAFB	205,124	93,238	141
Office Paper (up to 30% non-white)			
KAFB	11,132	5,060	8
LANL	311,086	141,403	208
Mixed Paper (mostly newspaper/ magazines)			
SNL	41,014	18,643	21
KAFB	5,668	2,576	4
LANL	37,500	17,045	24
Cardboard			
SNL	271,338	123,335	210
LANL	1,024	465	1
KAFB	144,066	65,485	108
Total	1,561,140	568,205	1,080

NOTE: Total recyclable material from SNL = 635,972 lb
 All other = 925,168 lb
 SNL's contribution was 40% of the total.

In 1998, 31,523 kg of asbestos waste was shipped for disposal. This was 124,428 kg less than was shipped in 1997.

3.2.6 The Polychlorinated Biphenyls (PCB) Program

PCBs are regulated under TSCA and implemented by 40 CFR 761. PCBs are defined as any material having a PCB concentration equal to or greater than 500 ppm. "PCB-contaminated" materials are those items with a PCB concentration greater than or equal to 50 ppm but less than 500 ppm. (Therefore, by regulatory definition, any item with less than 50 ppm is a "Non-PCB.")

SNL/NM's PCB Program is progressing to reduce the level of PCB and PCB-contaminated equipment to the greatest extent possible. Items affected by the program are primarily transformers, capacitors, switches, and fluorescent light ballasts. (Light ballast represent the largest single source of PCB waste and are recycled to the extent possible.) Other substances that may be PCB-contaminated include dielectric fluids, contaminated solvents, hydraulic oils, waste oils, heat transfer liquids, lubricants, paints, and casting wax. Items that are suspected to contain PCBs but remain sealed (and would otherwise need to be destructively tested) are allowed to remain in service.

The SNL/NM PCB Program produces an annual report by July 1st of the following reporting year detailing its activities, as required by TSCA. Program information is described in the PCB Program (PG) document (SNL 1995c).

1998 Activities

One PCB-contaminated transformer remains in service at SNL. SNL's power system upgrade has resulted in the replacement of older PCB-containing equipment with non-PCB equipment. There is no equipment left at SNL that "needs"

to be removed as required by regulation. All remaining equipment will be removed as time and resources permit.

Like other TSCA waste, PCB waste is handled by the HWMF and stored within the adjoining fenced compound. In 1998, 1,173 kg of PCB waste was shipped offsite. (This was 12,393 kg less than was shipped in 1997.) A total of 968 kg of recyclable PCB was shipped in 1998.

PCB Stain Removal

In 1998, the PCB Program continued to focus its attentions on cleaning up existing PCB spill contamination. A new program activity to remove PCB oil stains from concrete was initiated in 1997 and continued in 1998. PCB contamination is very difficult to remove from porous concrete since normal surface cleaning only brings up more PCBs from deeper layers within the material. Thus far, the decontamination trials have had limited success. New methods will continue to be tested.

3.3 WASTE MINIMIZATION AND POLLUTION PREVENTION (P2) PROGRAMS

3.3.1 P2 Program Scope

The P2 Program has been developed to infuse pollution prevention practices into SNL/NM's corporate culture. The P2 program encourages and creates practices that:

- Reduce or eliminate waste sources
- Improve process efficiency
- Conserve energy, water, and resource use
- Recycle potential waste items
- Procure products with recycled content, wherever feasible

The P2 Program is concerned with all waste streams—solid, hazardous, and radioactive. Program drivers are listed in Table 3-9.

The P2 Program works in concert with waste generator liaisons, ES&H coordinators, and a team of P2 representatives to support SNL/NM's line organizations. When requested, the P2 team can provide background research on waste reduction technologies and products, perform cost-benefit analyses, and locate and obtain P2 funding for new waste reduction processes.

P2 Awards

In 1998, the P2 team received recognition in several areas:

- SNL President's Quality Silver Award for "Synergistic Relationships in Pollution Prevention"
- Solid Waste Transfer Facility, DOE Pollution Prevention Award, Recycling Category
- New Mexico Facility Managers Network Award for Water Conservation, Large Facility Category
- SNL Employee Recognition Award for Steam Plant Optimization Project to reduce air emissions

3.3.2 Generator Set-Aside Fee (GSAF) Program

The GSAF Program was created to provide a direct incentive for waste generating organizations to minimize their waste. The program is part of a DOE program to set aside funds for pollution prevention activities by collecting a small fee from waste generators. The fees collected are used to fund P2 activities at SNL/NM. In 1998, \$75,900 in GSAF funds

were designated to implement five P2 projects as described below:

- **Better Light Fixtures** – Old incandescent light fixtures were replaced in Bldg. 6570 with energy efficient fluorescent lighting. The upgrade will save 11,140 kilowatt hours per year, which translates to a reduction of 9.5 tons of air pollutants.
- **Personal Protective Equipment (PPE)** – Additional PPE, which can be laundered and reused up to 100 times, was purchased for operations at TA-V. This will eliminate about 11.6 m³ of low level waste (LLW) per year.
- **Biodegradable Oil** – A new form of soy-based hydraulic oil was purchased for use in SNL's Fleet Services vehicles. The oil will replace petroleum based hydraulic oil. The change will eliminate about 0.5 metric tons of hazardous waste per year.
- **Steam Plant Optimization** – A two phase approach to improve fuel efficiency and reduce emissions at the Steam Plant continued in 1998. Phase 1 involved reprogramming boiler control operations' Phase 2 involved tuning the system to optimize boiler operations, improving fuel efficiency, and evaluating other cost-effective solutions for additional emissions reductions. Optimization will reduce air emissions by about 3 tons per year.
- **New Evaporator** – A new evaporator was installed at the Nuclear Generator Facility (NGF) for evaporating tritiated wastewater. This will eliminate waste management activities associated with the handling of radioactive water.

TABLE 3-9. Drivers for Pollution Prevention and Waste Minimization Programs

Regulation	Title or Description	Regulator/Agency
RCRA Section 6002	Federal Procurement	EPA
EO 12856	<i>Federal Agency Compliance with Right-to-Know Laws and Pollution Prevention Requirements</i>	Executive Office
EO 12902	<i>Energy Efficiency and Water Conservation at Federal Facilities</i>	Executive Office
EO 12873	<i>Federal Acquisition, Recycling, and Waste Prevention</i>	Executive Office
42 USC 13102	Pollution Prevention Act of 1990	EPA

NOTE: RCRA = Resource Conservation and Recovery Act
EPA = Environmental Protection Agency

3.3.3 Pollution Prevention Opportunity Assessments (PPOAs)

PPOA's are based on discovering new ways to reduce waste through:

- Improving process efficiency,
- Substituting less toxic materials,
- Controlling chemical inventory,
- Improving preventive maintenance, and
- Cutting back on overall energy use.

In 1998, one PPOA was conducted at SNL's Machine shop. Assessment activities were performed for the SNL Machine Shop. The P2 made recommendations that a new recycling system be installed for the main machine shop's coolant and for grinding operations.

3.3.4 Return-on-Investment (ROI) Projects

ROI funding is available from DOE for proposed projects that can demonstrate a cost return within two years of initial installation of P2 equipment or processes. In 1998, DOE provided \$721,000 in funding for nine projects as described below:

- **Reactor Fuel Repackaging** – Approximately 41 55-gal drums of reactor core material were repackaged for shipment. This material was originally derived from the N.S. Savannah, the United States' first and only nuclear merchant ship launched in 1959. The nuclear assemblies have been in storage onsite since 1976. In September 1998, approximately 2.1 metric tons were sent to Framatome Cogema Fuels in Lynchburg, Virginia for reprocessing. The material consisted of low-enriched uranium-235.
- **Better Recycling** – Two new conveyor systems were purchased for paper recycling operations at the Solid Waste Transfer Facility (SWTF). This will allow better recovery of "White paper" which has a higher recycling value. Annual saving are estimated at \$55,707.
- **Better Building Lights** – Incandescent lighting was replaced by energy efficient fluorescent lighting in Bldgs. 821/822 and 857/891. The combined upgrades will result in a reduction of 348.3 metric tons of air pollutants per year.
- **Recycling Concrete** – A concrete crusher was leased from Coronado Salvage to support demolition and decontamination (D&D) conducted by the Environmental Restoration (ER) Project. In this way, concrete debris can be reused, eliminating

approximately 2,267 metric tons per year of solid waste.

- **Chiller System** – A new chiller system was designed and installed by P2 for laser operations in Bldg. 865. The cooling water will be routed from an existing cooling tower, thereby significantly reducing water use.
- **Flue Gas Re-circulation** – A flue gas re-circulation system for Boiler 5 and 6 at the Steam Plant was designed and installed to reduce NO_x emissions by 33 percent.
- **ER Solid Phase Method** – A new system to analyze volatile organic compounds (VOCs) in soils and waste will be tested. If proven effective, the system will replace the standard shaker method, which is costly and time consuming.
- **Lead Recycling** – An existing electrochemical and alumina process conducted by LANL will be used to decontaminate lead for reuse within SNL. Approximately 12 m³ of mixed waste (MW) and 33 metric tons of hazardous waste will be eliminated by this process.
- **More Lead Recycling** – Lead from the Lovelace Respiratory Research Institute (LRRRI) will be recycled using the LANL process described above. Approximately 1.4 metric tons of hazardous waste will be eliminated.

3.3.5 Recycling and Waste Minimization

SNL/NM continues to work toward an even better recycling program. Currently, SNL routinely recycles paper products, oil, metals, tires, construction materials, office products, and various other categories. Waste recycling is

implemented through the waste management groups.

Other recycling and waste minimization efforts at SNL/NM include the following:

- **Chemical Exchange Program** – SNL routinely recycles chemicals by reapplication internally and by recycling at various offsite facilities. In 1998, 30 lb of mercury with an estimated value of \$30,000 was shipped to the Ohio State Groundwater Research Laboratory for recycling.
- **Lead Bank** – Lead shielding and other lead materials are collected for reuse and recasting. In 1998, approximately 7,000 kg of lead was reapplied; 12,000 kg was sent offsite for recasting.
- **"Green" Landscaping Practices** – SNL/NM reduces water, pesticide, and herbicide use by landscaping with native drought-tolerant plants and gravel "lawns" (xeriscaping).
- **Affirmative Procurement** – SNL purchased items with recycled content where feasible and cost effective. In 1998, SNL purchased \$950,331 worth of products with recycled contents, including construction materials, vehicular products, landscape products, park and recreation products, paper products, and non-paper office products.
- **Interagency Recycling** – SNL cooperatively recycles paper products with DOE/AL, KAFB, and LANL. Profits are shared between the facilities.

TABLE. 3-10. Categories of Waste Recycled at SNL/NM in 1998

Recycled Categories	Weight (kg)
Stainless steel	8,800
Copper	9,440
Iron	281,630
Aluminum metal	26,200
Lead	11,770
Capacitors, PC boards	8,380
Packing foam	150
Engine oils	87,000
Toner cartridges	6,700
Batteries	24,000
Tires	3,120
Newsprint	21,150
Wood	159,500
Mercury items	220
PCB items	836
Chemical Exchange Prg.	50
Fluorescent light bulbs	26,300
Non-PCB light ballasts	7,410
Office paper	278,140
Cardboard	188,480
Phone books	9,730
Aluminum cans	1,460
Other chemicals	360
Other scrap metal	16,580
Total	1,177,406

- **Trip-Reduction Program** – To reduce air emissions, SNL/NM participates in the City of Albuquerque's programs for ride sharing, busing, or non-automotive commuting. All trip reduction activities at SNL/NM are voluntary.

3.4 SPILL PREVENTION PLANS FOR OIL AND CHEMICAL STORAGE AND USE

SNL/NM has developed plans to prevent the unplanned release of oil or toxic materials at all facilities that use or store these materials. These plans address prevention and control, and in the event of a release, reporting and cleanup procedures. Toxic chemicals, such as bases,

solvents, water-based chemicals, and oil, require spill containments in areas where chemicals are stored or used.

A spill is defined as any uncontained release of a hazardous material into the environment, including releases into a secondary containment unit. The terms spill, release, and leak are synonymous when appropriate (e.g., radioactive material release, gas leak, etc.) At SNL/NM, a "large spill" is considered any hazardous release over 1 pound solid or 1 pint of liquid.

A hazardous material is any chemical defined as such in:

- 29 CFR 1910.1200, "Occupational Safety and Health Standards"
- 40 CFR 302, "Designations, Reportable Quantities (RQs) and Notifications"
- 40 CFR 355, "Emergency Planning and Notification"
- RCRA-listed
- PCBs
- Radioactive material

Oil Spill Containment

SNL/NM follows an Oil Spill Prevention Control and Countermeasures (SPCC) Plan (CDM 1995) in accordance with 40 CFR 112, "Oil Pollution Prevention." The plan outlines practices to prevent the discharge of oil from reaching any navigable waters of the U.S. or tributaries of such waters. At SNL/NM, this would be specifically applicable to the Tijeras Arroyo, which discharges to the Rio Grande. All storm water that drains into the arroyo discharges directly to the river. All wastewater outfalls to the City sewer are treated before being discharged to the river. The plan specifically identifies the requirements for oil storage and secondary containments around transformer pads, oil tanks, and other oil-containing equipment and storage locations. Further guidance is found in the *ES&H Manual* chapter on "Oils, Greases, and Fuels" (SNL 1997f).

TABLE 3-11. Important Documents for Waste Management Programs

Waste Management Program Documents	Reference
<i>Waste Management (PG)</i>	SNL 1997a
<i>ES&H Center Programmatic Waste Acceptance Criteria</i>	SNL 1996c
Hazardous Waste	
Hazardous Waste Management Facility (HWMF) Annual Reports	(no reference)
Biennial Hazardous Waste Report	(no reference)
Section 10E– “Chemical Spills,” <i>ES&H Manual</i>	SNL 1997b
Section 19A– “Hazardous Waste Management,” <i>ES&H Manual</i>	SNL 1999f
<i>SNL Waste Characterization Overview</i>	SNL 1999m
Radioactive Waste	
<i>Site Treatment Plan for Mixed Waste, Sandia National Laboratories, New Mexico FY98 Update (Rev., January 1998)</i>	SNL 1999e
Section 19B– “Low-Level Radioactive Waste Management,” <i>ES&H Manual</i>	SNL 1998c
Section 19C– “Mixed Waste Management,” <i>ES&H Manual</i>	SNL 1998d
Section 19D– “Radioactive Material Management Areas (RMMAs),” <i>ES&H Manual</i>	SNL 1998e
Section 19E– “Treatability Studies for Hazardous and Mixed Waste,” <i>ES&H Manual</i>	SNL 1997c
<i>Conceptual Site Treatment Plan for Mixed Waste (Oct 1993)</i>	SNL 1993
<i>Mixed Waste Site Treatment Plan, Compliance Plan Volume (CPV) Background Volume (Rev 2)</i>	SNL 1998b
Manzano Nuclear Waste Storage Facilities and Manzano Waste Storage Facilities Maintenance Support Program	SNL 1997d
<i>Radioactive and Mixed Waste Program</i>	SNL 1999g
Solid Waste	
Annual Solid Waste Reports	(no reference)
<i>Solid Waste Program (PG)</i>	SNL 1995d
Waste Minimization and Pollution Prevention (P2)	
<i>Pollution Prevention Plan</i>	SNL 1997e
Annual Report on Waste Generation and Waste Minimization Progress	(no reference)

NOTE: PG denotes a “Program Document,” which is a specific type of ES&H document.

As of December 1998, there was a total of 3,604,419 gal of oil stored onsite at 97 sites, primarily ASTs and transformers. Locations are recorded based on a minimum storage of 660 gal per site. Most of these sites are provided with secondary spill containments, such as concrete lined basins, retaining walls, containment reservoirs, earthen berms, sloped pads, and/or trenches. The annual SPCC oil storage facilities inventory and inspection report for SNL/NM’s oil storage locations are compiled by the Environmental and Emergency Management Department and attached to the SPCC Plan.

Reporting

Basic reporting requirements are given in:

- 40 CFR 370, “Hazardous Chemical Reporting: Community Right-to-Know” (EPCRA)
- 40 CFR 372, “Toxic Chemical Release Reporting: Community Right-to-Know” (EPCRA)
- DOE Order 232.1a, *Occurrence Reporting and Processing of Operations Information* (DOE 1997a)

3.5 UNDERGROUND STORAGE TANK (UST) MANAGEMENT

USTs at SNL/NM are regulated by the NMED UST Bureau under 20 NMAC 5. In 1990, the State of New Mexico adopted Federal standards contained in RCRA Subpart I, and implemented under 40 CFR 280, "Underground Storage Tanks." The EPA transferred authority to the State in accordance with 40 CFR 281, "Approval of State UST Programs." The five active registered tanks owned by SNL/NM in 1998 were as follows:

Location	Material Stored	Gallon Capacity
Bldg. 888	Oil (1 of 2)	20,000
Bldg. 888	Oil (2 of 2)	20,000
Bldg. 862	Emergency Generator Fuel	9,730
Bldg. 6523	Hydraulic Oil, Centrifuge Facility	7,000
Bldg. 983	Ethylene Glycol	1,500
Total Volume		58,230

UST Status

December 22, 1998 marked the deadline for the 10 year phase-in period for which EPA required all USTs to be upgraded to current standards. At SNL, two tank systems, which would not have met these standards, were closed out, as witnessed by the UST Bureau. These tanks are described below:

- **Bldg. 983 Tank** - On January 28, 1998, during an inspection by the UST Bureau, a tank was found at Bldg. 983, which had been previously unaccounted for and unregistered. The UST Bureau issued a Notice of Violation (NOV) on February 9, 1998 for the lack of registration and for not having proper UST monitoring equipment installed. Due to this discovery, SNL

immediately performed a thorough and diligent search for any other unaccounted for tanks or UST systems. No other USTs were discovered. SNL registered the tank and then closed it in place by filling it with grout in January 1999.

- **Bldg. 6523, Centrifuge Facility** - In December 1998, it was determined that the piping system supplying hydraulic oil to SNL's two centrifuges fell under UST regulations. (At least 10 percent of the piping system was underground.) Since the system, which had been installed in the 1960's, did not meet current regulations, all the pipes were removed and the system was replaced with an aboveground setup, not subject to UST regulations.

Requirements for SNL/NM's UST program management are described in the *ES&H Manual*, "Underground Storage Tanks" (SNL 1997g).

3.6 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE ACTIVITIES

NEPA, signed into law in January 1970, is one of the nation's most comprehensive legislative and public policy statement on protection of the environment. It requires Federal agencies to consider environmental impacts of their proposed activities and to prepare environmental documentation on potential environmental impacts. Where these impacts may be significant, the process of assessing the impacts and determine subsequent agency action must provide for public review of the decision-making process.

NEPA Program

SNL/NM's NEPA Program, is coordinated with the DOE Kirtland Area Office (DOE/KAO). SNL provides DOE with technical assistance on NEPA and its associated resource protection

laws, such as the Endangered Species Act (ESA) and the National Historic Preservation Act (NHPA). SNL prepares a NEPA Checklist on proposed actions or projects with potential impacts and sends them to DOE/KAO for review. Although SNL can suggest courses of action, DOE/KAO has the responsibility to determine if the proposed action:

- (1) Falls under a Categorical Exclusion,
- (2) Has already been analyzed in an existing NEPA document, or
- (3) Requires further NEPA documentation.

Most proposed actions at SNL/NM fall either within a "Categorical Exclusion" or are addressed under an existing EA or EIS.

NEPA guidance is available in Chapter 10B of the *ES&H Manual* "NEPA, Sensitive Species, and Historic Properties" (SNL 1999b). The *NEPA Program Document*, which describes how new and ongoing projects are reviewed for NEPA determinations, was completely rewritten and submitted to DOE in 1999 (SNL 1999h, draft).

DOE's NEPA Regulations

In 1996, DOE amended 10 CFR 1021, "National Environmental Policy Act," to incorporate changes to its regulations designed to increase DOE's efficiency and cost effectiveness in implementing NEPA requirements. DOE Order 451.1, *National Environmental Policy Act Compliance Program* (DOE 1997b), first issued on September 11, 1995, establishes responsibilities and procedures to implement NEPA in conformance with DOE NEPA regulations. Other drivers for the program are contained within the DOE Secretary's Policy Statement on NEPA made in June 1994 (DOE 1994).

SNL/NM Site-Wide Environmental Impact Statement (SWEIS)

In 1997, DOE/AL announced its intention to prepare a SWEIS for SNL/NM. As a matter of policy, the DOE prepares such NEPA

documents for its large, multi-facility installations. The SWEIS will address operations and activities that DOE foresees at SNL/NM projected for the next 10 years and provide an overall baseline for comparison of current environmental conditions with the effects of proposed future projects and activities.

A comprehensive document like the SWEIS will also allow DOE to "tier" its NEPA documents and reduce the need to revisit the same discussions for each new project proposed. In this way, DOE can focus on project-specific issues in its NEPA determinations. In summary, the primary areas of focus addressed by the SWEIS are as follows:

- Assess public and worker **health impacts** from current and planned activities;
- Assess **environmental impacts** from current and planned activities and potential unplanned releases;
- Describe the **social environment** affected by SNL/NM's operations;
- Study the **cumulative effects** of past, present, and future operations at SNL/NM;
- Determine potential impacts on **land use** plans, policies, and controls;
- Assess potential **emergency scenarios**; and
- Study the factors effecting **waste management** practices including pollution prevention, waste minimization, and waste stream characterization.

Terrestrial Surveillance Program

There are two major activities conducted under the general term "environmental monitoring." These are environmental surveillance and effluent monitoring. Effluent monitoring is the direct measurement of pollutants from an outfall or emission source, while the purpose of environmental surveillance is to characterize and measure the level of pollutants that have accumulated in the ambient environment from one or more sources. At SNL/NM, environmental surveillance is conducted for terrestrial media, groundwater, and ambient air. This chapter discusses sampling of the terrestrial environment, which currently includes soil, sediment (water-deposited), vegetation, and surface water. Additionally, ambient gamma radiation levels are measured with thermoluminescent dosimeters (TLDs).

4.1 PROGRAM BACKGROUND

Annual terrestrial surveillance sampling is performed by SNL/NM's Environmental and Emergency Management Department in and around SNL/NM's operational areas and at perimeter and offsite (community) locations.

Program Objectives

Terrestrial Surveillance Program objectives can be summarized by the following excerpts based on requirements given in DOE Order 5400.1, *General Environmental Protection Program*, (DOE 1990):

- Collect and analyze samples so as to characterize environmental conditions, and define increasing or decreasing trends.
- Establish background levels of pollutants to define baseline conditions (offsite sampling).
- Provide continuing assessment of pollution abatement programs.
- Identify and quantify new or existing environmental quality problems and their potential impacts, if any.
- Verify compliance with applicable environmental laws and regulations and commitments made in National Environmental Policy Act (NEPA) documents, such as Environmental Impact Statements (EISs), as well as other official documents.

Program Activities

The "bottom-line" purpose of environmental surveillance is to determine any perceivable impacts to the environment. To this purpose, terrestrial surveillance at SNL/NM can be divided into the following activities:

- Sample site selection
- Sample collection (raw field data)
- Sample management and quality assurance

- Selection of analyte parameters (to provide a broad base of constituents for environmental characterization)
- Chemical analysis (conducted by offsite EPA-approved laboratories)
- Database management
- Statistical analysis of raw data results and historical data analysis to determine trends
- Comparison of results to standards where they exist

Regulatory Oversight and Comparisons

The Terrestrial Surveillance Program is primarily interested in comparing onsite and perimeter values to local offsite background levels. Background values are taken from areas where “natural” conditions are present. Onsite and perimeter values are compared to standards where they exist, such as Resource Conservation and Recovery Act (RCRA) proposed action levels for soils and 40 CFR 143.3, “Secondary Maximum Contaminant Levels” for drinking water. Additionally, non-radiological results (metal analytes) are compared to U.S. Surface Soil averages published in *Trace Elements in Soils and Plants* (CRC 1992). The range of “normal” values across the nation is effected by the level of natural constituents (mineralogy) present in various rock and soil types.

Although, radiological standards exist for air and water, there are, as yet, no State or Federal regulatory standards for radiological contaminants in soil. SNL follows the standards and requirements for radionuclide levels in soils given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993).

Split Samples with the State

The DOE Oversight Bureau of the New Mexico Environment Department (NMED) periodically splits samples with SNL/NM for an additional level of verification. These comparison results are available from the Bureau upon request.

Discovering Trends

Isolated analyses performed on each years’ results can only give a “snap shot” picture of environmental conditions at any single point in time — thus, a single sampling event allows the Terrestrial Surveillance Team to assess the general spatial distribution of contaminants throughout the site at a single point. However, this cannot show increasing or decreasing trends or indicate if conditions at a particular site are remaining stable. Additionally, a single data point from a sampling site is not an accurate representation because of other fluctuating factors, such as slight changes in sampling locations, different climate conditions, and laboratory variations/errors. A measure of the true condition at a site is best made over a larger data set gathered over several years.

Statistical analysis detects patterns of migration, which may point to movement of contaminants either onto or off of SNL/NM property. In this way, the Terrestrial Surveillance Team can identify, well in advance, any potential areas of concern and, most importantly, determine if elevated levels are derived from SNL/NM's operations. Any indication of increasing levels will be looked at in the context of the contaminant level present. For example, in many cases, an increasing trend may be detected, but the contaminants present may be much lower than offsite (baseline) levels and considerably less than any associated RCRA proposed action levels. Therefore, further investigation is determined on a site-by-site basis and, where appropriate, mitigation measures will be instituted.

4.2 SAMPLING LOCATIONS

Annual sampling was performed in July 1998 at 72 fixed locations. "Fixed locations" are sampling sites where the Terrestrial Surveillance Team collects samples from the same general area to effectively make statistical comparisons with samples taken in previous years. Sampling is performed in three distinct areas:

- **Onsite** – 39 locations
- **Perimeter** – 17 locations
- **Offsite** – 16 locations
(Nine of these locations are strictly thermoluminescent dosimeter [TLD] monitoring stations.)

The types of terrestrial media collected from each onsite and perimeter location are shown in Table 4-1 and 4-2, respectively. A map showing these sites is illustrated in Figure 4-1.

Criteria for Choosing Onsite and Perimeter Sampling Locations

Onsite – Onsite sampling locations are, for the most part, sited within or near areas of past or present SNL/NM operations. This includes SNL's five technical areas and remote test locations within the Coyote Test Field (CTF). Locations are primarily chosen in areas of known contamination or in areas where contamination, if present, would have the greatest potential of accumulating. Other considerations that support the determination of an optimum sampling site include topography, wind direction, and the proximity to existing sampling sites (so as to limit redundant data). There are, however, a few sites that are chosen in areas not associated with any particular facility or operation. These onsite locations are designed to provide a representative profile of the general pollutant accumulation from SNL/NM facilities as a whole.

Perimeter – Perimeter sampling locations establish if contaminants are migrating either onto or off of SNL/NM site operational areas. Perimeter locations are sited at close proximity to SNL/NM operational areas but off of SNL property. These may be on KAFB property or just outside the base boundary.

New sampling sites are added as necessary, (and as resources allow) to monitor changes in SNL's activities, such as new facility start-ups (effluents), initiation of environmental remediation activities (disturbed soil areas), and new sites of contaminant discovery. A new sampling site may also be added to better characterize an area where high or increasing values are present. Conversely, some locations may be removed from the survey if historical data continues to show that there is no concern at a particular site. This allows resources to be allocated in higher priority areas that are potentially more relevant. (No new sites were added in 1998.)

Criteria for Choosing Offsite Sampling Locations.

Offsite or "community" samples are collected from up to a 25-mile radius of SNL/NM's facilities. These sites are meant to represent natural background conditions with which to statistically compare onsite and perimeter data. Sites are chosen far enough away from SNL facilities so as not to contain any pollutants that could be derived from SNL activities. Figure 4-2 shows offsite sampling sites. Table 4-3 lists offsite locations and the media that was collected from each site in 1998.

4.3 TERRESTRIAL MEDIA COLLECTED

Terrestrial samples are used to determine the presence and distribution of environmental pollutants at or near the ground surface. The following paragraphs detail the sample collection criteria and method. Table 4-4 lists the type of laboratory analysis performed on each sample category.

Soil – Soil samples are collected to ascertain the presence of air-deposited pollutants or contaminants that have been transported and deposited through surface runoff. Soil was collected from 50 locations (31 onsite, 13 perimeter, and six offsite) using a small trowel to scoop the top few inches of the ground surface. Samples are desiccated (dried) before analysis.

Sediment – Sediment samples were collected from a total of nine locations (two offsite, four onsite, and three perimeter). Sediment is collected in arroyos (onsite and perimeter) or along the riverbanks of the Rio Grande (offsite) to ascertain the presence of residual pollutants that may have been transported and deposited by running water. Pollutants found in onsite sediments may derive from storm water runoff or direct surface discharge. All surface discharges at SNL require a permit to ensure that the water meets established standards. Sediment samples were collected using the trowel scoop method. Samples are desiccated before analysis.

Vegetation – Samples were obtained from 28 locations (16 onsite, six perimeter, and six offsite) by cutting off the top few inches of growth. Samples are primarily collected from various grass species to ascertain the presence of contaminants taken up by a plant and available as forage to animals. (Grass is chosen because of its abundance, but small leafy plants may be

Rio Grande Water Quality

Potential pollutants in the Rio Grande derive from a multitude of sources. Wastewater is discharged to the river from sewer treatment plants and urban and agricultural runoff. SNL monitors its wastewater effluent and storm water runoff to ensure that its effluents meet regulatory standards. The City, in turn, must meet National Pollutant Discharge Elimination System (NPDES) standards before discharging treated wastewater to the river. However, many discharge sources to the river are not monitored at all. Urban and agricultural runoff from streets, commercial areas, and farms add pollutants to the river, including fertilizers, pesticides, animal manure, nitrates, VOCs, and metals. The EPA has designated the Rio Grande in the Albuquerque area, as exceeding national criteria levels for four criteria pollutant indicators: ammonia, dissolved oxygen, pH, and phosphorus. Two web sites give water quality information on the Rio Grande:

Environmental Protection Agency (EPA):

<http://www.epa.gov/surf2/hucs/13020203/score.html>

U.S. Geological Survey (USGS):

<http://water.usgs.gov/pubs/circ/circ1162/nawqa91.4.html>

used where grass is not available.) Although, there is no livestock present at KAFB (other than the horses at the KAFB stable) hypothetically, contaminated vegetation is a potential vector into the food chain to humans.

Surface water – Water samples are taken at upgradient and downgradient sites along the Rio Grande, relative to SNL/NM. Samples are compared to characterize the presence of waterborne contamination, particularly looking for any increase in contamination at the downgradient location. The only surface water available on KAFB is at several remote springs, which are sampled by the Groundwater Protection Program (GWPP). Samples are collected by grab sampling (dip off the surface) and are divided into three categories: unfiltered water (total water), filtered water, and suspended solids collected off filters (suspended solids > 0.45 micron [μm]).

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TABLE 4-1. Onsite Terrestrial Surveillance Locations and Sample Types

There are 39 onsite sampling locations.

Location Number	Sampling Location	Vegetation	Soil	Sediment	TLD
1	Pennsylvania Ave.		⊕		☒
2NW	Mixed Waste Landfill (northwest)	❖	⊕		☒
2NE *	Mixed Waste Landfill (northeast)	❖	⊕		
2SE	Mixed Waste Landfill (southeast)		⊕		
2SW	Mixed Waste Landfill (southwest)		⊕		
3	Coyote Canyon Control		⊕		☒
6	TA-III (east of water tower)	❖	⊕		☒
7 *	Unnamed Arroyo (north of TA-V)		⊕		☒
20 *	TA-IV (southwest)	❖	⊕		☒
31	TA-II Guard Gate				☒
32S	TA-II, Bldg. 935 (south bay door)		⊕		
32E	TA-II, Bldg. 935 (east personnel door)		⊕		
33	Coyote Springs	❖	⊕		
34	Lurance Canyon Burn Site	❖	⊕		
35	Chemical Waste Landfill (CWL)	❖	⊕		
41	TA-V (northeast fence)		⊕		☒
42	TA-V (east fence)	❖	⊕		☒
43	TA-V (southeast fence)	❖	⊕		☒
45	RMWMF, TA-III (northwest corner)	❖	⊕		☒
45E	RMWMF, TA-III (east fence)				☒
46	TA-II (south corner)	❖	⊕		☒
47	Tijeras Arroyo (east of TA-IV)				☒
48	Tijeras Arroyo (east of TA-II)				☒
49	Near the Explosive Component Facility (ECF)	❖	⊕		
51	TA-V (north of culvert)	❖	⊕		
52	TA-III, northeast of Bldgs. 6716 and 6717	❖	⊕		
53 *	TA-III south of long sled track		⊕		
54	TA-III, Bldg. 6630		⊕		
55	Large Melt Facility (LMF), Bldg. 9939	❖	⊕		
56	TA-V, Bldg. 6588 (west corner)		⊕		
57	TA-IV, Bldg. 970 (northeast corner)		⊕		
66	KAFB Facility	❖	⊕		
72	Arroyo del Coyote (midstream)			⊗	
74	TA-IV, Tijeras Arroyo (midstream)			⊗	
75	Arroyo del Coyote (downgradient)			⊗	
76	Thunder Range (north)		⊕		
77	Thunder Range (south)		⊕		
78	School House Mesa		⊕		
79	Arroyo del Coyote (upgradient)			⊗	

NOTE: * Replicate sampling locations: In addition to single samples taken for each media, two replicate samples are collected for internal checks on consistency of laboratory results.

RMWMF = Radioactive and Mixed Waste Management Facility

TABLE 4-2. Perimeter Terrestrial Surveillance Locations and Sample Types
There are 17 perimeter sampling locations.

Location Number	Sampling Location	Vegetation	Soil	Sediment	TLD
4	Isleta Reservation Gate	❖	⊕		☒
5	McCormick Gate	❖	⊕		☒
12	Northeast Perimeter	❖	⊕		
16	Four Hills		⊕		☒
18	North Perimeter Road				☒
19	USGS Seismic Center Gate		⊕		☒
39	Northwest DOE Complex				☒
40	TA-I, northeast (by Bldg. 852)				☒
58	North Base Housing	❖	⊕		
59	Zia Park (southeast)		⊕		
60	Tijeras Arroyo (downgradient)	❖	⊕	⊗	
61	Albuquerque International Sunport (west)		⊕		
63	No Sweat Boulevard		⊕		
64 *	North Manzano Base	❖	⊕		
65E	Tijeras Arroyo, east (upgradient)		⊕	⊗	
73 *	Tijeras Arroyo (upgradient)			⊗	
80	Madera Canyon		⊕		

NOTE: * Replicate sampling locations: In addition to single samples taken for each media, two replicate samples are collected for internal checks on consistency of laboratory results.

TABLE 4-3. Offsite (Community) Terrestrial Surveillance Locations and Sample Types
There are 16 offsite sampling locations within a 25-mile radius of SNL/NM operations.

Location Number	Sampling Location	Vegetation	Soil	Surface water	Sediments	TLD
8	Rio Grande, Corrales Bridge (upgradient)	❖	⊕	●	⊗	
9	Sedillo Hill, I-40 (east of Albuquerque)	❖	⊕			
10	Oak Flats	❖	⊕			☒
11 *	Rio Grande, Isleta Pueblo (downgradient)	❖	⊕	●	⊗	☒
21	Bernalillo Fire Station 10, Tijeras					☒
22	Los Lunas Fire Station					☒
23	Rio Rancho Fire Station, 19th Ave.					☒
24	Corrales Fire Station					☒
25	Placitas Fire Station	❖	⊕			☒
26	Albuquerque Fire Station 9, Menaul NE					☒
27	Albuquerque Fire Station 11, Southern SE					☒
28	Albuquerque Fire Station 2, High SE					☒
29	Albuquerque Fire Station 7, 47th NW					☒
30	Albuquerque Fire Station 6, Griegos NW					☒
62	East resident	❖	⊕			
68	Las Huertas Creek					

NOTE: * Replicate sampling locations: In addition to single samples taken for each media, two replicated samples are collected for internal checks on consistency of laboratory results.

FIGURE 4-2. Offsite Sampling Locations

TABLE 4-4. Analysis Performed on Environmental Media Sample Types

Media	Radiological Analysis					Nonradiological Analysis	
	Gross Alpha	Gross Beta	Gamma Spec	Tritium	U _{tot}	ICP-20 Metals	Percent H ₂ O
• Soil			✓	✓	✓	✓	✓
• Sediment			✓	✓	✓	✓	✓
• Vegetation			✓	✓	✓	✓	✓
• Surface Water							
- Filtered	✓	✓	✓	✓	✓	✓	
- Unfiltered	✓	✓	✓	✓	✓	✓	
- Filters (Suspended solids)	✓	✓	✓		✓	✓	

NOTE: ICP = Inductively Coupled Plasma (method)
U_{tot} = Uranium, total

Thermoluminescent Dosimeters (TLDs) – Ambient levels of gamma radiation are measured with TLDs. The dosimeters are placed on aluminum poles at a height of 1–1.5 m. The dosimeters are measured and exchanged quarterly (January, April, July, and October) at 33 stations. Gamma radiation may derive from natural sources such as cosmic radiation and rocks, or man-made activities and products. At SNL/NM, low levels of gamma radiation may be measured just outside high-energy test facilities, such as SNL's reactor and accelerator facilities, and near the Radioactive and Mixed Waste Management Facility (RMWMF). TLDs that are close to these types of facilities are classed as "operational" and are not considered representative of the ambient gamma levels.

4.4 PRIORITIZATION ANALYSIS METHODOLOGY

In order to bring clarity and simplification to terrestrial surveillance results, members of the Terrestrial Surveillance Team developed a new statistical methodology to aid in prioritizing sites found with various levels of contamination—from "no detected values" to analyte values found "higher than offsite and increasing." The

Prioritization Statistical Analysis Prioritization Method (Shyr, Herrera, and Haaker 1998) is based on two questions:

1. Are the results higher than offsite (baseline) measurements?
2. Is there an increasing trend over the last eight years?

Based on the results of these questions, sampling locations are classified into four priority levels as shown in Table 4-5. Category 1 represents the level of most significant concern, while Category 4 is the level of no concern at all. To date, there has been no Category 1 sites identified at SNL/NM. Therefore, this report discusses only Category 2 and 3 results. As shown in the table, specific actions will be taken depending on the designated category.

TABLE 4-5. Decision Matrix for Determining Priority Action Levels Based on Categories Assigned at Each Sampling Location

Category	Are contaminant measurements higher than offsite?	Is there an increasing trend over the last 8 years?	Priority for further investigation
1	Yes	Yes	1st Priority - Immediate attention needed. Specific investigation planned and/or notifications made to responsible parties.
2	Yes	No	2nd Priority - Some concern. Investigation planned and/or notifications made to responsible parties.
3	No	Yes	3rd Priority - Only a minor concern since contaminants present are not higher than offsite values. An investigation may or may not be needed.
4	No	No	4th Priority - No concern. No further investigation required.

NOTE: Based on Prioritization Statistical Analysis Methodology (Shyr, Herrera, and Haaker 1998).

Comparison of Results

Data from onsite and perimeter locations over the last eight years (August 1991 to August 1998) were compared to data from offsite locations gathered during the same period. This set of data provides a record from which to perform a trend analysis. Onsite and perimeter data were also compared to:

- U.S. surface soil averages (CRC 1992),
- RCRA Subpart S proposed action levels (where available),
- "Secondary Maximum Contaminant Levels" for drinking water, and
- Laboratory detection limits.

4.5 RADIOLOGICAL PARAMETERS

Radiological analysis is performed on all soil, sediment, vegetation, and surface water samples as shown in Table 4-4. The complete report detailing 1998 terrestrial surveillance results is published in *1998 Data Analysis in Support of the Annual Site Environmental Report* (SNL

1999i). (This and other documents important to the Program are listed in Table 4-7 at the end of the chapter.) Radiological analyses include the following analytical procedures:

- **Gross alpha** – This test detects the spontaneous emission of alpha particles by certain radioisotopes. Alpha particles arise from a transformation in an unstable nucleus, which produces a helium nuclei (two protons and two neutrons). Analysis for gross alpha emissions detects the presence of any alpha-emitting isotopes, such as plutonium and americium. A high result may trigger an isotopic analysis to determine the specific species present. Currently, this test is only run on water samples.
- **Gross beta** – This test detects the spontaneous emission of beta particles, which result from transformation in the nucleus of unstable radioactive isotopes. A beta particle may be negative, as an electron, or positive, as a positron. Gross beta analysis detects the presence of any beta-emitting isotopes, such as neptunium and tritium. Again, a high result may

trigger an isotopic analysis. Currently, this test is only run on water samples.

- **Gamma spectroscopy** – Gamma emissions are high-energy electromagnetic energy emitted by certain radioactive atoms. The gamma spectrometry test identifies and quantifies the presence of gamma-emitting isotopes, such as cesium-137.
- **Tritium** – Tritium is a radioactive isotope of hydrogen with a half-life of 12.3 years. An ordinary hydrogen atom has one proton and one electron; tritium has two neutrons in addition to this. Tritium occurs naturally in the environment and is also a common contaminant related to nuclear weapons research and development.
- **Uranium, total (U_{tot})** – All uranium isotopes are radioactive and are differentiated by the number of neutrons present (92 protons and 142 or more neutrons), uranium-234, -235, -236, -238, and -239/240. A test to measure total uranium (U_{tot}) is a general trend indicator for detecting all isotopes of uranium. Elevated levels may trigger an isotope-specific analysis.

4.6 ONSITE AND PERIMETER RADIOLOGICAL RESULTS

Radiological parameter results are discussed for each sample media analyzed for all onsite and perimeter locations. Analyte results found to be statistically higher than offsite results (Category 2), or results that show increasing trends but remain below offsite results (Category 3), are highlighted in text boxes. As mentioned earlier, there have been no Category 1 results for which both criteria are met. All Category 2 and 3

results are identified by location on the map in Figure 4-3.

4.6.1 Vegetation Results

CATEGORY 2

Tritium– Location 2NE was the only site that showed an elevated radiological contaminant result in vegetation. Samples contained tritium at 4.2–26 picocuries per milliliter (pCi/ml). This location, near the Mixed Waste Landfill (MWL), is a known area of contamination. Results are consistent with past measurements and there is no indication of an increasing trend.

Tritium – Vegetation		Cat-2
Location	1991 - 1998 Average Value	Offsite Average Value
2NE	10.38 pCi/ml	0.034 pCi/ml

4.6.2 Soil Results

CATEGORY 2

Tritium – There were no changes from the 1997 status for Category 2 sites for tritium contamination. Three sites in areas of known tritium contamination remained elevated over offsite values (32E and 32S, east of TA-11, and 2NE, near the MWL). Results are consistent with past measurements and there is no indication of an increasing trend.

Tritium – Soil		Cat-2
Location	1991 - 1998 Average Value	Offsite Average Value
32E, 32S, 2NE	190.97 pCi/ml	0.079 pCi/ml

FIGURE 4-3. Onsite and Perimeter Sampling Locations that Reported Category 2 or Category 3 Results in 1998
 Category 2 results are higher than offsite; Category 3 results are not higher than offsite but show an increasing trend.

98_4-3.ai

Uranium, total (U_{tot}) – There were no sites with results higher than offsite samples for U_{tot} in 1998. Results are consistent with past measurements.

Cesium-137 – Higher than offsite results were noted at locations 12, 34, 64, and 80; these locations were on or near the withdrawal area in the northeast section of KAFB. These same locations were noted in last year's report as higher than offsite for cesium-137.

Cesium-137 – Soil		Cat-2
<i>Location</i>	<i>1991 - 1998 Average Value</i>	<i>Offsite Average Value</i>
12, 34, 64, 80	1.079 pCi/g	0.270 pCi/g

CATEGORY 3

Tritium – Initially, 1998 samples indicated that five locations showed an increasing trend: 1, 52, 77 (onsite), 64 (perimeter), and 25 (offsite). However, upon further verification, the majority of the results at these locations were below the detection limit and thus could not be considered as real trends.

Uranium, total (U_{tot}) – Trending analysis performed in 1997 indicated that several onsite locations showed an increasing trend for U_{tot} . However, this was later modified upon clarification. The first indication that something was amiss was the fact that August 1991 and May 1992 results were anomalously low compared to subsequent sampling periods. There was no change in SNL's operational status or testing activities that would account for a sudden increase. Because of this, the past data was investigated for a possible laboratory analysis induced bias.

In early 1999, an audit was performed at the analytical laboratory that produced the 1991-1992 results. During an interview with lab personnel it was revealed that there were indeed mechanical difficulties with the laboratory equipment used to measure total uranium during the 1991-1992 time frame. In fact, the lab had

the equipment checked and serviced at least twice during this time after consistently low recovery rates for radiological parameters had been noted. With this information it was concluded that the radiological results from 1991 and 1992 were likely not accurate. The data was deleted from the statistical analysis and the analysis was run again. The adjusted data set produced no evidence of an increasing trend.

Cesium 137 – Three sites showed an increasing trend for cesium-137: 2NE and 2NW near the MWL, and 59, west of TA-1. Onsite sample results ranged from 0–0.63 pCi/g. These values are within the range of background cesium-137 concentrations from soils in the Albuquerque vicinity (Hostak 1995). Notice that the average value for these three locations (0.258 pCi/g) is below the average offsite value (0.270 pCi/g) during the 1991 - 1998 time frame.

Cesium-137 – Soil		Cat - 3
<i>Location</i>	<i>1991 - 1998 Average Value</i>	<i>Offsite Average Value</i>
2NE, 2NW, 59	0.258 pCi/g	0.270 pCi/g

4.6.3 Sediment Results

CATEGORY 2

There were no locations that had significantly higher than offsite results for tritium, U_{tot} , or cesium-137.

CATEGORY 3

There were no locations that are considered to have an increasing trend for tritium, U_{tot} , or cesium-137. Location 75, situated down-gradient on the Arroyo del Coyote had a decreasing trend for both tritium and U_{tot} .

4.6.4 Surface Water Results

As mentioned earlier, the only perennial water that occurs on KAFB is at several remote springs. These are sampled by the Groundwater Protection Program (GWPP).

Offsite water samples are taken from the Rio Grande at upgradient and downgradient locations relative to the point where Tijeras Arroyo empties into the river. Because Tijeras Arroyo drains a large portion of KAFB, including SNL operational areas, a difference of the two results could point to potential sources, such as from KAFB, that are contributing contaminants at the total outfall. However, similar to past years' results, radionuclide contaminants above normal background have not been detected in the Rio Grande.

4.6.5 Thermoluminescent Dosimeter (TLD) Results

Although TLD data have been measured since 1983, only 1991-1998 results were used in the statistical trending analysis. This was done in order to remain consistent with trend analyses performed on other terrestrial media. Table 4-6 shows the 1998 results for operational areas (near work-related radioactive sources), and onsite, perimeter, and offsite locations.

The 1998 sampling period occurred from January 13, 1998 through January 7, 1999. As can be seen from the table, 1998 onsite and perimeter results are slightly higher than offsite results. However, over the span of eight years from which data analysis is calculated, there were no statistical differences between onsite, perimeter, and offsite (community) TLD results. A graph of the results over the past eight years is shown in Figure 4-4. (Operational locations were not used in this analyses.)

Change in TLD Station Status

In 1996, the Radioactive and Mixed Waste Management Facility (RMWMF) opened for

operation. As a result of handling low level radioactive waste (LLW), this facility began emitting low levels of gamma radiation. The increase was detected on the nearby TLDs. However, because the RMWMF is an operational area, and DOE standards are higher for radioactive material areas, locations 45 and 45E can no longer be considered representative for ambient onsite levels of gamma radiation. Results from this TLD site are reported quarterly to RMWMF facility personnel.

4.7 NONRADIOLOGICAL PARAMETERS

Beginning in 1993, the scope of the Terrestrial Surveillance Program was broadened to include sample analysis of certain metals that are key indicators of contaminants in soil. The list of 21 metals has been modified over time to best represent a broad range of toxic pollutant indicators based on RCRA and CERCLA target list metals. With the exception of mercury (because it is a liquid at normal temperatures), the presence and quantity of all analytes are determined by EPA's Inductively Coupled Plasma-Atomic Emission Spectrum (ICP-AES) method. When samples are super heated to a plasma state, individual elements can be identified by the atomic emission spectrum produced. For this reason the list of metals is often referred to as ICP-20 metals.

ICP-20 Metals

The Terrestrial Surveillance Team has modified the analyte list over time by selecting the most useful metals. For example, calcium, silicon, strontium, and titanium were removed from the list since they are naturally abundant in the soil and are not useful indicators of pollution. These metals were replaced with thallium, selenium, arsenic, and antimony. The current list of 20 metals plus mercury is as follows:

FIGURE 4-4. TLD Results Summarized Over the Past Eight years (1991 - 1998)

TABLE 4-6. Thermoluminescent Dosimeter Results for 1998

Location Class	Sample Size	Mean (mrem/yr)	Error (mrem/yr)	Minimum (mrem/yr)	Maximum (mrem/yr)
SNL/NM (Operational)	2	119.25	3.50	106.9	131.6
SNL/NM (Onsite)	14	99.50	2.60	90.0	103.9
Perimeter	7	95.73	3.21	88.2	106.3
Offsite	12	93.71	3.10	83.3	114.4

Aluminum (Al)	Antimony (Sb)
Arsenic (As)	Barium (Ba)
Beryllium (Be)	Cadmium (Cd)
Chromium (Cr)	Cobalt (Co)
Copper (Cu)	Iron (Fe)
Lead (Pb)	Manganese (Mn)
Magnesium (Mg)	<i>Mercury (Hg)</i>
Nickel (Ni)	Potassium (K)
Selenium (Se)	Silver (Ag)
Thallium (Tl)	Vanadium (V)
Zinc (Zn)	

As was done for radiological results, locations were categorized from 1 to 4 based on the contamination present and the results of the trend analysis. Again, there were no sites designated as Category 1 and Category 4 locations are not discussed because they are of no environmental concern. Figure 4-3 shows locations where nonradionuclide contaminants have been detected. A complete report detailing terrestrial surveillance data results can be found in the *1998 Data Analysis in Support of the Annual Site Environmental Report* (SNL 1999i).

4.8 ONSITE AND PERIMETER NONRADIOLOGICAL RESULTS

4.8.1 Vegetation Results

Vegetation is collected from 16 onsite and six perimeter sampling locations. This is the first year any elevated vegetation results have been

reported, since laboratory analysis of vegetation samples began in 1996. As yet, there are not enough sample points to conduct a trend analysis, so only higher than offsite (Category 2) results are reported.

CATEGORY 2

Magnesium and potassium - Magnesium and potassium were elevated over offsite values for vegetation samples at perimeter location 60. Location 60 is located downgradient on the Tijeras Arroyo. Monitoring will continue at this location.

Magnesium – Vegetation		Cat-2
Location	1996 - 1998 Average Value	Offsite Average Value
60	5,000 mg/kg	49.167 mg/kg

Potassium – Vegetation		Cat-2
Location	1996-1998 Average Value	Offsite Average Value
60	58,000 mg/kg	3,733.33 mg/kg

There were no Category 3 designations as there are still not enough data points to test for a trend.

4.8.2 Soil Results

NOTE TO READER: Three onsite locations showed higher than offsite values (Category 2). The results are discussed by location rather than by analyte. Category 3 results are discussed by each analyte.

Well over half the sites sampled (33 of the 56) at onsite and perimeter locations were designated as Category 4 (no concern). Many of these sites showed values significantly below community levels and/or demonstrated decreasing trends.

CATEGORY 2, Location 20

Elevated values for cadmium and lead continue to show at onsite location 20, near the KAFB skeet shooting range. The Air Force has closed the skeet range and cleanup is progressing. Since the skeet range is Air Force property, SNL is not involved in the remediation. The Terrestrial Surveillance Program will continue collecting samples in the outlying areas of the skeet range. Lead values are expected to remain above normal.

Lead - The value for lead averaged over the last six years, was 6,555 parts per million (mg/kg) (1993-1998), as compared to average offsite lead values of 20 mg/kg over the same time frame. The high values are not surprising considering the large amount of lead shot in the soil. To determine whether or not lead is leaching into the soil, a toxicity characteristic leaching procedure (TCLP) for lead was conducted in 1996, 1997, and 1998. Results indicated that lead is not leaching into the soil.

Lead - Soil		Cat-2
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
20	6,555 mg/kg	20.03 mg/kg

Cadmium - Cadmium values ranged from 0.5–2.4 mg/kg at location 20. The majority of offsite values for cadmium were 0.5 mg/kg, which is the method detection limit. The proposed RCRA Subpart S action level for cadmium is 40 mg/kg, which is above observed concentrations.

Cadmium - Soil		Cat-2
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
20	1.59 mg/kg	0.52 mg/kg

CATEGORY 3, Location 20

Cobalt - Location 20 showed an increasing trend for cobalt, not observed in 1997. Values ranged from 4.5–5.7 mg/kg. The proposed RCRA Subpart S action level for cobalt is 4,800 mg/kg, which is above observed concentrations.

Cobalt - Soil		Cat-3
<i>Location</i>	<i>1993 - 1996 Average Value</i>	<i>Offsite Average Value</i>
20	5.29 mg/kg	5.39 mg/kg

CATEGORY 2, Location 64

Perimeter location 64, just north of Manzano Base, was elevated for iron, cobalt, magnesium, manganese, and zinc. This is the same as last year's results except that elevated iron was seen for the first time in 1998.

Iron - The average concentration of iron at location 64 was 21,111 mg/kg. The maximum concentration of 29,000 mg/kg was recorded in August 1993; the minimum concentration of 17,000 mg/kg was recorded in August 1994 and July 1997. The proposed RCRA Subpart S action level for iron is 21,000 mg/kg, which is slightly below observed concentrations. However, it should be noted that the EPA considers iron only a moderately hazardous metal. Monitoring will continue at this location.

Iron - Soil		Cat-2
<i>Location</i>	<i>1993-1998 Average Value</i>	<i>Offsite Average Value</i>
64	21,111 mg/kg	2703.70 mg/kg

Cobalt - The maximum cobalt concentration at location 64 was recorded in August 1993 at 14 mg/kg. This is well below the proposed RCRA action level of 4,800 mg/kg and also within the range of U.S. surface soil background cobalt concentrations, 3–50 mg/kg (CRC 1992).

Cobalt - Soil		Cat-2
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
64	8.49 mg/kg	5.39 mg/kg

Magnesium - The maximum magnesium concentration at location 64 was recorded in August 1993 at 9,400 mg/kg. This is well below the proposed RCRA action level of 460,000 mg/kg and also within the range of U.S. surface soil background magnesium concentrations of 300–100,000 mg/kg (CRC 1992). Magnesium is considered a low hazardous metal, but monitoring will continue at this location.

Magnesium– Soil		Cat-2
<i>Location</i>	<i>1993-1998 Average Value</i>	<i>Offsite Average Value</i>
64	6,555.55 mg/kg	3,612.96 mg/kg

Manganese - Manganese results for location 64 ranged from 490–760 mg/kg. Maximum concentration for manganese was reported at 760 mg/kg in August 1993. Although the reported values are above the proposed RCRA action level of 400 mg/kg, this was still within the average U.S. surface soil background levels of 20–3,000 mg/kg. If increasing levels continue to be noted in the future, a more thorough analysis of this site will be initiated.

Manganese– Soil		Cat-2
<i>Location</i>	<i>1993-1998 Average Value</i>	<i>Offsite Average Value</i>
64	563.33 mg/kg	364.44 mg/kg

Zinc - The maximum value for zinc at location 64 was reported in August 1993 at 110 mg/kg (significantly below the proposed RCRA action level of 23,000 mg/kg). Since then, values have ranged from 64–78 mg/kg.

Zinc – Soil		Cat-2
<i>Location</i>	<i>1993-1998 Average Value</i>	<i>Offsite Average Value</i>
64	79.00 mg/kg	44.52 mg/kg

CATEGORY 2, Location 65E

Perimeter Location 65E

A fairly new perimeter location, added in 1995, is "Tijeras Arroyo East" just upgradient of the point where the arroyo crosses over onto KAFB property. This site was elevated for cobalt and magnesium similar to 1997 results but,

additionally, also showed higher than offsite results for iron, manganese, potassium, and zinc in 1998.

Cobalt - The maximum cobalt concentration at location 65E was 12 mg/kg, reported in 1996. This is significantly below the proposed RCRA action limit of 4,800 mg/kg, and well within the average U.S. surface soil background levels of 3–50 mg/kg (CRC 1992).

Cobalt – Soil		Cat-2
<i>Location</i>	<i>1995 - 1998 Average Value</i>	<i>Offsite Average Value</i>
65E	9.20 mg/kg	5.39 mg/kg

Magnesium - The maximum magnesium concentration at location 65E was 11,000 mg/kg, reported in 1996 and again in 1998. This is significantly below the proposed RCRA action limit of 460,000 mg/kg, and well within the average U.S. surface soil background levels of 300–100,000 mg/kg (CRC 1992).

Magnesium – Soil		Cat-2
<i>Location</i>	<i>1995 - 1998 Average Value</i>	<i>Offsite Average Value</i>
65E	7,960 mg/kg	3,612.96 mg/kg

Iron - The maximum iron concentration at location 65E was 28,000 mg/kg, reported in 1996 and again in 1998. The average iron concentration at location 65E is 22,000 mg/kg. This is above the proposed RCRA action limit of 21,000 mg/kg, but well within the average U.S. surface soil background levels of 1,000–100,000 mg/kg (CRC 1992). Monitoring will continue at this location since 1998 was the first year that iron concentrations were higher than offsite concentrations.

Iron – Soil		Cat-2
<i>Location</i>	<i>1995 - 1998 Average Value</i>	<i>Offsite Average Value</i>
65E	22,000 mg/kg	2,703.7 mg/kg

Manganese - Manganese concentrations at location 65E ranged from 220–750 mg/kg. The average manganese concentration at location 65E is 538 mg/kg, which is above the proposed

RCRA action limit of 400 mg/kg, but concentrations are well within the U.S. surface soil background concentration of 30–5000 mg/kg (CRC 1992). Monitoring at this location will continue and any developing trends noted.

Manganese – Soil		Cat-2
<i>Location</i>	<i>1995 - 1998 Average Value</i>	<i>Offsite Average Value</i>
65E	538.0 mg/kg	364.44 mg/kg

Potassium – Potassium concentrations at location 65E ranged from 2,200–6,800 mg/kg. The average potassium concentration at location 65E is 4,440 mg/kg, which is below the proposed RCRA action limit of 100,000 mg/kg. U.S. surface soil background concentrations are not available, but New Mexico Surface Soil concentrations are reported at 1,900 – 63,000 mg/kg.

Potassium – Soil		Cat-2
<i>Location</i>	<i>1995 - 1998 Average Value</i>	<i>Offsite Average Value</i>
65E	4,440 mg/kg	2,533.33 mg/kg

Zinc – Zinc concentrations at location 65E ranged from 41–100 mg/kg. The average zinc concentration at location 65E is 77.4 mg/kg, which is below the proposed RCRA action limit of 23,000 mg/kg, but concentrations are well within the U.S. surface soil background concentration of 13 – 300 mg/kg (CRC 1992). Monitoring at this location will continue and any developing trends noted.

Zinc – Soil		Cat-2
<i>Location</i>	<i>1995 - 1998 Average Value</i>	<i>Offsite Average Value</i>
65E	77.4 mg/kg	44.52 mg/kg

CATEGORY 3

The following section describes sites that showed an increasing trend for a particular contaminant in soils. Most of the contaminants detected at these locations are minute in value and well below the associated RCRA Subpart S action level.

Chromium - Location 64 showed an increasing trend for chromium, which was not seen last year. Chromium results ranged from 17–53 mg/kg from 1993 to 1998 with an average result of 28.44 mg/kg. These values are well below the proposed RCRA Subpart S action level of 400 mg/kg. U.S. surface soil concentrations are from 7–1,500 mg/kg (CRC 1992). This was the first time an increasing trend was observed for chromium at this location.

Chromium – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
64	28.44 mg/kg	29.72 mg/kg

Aluminum - Location 77 had an increasing trend for aluminum for the first time in 1998, with values ranging from 6,900–13,000 mg/kg. The RCRA Subpart S action level for aluminum is 80,000 mg/kg. This sampling location was added in 1995 and is southeast of TA-III in the Thunder Range area.

Aluminum – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
77	9,180 mg/kg	1,225.93 mg/kg

Barium – Location 33, located within the withdrawal area at Coyote Springs, was elevated for barium. Once again in 1998, barium in the soil showed an increasing trend with values ranging from 86–150 mg/kg. This location is controlled for access and has been posted “Not a Source for Drinking Water,” however, the water is made available for local wildlife. The proposed RCRA Subpart S residential action limit for barium is 5,600 mg/kg. The range of barium for U.S. surface soils is 20–1,500 mg/kg (CRC 1992). Monitoring will continue at this location.

Barium – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
33	120 mg/kg	165.30 mg/kg

Chromium - Onsite location 78 and perimeter location 12 both showed an increasing trend for chromium. Values ranged from 15–72 mg/kg. The RCRA Subpart S action level is 400 mg/kg.

Chromium – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
78, 12	32.5 mg/kg	29.72 mg/kg

Cobalt - Multiple onsite locations showed an increasing trend for cobalt: 2NE, 2NW, 2SE at the Mixed Waste Landfill (MWL), and 32E, 6, 77, and 78 at various other locations throughout the site. Values from all locations combined ranged from 2.3–5.9 mg/kg. All locations were much lower than the RCRA Subpart S action level of 480 mg/kg.

Cobalt – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
2NE, 2NW, 2SE, 32E, 6, 77, 78	3.56 mg/kg	5.39 mg/kg

Copper - Multiple onsite and perimeter locations showed an increasing trend for copper: onsite locations were 2NW, 6, 7, 41, 52, 53, 76, 77, and 78; and perimeter locations were 16, 19, and 61. Combined values for all locations ranged from 4–24 mg/kg, which is well below the proposed RCRA Subpart S action level of 2,960 mg/kg.

Copper – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
2NW, 6, 7, 41, 52, 53, 76, 77, 78, 16, 19, 61	9.26 mg/kg	13.54 mg/kg

Iron - Three onsite locations (6, 77, and 78) and one perimeter location (58) were noted with an increasing trend for iron. Combined values for all locations ranged from 7,100–17,000 mg/kg. The RCRA Subpart S action level is 21,000 mg/kg. Monitoring will continue at these

locations. Iron is considered a moderate hazard concern.

Iron – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
6, 58, 77, 78	10,814.29 mg/kg	2,703.70 mg/kg

Lead - Three onsite locations (2NW, 7, and 52) and one perimeter location (59) were noted with an increasing trend for lead. Combined values for all locations ranged from 5–21 mg/kg. There is no RCRA Subpart S action level for lead. The U.S. surface soil concentration for lead is 10–70 mg/kg (CRC 1992). Monitoring will continue at these locations.

Lead – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
2NW, 7, 52, 59	11.39 mg/kg	20.03 mg/kg

Magnesium - Two onsite locations, 33 and 57, were noted with an increasing trend for magnesium with values ranging from 3,400–5,400 mg/kg, still well below the RCRA Subpart S action level of 460,000 mg/kg. Monitoring will continue at these locations.

Magnesium – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
33, 57	4,193.33 mg/kg	3,612.96 mg/kg

Manganese - Onsite location 6 was the only location noted with an increasing trend for manganese. Values for this location range from 130–240 mg/kg. The RCRA Subpart S action level is 400 mg/kg. Monitoring will continue at this location.

Manganese – Soil		Cat-3
<i>Location</i>	<i>1993 - 1998 Average Value</i>	<i>Offsite Average Value</i>
6	165.56 mg/kg	364.44 mg/kg

Potassium - Onsite location 77 was noted with an increasing trend for potassium with values

ranging from 1,900–3,300 mg/kg. The RCRA Subpart S action level is 1,000,000 mg/kg. Monitoring will continue at this location.

Potassium – Soil		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
77	2,460 mg/kg	2,533.33 mg/kg

Vanadium - Onsite location 78 was noted with an increasing trend for vanadium with values ranging from 11–20 mg/kg, well below the RCRA Subpart S action level of 560 mg/kg. Monitoring will continue at this location.

Vanadium – Soil		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
78	15.60 mg/kg	24.43 mg/kg

Zinc - Three onsite locations (7, 57, and 77) were noted with an increasing trend for zinc. Combined values ranged from 24–56 mg/kg, well below the RCRA Subpart S Action level of 23,000 mg/kg. Monitoring will continue at these locations.

Zinc – Soil		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
7, 57, 77	35.27 mg/kg	44.52 mg/kg

4.8.3 Sediment Results

Sediments are collected from four onsite locations at several points along the Tijeras Arroyo and Arroyo del Coyote. Upgradient and downgradient samples are taken in Tijeras Arroyo at perimeter locations a short distance from the KAFB boundary.

There were no Category 2 designations in 1998. However, increasing trends (Category 3) were noted at three onsite locations (72, 74, and 75) and two perimeter locations (60 and 73) as discussed below. Community location 8 (upgradient on the Rio Grande near the Corrales

Bridge) was observed to have increasing values of barium, cobalt, copper, magnesium, and nickel.

CATEGORY 3

The following section describes sites that showed an increasing trend for contaminants in sediment samples (analyzed over the last five years). However, it should be noted that most contaminants detected at these locations were at very minute levels and well below the associated RCRA Subpart S action level. Monitoring will continue at all locations discussed below. Also the average values for locations noted were generally very close to or below the average offsite value as shown in the boxes below.

Aluminum - Two onsite locations, 72 and 75, showed an increasing trend for aluminum with combined values ranging from 4,600–18,000 mg/kg. The RCRA Subpart S action level is 80,000 mg/kg. It should be noted that location 75, situated on the Arroyo del Coyote (downgradient), is a fairly new sampling location, added in 1995 and limited data has been collected.

Aluminum – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
72, 75	7,676.92 mg/kg	8,196.30 mg/kg

Barium - Onsite location 72 was observed to have an increasing trend for barium with ranging from 52–220 mg/kg, well below the RCRA Subpart S action level of 5,600 mg/kg.

Barium – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
72	99.56 mg/kg	193.37 mg/kg

Chromium - Perimeter location 60 showed an increasing trend for chromium with values ranging from 18–39 mg/kg. The RCRA Subpart S action level is 400 mg/kg.

Chromium – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
60	27.56 mg/kg	29.63 mg/kg

Cobalt - Two onsite locations, 72 and 75, showed an increasing trend for cobalt with combined values ranging from 3.1–6.3 mg/kg, well below the RCRA Subpart S action level of 4,800 mg/kg. It should be noted that location 75, (Arroyo del Coyote – downgradient), is a fairly new sampling location, added in 1995 and limited data has been collected.

Cobalt – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
72, 75	4.41 mg/kg	4.28 mg/kg

Copper - Three onsite locations (72, 74, and 75) and one perimeter location (60) showed an increasing trend for copper with combined values ranging from 6.7–25 mg/kg, well below the RCRA Subpart S action level of 3,000 mg/kg. Locations 74 (Tijeras Arroyo: mid-stream) and 75 (Arroyo del Coyote) were added in 1995.

Copper – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
72, 74, 75, 60	10.00 mg/kg	9.91 mg/kg

Lead - Onsite location 73 showed an increasing trend for lead with values ranging from 0.5–7 mg/kg. There is no RCRA Subpart S action level defined for lead. The U.S. surface soil concentration is between 10–70 mg/kg (CRC 1992). The usual detection limit for lead is 5 mg/kg.

Lead – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
73	5.50 mg/kg	13.70 mg/kg

Nickel - Onsite location 72 was observed to have an increasing trend for nickel. Values

ranged from 6–13 mg/kg, well below the RCRA Subpart S action level of 1,600 mg/kg.

Nickel – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
72	8.67 mg/kg	8.67 mg/kg

Zinc - Onsite location 72, and perimeter location 60 both showed an increasing trend for zinc. Combined values ranged from 21–58 mg/kg, well below the RCRA Subpart S action level of 23,000 mg/kg.

Zinc – Sediment		Cat-3
Location	1993 - 1998 Average Value	Offsite Average Value
72, 60	30.06 mg/kg	39.52 mg/kg

4.8.4 Surface Water Results

In 1998, surface water grab samples were taken offsite at the Rio Grande and Las Huertas Creek. As mentioned earlier, the Groundwater Protection Program (GWPP) has responsibility for sampling the onsite Coyote Springs location. The Rio Grande, being an offsite location, is not classified as either a Category 2 or Category 3. Samples are taken at upgradient and downgradient locations to ascertain if a difference in contaminant load is present in the analyzed parameters. 1998 results showed that there was no statistical difference between the upgradient and downgradient samples.

4.9 NON-ROUTINE SURVEILLANCE ACTIVITIES

City of Albuquerque Soil Amendment Facility

Non-routine soil samples were collected in 1997 and 1998 at the City of Albuquerque Soil Amendment Facility (SAF). Sludge from the

sewer treatment plant is trucked to the facility, and allowed to dry. Some is taken for sale as compost at local nurseries, and the rest is tilled into the ground at one of 16 fields at the SAF. The fields are rotated on a semi-annual basis, such that each field is used for approximately six months every seven years.

SNL/NM is currently prohibited from discharging any measurable radioactivity above natural background, into the sanitary sewer system. Sampling was conducted to establish a baseline level of radioactivity at the facility, in anticipation of a change to the City of Albuquerque's "Sewer Use and Wastewater Control Ordinance," which should allow discharges of low-level radioactive waste water by SNL. In 1998, samples were collected at the field in use (#9) and the two most recently used fields (#5 and #4). In 1997, samples were collected at all 16 fields and from the sludge set aside for sale to the public. Since some institutions, primarily hospitals, are allowed to discharge radioactive materials to the sanitary sewer, this baseline sampling should aid in future evaluations of SNL's contribution, if any, to the radiological conditions at the SAF.

Samples were analyzed for gamma spec, tritium, and U_{tot} . The handling, treatment, and tilling process makes it reasonable to assume that any radioactivity present in any given field is distributed fairly homogeneously. Nevertheless, to ensure that the samples were as representative as possible of the average conditions at each field, the samples were collected as composites from the (approximate) four quadrants of each field.

Because the samples are a mixture of sludge and soil, there is no real "background" point of comparison for this type of sample. In 1997 and 1998, U_{tot} and tritium levels were greater than those in offsite surface soil samples. The U_{tot} difference is likely due to the concentration, in the sludge, of the naturally-occurring uranium in groundwater. The cause of the increased tritium concentration is

unknown. In 1997 and 1998, no unexpected radionuclides were identified by gamma spectroscopy. Cesium-137 was detected in many of the samples, but the concentrations were at or below that seen in offsite surface soils due to fallout from past nuclear testing. This is likely due to the dilution caused by the mixing of surface soils with sludge that has relatively low cesium-137 concentrations, as well as the tilling process itself (mixing with subsurface soils).

4.10 ECOLOGICAL STUDIES

TA-II Monitoring Study

Ecological monitoring was conducted at SNL/NM over a period of four months from June through September 1998. The study collected baseline information on small mammals, birds, and vegetation. Various data sets were compiled including visual population counts, mark-and-release trapping, and contamination data. Contamination data was obtained from the tissue samples of several rodents.

The purpose of the study is to compare animal and plant populations inhabiting or frequenting TA-II (a known area of contamination) with similar species found in an uncontaminated control site. TA-II is the site of several Environmental Restoration (ER) areas including the Classified Waste Landfill (CIWL). The control site was located at the southeastern end of KAFB near the perimeter fence between the base and the Isleta Pueblo.

Baseline Monitoring

Baseline monitoring is performed to record basic environmental conditions at both the control site and TA-II, such as population

estimates, and plant/animal species identification. (In 1998, however, population data were not taken at the control site due to budget restraints.) The mark-and-release portion of the study recorded individual data on each captured animal, such as species, sex, various body dimensions, and the number of recaptures. Small mammals found at TA-II included:

- Grasshopper mouse (*Onychomys leucogaster*)
- Silky pocket mouse (*Perognathus flavus*)
- Deer mouse (*Peromyscus maniculatus*)
- Brush mouse (*Peromyscus boglii*)

Twelve bird species were recorded. The most common included the western meadowlark (*Sturnella neglecta*) and the mourning dove (*Zenaida macroura*).

Contaminant Monitoring

Contamination data were collected using mice for whole body tissue analysis at both the study site and the control site. This was necessary to determine what internal contaminant loads were present. Tissue samples were analyzed for radiological parameters—tritium, strontium-90, U_{tot} , and by gamma spectroscopy.

FIGURE 4-5. Merriam's Kangaroo Rat

Nonradiological parameters included all metals as listed in Section 4.7. Results were compared to determine statistical differences between species located in the vicinity of TA-II with species from the uncontaminated control site. No statistical difference was noted between the two sites. All results are given in the ecological monitoring report (SNL 1999k).

Small mammals found at the control site included:

- Silky pocket mouse (*Perognathus flavus*)
- Deer mouse (*Peromyscus maniculatus*)
- Merriam's kangaroo rat (*Dipodomys merriami*) (Figure 4-5)
- White-footed mouse (*Peromyscus leucopus*)

TABLE 4-7. Important Documents for the Terrestrial Surveillance Program

Program Document	Reference
SNL/NM Summary Pamphlet Calendar Year 1998, Summary of the Annual Site Environmental Report (ASER)	SNL 1998o
Environmental Monitoring Plan	SNL 1996g
Environmental Monitoring and Surveillance Program (PG)	SNL 1998d
Quality Assurance Project Plan (QAPjP) for Terrestrial Surveillance	SNL 1996h
Environmental ALARA Program (PG)	SNL 1996i
The Role of Data Analysis in Sampling Design of Environmental Monitoring	Shyr, Herrera, and Haaker 1998
1998 Data Analysis Report in Support of the Site Environmental Report	SNL 1999i
Ecological Monitoring for 1998: Small Mammals, Birds, and Vegetation	SNL 1998n

NOTE: PG denotes a "Program Document," which is a special type of ES&H document.

Air Quality Compliance and Meteorological Monitoring

SNL/NM produces both radiological and nonradiological air pollutants from facility operations that include research and development activities, environmental remediation, waste handling, steam-generated heating, paint and machine shop work, emergency generator use, and vehicle emissions. Air quality compliance is met by adhering to specific permit conditions, keeping required records, and periodic direct emission sampling, as required. SNL/NM complies with local, State, and Federal regulations in accordance with the objectives of the Clean Air Act (CAA) and the Clean Air Act Amendments (CAAA) of 1990.

5.1 METEOROLOGICAL MONITORING PROGRAM

The Meteorological Monitoring Program at SNL/NM commenced operations in January 1994 with the initiation of the Clean Air Network (CAN) Program. This program, which is part of the Environmental and Emergency Management Department, conducts both meteorological and ambient air monitoring activities (Section 5.2).

The Meteorological Program is essential to compliance with the following regulations and DOE Orders:

- DOE Orders—5400.1, *General Environmental Protection Program* (DOE 1990)

- DOE 151.1, *Comprehensive Emergency Management* (DOE 1996d)
- 10 CFR 834 (proposed), “Radiation Protection of the Public and the Environment”
- 40 CFR 51, “Guidelines for Onsite Meteorological Measurements”

Meteorological data generated is used in air dispersion modeling as well as in support of regulatory permitting. All data are consistent with program guidelines required for these regulatory modeling applications.

Tower Instrumentation

The meteorological monitoring network consists of eight fully instrumented meteorological towers: six 10-meter towers, one 50-meter tower, and one 60-meter tower. Tower locations are illustrated in Figure 5-1. All meteorological towers are instrumented to measure temperature, wind velocity, and the standard deviation of horizontal wind speed (sigma theta) at 3- and 10-meter levels, and at the top of the two taller towers (with the exception of tower A15, which has no 3-meter level instrumentation). Additionally, relative humidity is measured at all 3-meter instrumented levels. Both rainfall and barometric pressure are measured at the 1-meter level at towers A36 and A21; tower SC1 measures rainfall only at the 1-meter level. All instrumentation is checked weekly and calibrated on a routine basis.

99_5-1.ai

FIGURE 5-1. Meteorological Tower Network at the SNL/NM Site

Uses for Meteorological Data

The primary objective of the Meteorological Monitoring Program is to provide representative local meteorological data for atmospheric dispersion and transport calculations. Other uses include: (1) providing meteorological information to emergency response personnel in the event of a hazardous or other unplanned release, (2) contributing to the regulatory permitting process and decision making, (3) determining optimum air monitoring station locations, and (4) providing meteorological data to SNL/NM's research and development projects.

5.1.1 Meteorological Monitoring Results

The A36 60-meter tower is used to describe general meteorology at SNL/NM because of its central geographic position and availability of data at all instrument levels. The A15 50-meter tower, while closer to the most populous part of SNL/NM in TA-I, shows micro-scale urbanization effects not seen within the rest of the network. The 1998 annual climatic summary, which was developed using information from the A36 tower, is shown in Table 5-1.

TABLE 5-1. The 1998 Annual Climatic Summary from Tower A36

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Totals
Temperature (°C)													
Daily Maximum	7.4	10.3	17.4	18.8	24.2	30.6	28.5	26.9	25.1	20.7	13.1	9.8	19.4
Daily Minimum	-0.3	-1.8	0.2	3.8	12.1	16.2	19.8	20.4	20.0	6.8	0.1	-4.2	7.7
Average	3.8	3.5	7.5	10.6	18.9	23.6	23.4	23.9	23.2	14.3	8.6	3.8	13.8
Temperature Extremes (°C)													
High	13.7	19.4	24.2	26.2	31.3	37.9	35.4	33.8	31.7	28.0	18.8	15.7	37.9
Low	-5.6	-6.8	-6.8	-2.7	1.3	8.4	14.2	14.0	10.9	0.3	-5.3	-11.0	-11.0
Relative (%) Humidity													
	54.6	55.2	46.5	34.0	21.5	18.1	53.2	43.7	32.8	46.3	50.7	49.9	42.2
Precipitation (cm)													
Monthly	0.4	2.1	7.4	1.7	0.00	0.4	6.3	4.7	1.4	4.0	0.7	0.4	29.5 total
24-Hour Max	0.2	1.3	3.7	1.6	0.00	0.4	2.0	2.3	0.9	1.0	0.4	0.4	3.7 max
Wind (m/s)													
Monthly	2.6	3.6	3.9	4.0	4.2	4.4	3.4	3.7	3.7	3.9	2.7	3.1	3.6
24-Hour Max	4.6	7.4	6.7	6.5	6.5	6.7	6.0	8.4	6.3	7.8	6.5	6.9	8.4 max
Maximum Gust	18.5	26.9	24.5	22.9	24.5	19.7	22.1	23.7	19.7	22.1	21.3	20.5	26.9 max
Barometric Pressure (mb)													
	832.8	829.5	830.7	832.1	832.8	833.0	838.0	838.9	835.1	835.6	836.0	836.5	834.2

NOTE: m/s = meters/second cm = centimeters in. = inches mb = millibars mph = miles per hour

°F = Farenheight °C = Celsius

Conversions to English Units: Temperature °F = (1.8 °C) + 32
 Wind Speed mph = (m/s)(2.2369)
 Rainfall in. = (2.54)(cm)

In general, the annual statistics for each of the towers are similar. However, daily meteorology at each site varies considerably across the network. This has implications on transport and dispersion of pollutants, which is particularly important in atmospheric emergency release scenarios and dispersion modeling. Table 5-2 lists some of the extremes and variations found in meteorological measurements across SNL/NM.

5.1.2 Wind Analysis

Figure 5-2 portrays annual wind roses for three locations across SNL/NM. A wind rose is a graphical presentation of wind speed and direction frequency distribution. Wind direction is the true bearing when facing the wind (the direction from which the wind is blowing). As seen in the figures, wind directions and speeds can vary significantly across SNL/NM. Although not shown, the annual wind frequency distribution for TA-I shows a different pattern with the greatest direction frequency from the east and east-northeast, as winds blow from Tijeras Canyon. The annual predominant direction at most towers is produced by the topographic influences that create nocturnal drainage flows.

A comparison of the A15 tower wind speed data with the rest of the network reveals building effects (urbanization) on wind speed; the large percentage of calms and very low wind speeds produces the slowest average annual wind speed as shown in Table 5-2. In addition to the lower wind speeds, stability class frequency (not shown) is also affected by the variations in wind direction by flow around and over buildings. Completely lost in the annual frequency distribution, is the diurnal pattern of wind flow common through many areas of SNL/NM. Figure 5-3 shows the day and night wind frequency distributions, respectively, for tower A36. In general, the closer to the mountains or canyons the greater the frequency of winds coming from the easterly directions at night.

Daytime wind patterns are not quite as pronounced, but generally flow toward the mountains or channel into the canyons.

5.2 AMBIENT AIR SURVEILLANCE PROGRAM

Ambient air surveillance, conducted within the CAN Program, is integral to compliance with 40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards," and 40 CFR 58, "Ambient Air Quality Surveillance." Monitoring activities also follow DOE Order 5400.1 (DOE 1990). A complete list of applicable air quality regulations is given in Table 5-12 (Section 5.5).

The primary objective in gathering ambient air surveillance data is to establish background concentration levels for pollutants of concern, show compliance with the National Ambient Air Quality Standards (NAAQS) and local ambient air quality standards, and evaluate effects, if any, from SNL/NM's operations on the public and the environment.

Ambient air monitoring is performed at six locations with 10 monitors described briefly below and illustrated in Figure 5-4.

- **Criteria Pollutant Monitoring Station (CPMS)** – There is one CPMS in the network, located in the most populated area of SNL/NM. The CPMS performs continuous monitoring of sulfur dioxide (SO₂), carbon monoxide (CO), nitrous oxides (NO_x), and ozone (O₃). Data are then compiled into hourly averages. A particulate monitor is part of the CPMS and is also used to collect data on lead (Pb) concentrations.

TABLE 5-2. Variations and Extremes in Meteorological Measurements Across the Meteorological Tower Network

Extremes and Variations Across the CAN Network

Wind Speed

	Minimum (m/sec)	Maximum (m/sec)	Spread (m/sec)
○ Average Annual Wind Speed	2.73 (A15)	3.80 (CW1)	1.07
○ Greatest Difference in Wind Speed over 24 hours	3.33 (MW1)	8.30 (SC1)	4.97
○ Greatest Difference in Daily Maximum Wind Speed	14.9 (A21)	28.5 (SC1)	13.6
○ Average Difference in Daily Wind Speed	1.34 (all towers)		

Temperature

	Minimum (°C)	Maximum (°C)	Spread (°C)
○ Average Annual Temperature	13.3 (SC1)	13.9 (A21)	0.6
○ Network Annual Temperature Extremes	-12.3 (CW1)	39.8 (A15)	52.1
○ Greatest Variation in Daily Minimum Temperature	4.1 (KU1)	6.1 (SC1)	2.0
○ Greatest Difference in Average Daily Temperature	3.67 (SC1)	7.03 (A36)	3.35
○ Greatest Variation in Daily Maximum Temperature	14.6 (SC1)	18.7 (CW1)	4.1

Precipitation

	Minimum (cm)	Maximum (cm)	Spread (cm)
○ Annual Precipitation (Extremes)	29.50 (SC1)	36.63 (A21)	7.13
○ Daily Rainfall Variation	0.56 (SC1)	1.95 (A36)	1.39
○ Greatest Monthly Precipitation Difference	6.25 (A36)	10.16 (SC1)	3.91
○ Greatest in Daily Rainfall		4.37 (SC1)	

Note: Tower locations are shown in parentheses. Winter precipitation that falls as snow is underestimated (mostly at the SC1 tower).

FIGURE 5-2. 1998 Annual Wind Roses for Towers CL1, A36, and SC1

FIGURE 5-3. 1998 Annual Wind Roses for Daytime and Nighttime Wind Frequency at the A36 Tower

99_5-3.ai

99_5-4.ai

FIGURE 5-4. Ambient Air Monitoring Equipment Located at Six Stations

- **Particulate Matter (PM) Stations** – There are six PM monitoring stations distributed throughout the site. PM with a diameter equal to or less than 10 microns (PM_{10}) is a criteria pollutant because it is an inhalation hazard. PM_{10} samples are collected over a 24-hour period starting and ending at midnight, every sixth day. This schedule is consistent with the National Air Sampling Program. Monitoring at one site was discontinued in August 1998.
- **Volatile organic compound Stations** – There are four VOC monitoring stations. VOCs comprise the organic vapors given off by chemicals such as petroleum products and solvents. VOC samples are collected once a month over a 24-hour period.

5.2.1 Ambient Air Monitoring Results

Criteria Pollutants

The automated data recovery for criteria pollutants in 1998 was 97.6 percent. Criteria pollutants, as defined by the EPA, are sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter, and lead (Pb). The CPMS station measures gaseous criteria pollutants and particulate lead. Table 5-3 lists the State and Federal ambient air quality standards for criteria pollutants and monitored results from the CPMS.

Annual Federal standards for criteria pollutants cannot be violated, however, exceedences of the short-term standards are allowable once a year. State standards also allow short-term exceedences due to meteorological conditions such as in the case of an atmospheric inversion where air mixing may be extremely restricted. There were no short-term exceedences or violations in 1998.

In 1997, the EPA reviewed several NAAQSs. The form of the standard for ozone was changed from an hourly standard of 0.120 ppm to an

8-hour standard of 0.080 ppm. The fourth highest daily maximum may not exceed this value. A new standard was developed for PM to include particulates with a diameter less than or equal to 2.5 μm . Data gathering for this pollutant commenced in 1998, and will be nation-wide by the end of 1999.

Particulate Matter - PM_{10}

Data recovery for PM_{10} was 88 percent complete based on the every-sixth-day sampling schedule. In general, 24-hour (daily) PM_{10} concentrations were low except for several occasions during the warm season when gusty winds re-suspended soil particles. The highest daily particulate loading (35 $\mu g/m^3$) occurred at the CWPM site (Table 5-3). Table 5-4 lists the quarterly PM_{10} averages and the annual average at each location. The CWPM station had the highest annual loading for 1998 due to construction activities in the area. There were no exceedences of Federal or State standards for PM_{10} during 1998.

Table 5-5 shows the types of radiological and nonradiological analyses conducted on samples collected at each PM_{10} station. PM samples are analyzed for 20 metals and four radiological determinations. Filters are consolidated into monthly composites for the analyses. Monthly composites varied from four to six filters per month throughout 1998 depending on the sampling schedule and some missed samples (for example, monthly composites for two months contained four instead of five filters due to missed samples). Analyses are conducted by an EPA-approved offsite laboratory. The laboratory results for the samples are subtracted from the monthly blank analysis. The final analytical results are averaged over the year (Table 5-6) and compared to threshold limit values (TLVs) as a reference using time weighted averages (TWAs).

The PM_{10} analytical results are generally consistent with metals found in local soil analyses at SNL/NM. As can be seen from Table 5-6, beryllium, as a total metal, was not

TABLE 5-3. 1998 Criteria Pollutant Results as Compared to Regulatory Standards

Criteria Pollutant	Averaging Time	Unit	NMAQS Standard	NAAQS Standard	Yearly Summary of Measured Concentrations
Carbon Monoxide	1 hour	ppm	13.1	35	4.93
	8 hours	ppm	8.7	9	2.28
Nitrogen Dioxide	24 hours	ppm	0.10		0.035
	Annual	ppm	0.05	0.053	0.014
Sulfur Dioxide [§]	3 hours	ppm		0.50	0.023
	24 hours	ppm	0.10	0.14	0.003
	Annual	ppm	0.02	0.03	
Ozone	1 hour	ppm	0.12	0.12	0.081
	8 hour	ppm		0.080	0.070
PM ₁₀	24 hours	µg/m ³	150	150	35*
	Annual	µg/m ³		50	12.20**
Total Suspended Particulates	7 days	µg/m ³	110	Not	N/A
	30 days	µg/m ³	90	Applicable	N/A
Lead	30 days	µg/m ³			0.0001
	Any quarter	µg/m ³		1.5	< 0.0001

NOTE: ppm = parts per million; µg/m³ = micrograms per cubic meter

N/A = not available

NMAQS = New Mexico Air Quality Standards

NAAQS = National Ambient Air Quality Standards

[§]Standards are defined in µg/m³ and have been converted to ppm.

* Highest 24-hour particulate loading measured at the CWPM site in September.

** Highest annual particulate loading measured at the CWPM site.

TABLE 5-4. Quarterly and Annual Averages of PM₁₀ at SNL/NM for 1998

Station	Jan-Mar (µg/m ³)	Apr-Jun (µg/m ³)	Jul-Sep (µg/m ³)	Oct-Dec (µg/m ³)	Annual (µg/m ³)
A2PM	7.27	14.73	16.78	9.61	12.10
CPMS	8.55	14.87	13.93	9.42	11.69
CWPM	8.13	12.35	16.89	11.42	12.20
KUPM	6.22	14.18	16.08	8.86	11.33
MWPM	6.17	12.93	Closed Station		9.55
PVPM1	7.35	14.07	15.38	8.78	11.39

NOTE: µg/m³ = micrograms per cubic meter

TABLE 5-5. PM₁₀ Sample Analyses Conducted at the Five PM Monitors and the CPMS Site

Station	ICP Metals	Total Uranium	Gamma Spectroscopy	Gross Alpha	Gross Beta
PVPM	✓		✓	✓	✓
CWPM	✓		✓	✓	✓
A2PM	✓		✓	✓	✓
KUPM	✓	✓	✓	✓	✓
MWPM	✓	✓	✓	✓	✓
CPMS	(lead only)	--	--	--	--

NOTE: PM₁₀ = particulate matter (diameter equal to or less than 10 microns)

ICP = Inductively Coupled Plasma (method)

TABLE 5-6. PM₁₀ Average Annual Concentration by Station Location

Analyte	Units	A2PM	CWPM	KUPM	MWPM	PVPM1	CPMS*	TLV**
Metals								
Aluminum	ug/m ³	0.0862	0.1098	0.0895	0.0676	0.0661		2,000
Arsenic	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000		10
Barium	ug/m ³	0.0032	0.0022	0.0026	0.0013	0.0034		50
Beryllium	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000		2
Cadmium	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000		10
Calcium	ug/m ³	0.2770	0.2549	0.1543	0.0747	0.2229		2,000
Chromium	ug/m ³	0.0001	0.0001	0.0002	0.0001	0.0002		10
Cobalt	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000		20
Copper	ug/m ³	0.0126	0.0050	0.0119	0.0055	0.0156		1,000
Iron	ug/m ³	0.0909	0.1044	0.0856	0.0668	0.0786		5,000
Lead	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	150
Magnesium	ug/m ³	0.0408	0.0379	0.0353	0.0309	0.0322		10,000
Manganese	ug/m ³	0.0026	0.0030	0.0024	0.0020	0.0022		200
Molybdenum	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000		5,000
Nickel	ug/m ³	0.0000	0.0000	0.0003	0.0001	0.0002		50
Potassium	ug/m ³	0.0417	0.0411	0.0421	0.0325	0.0451		N/A
Selenium	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000		200
Silicon	ug/m ³	0.0266	0.0217	0.0459	0.0117	0.0296		10,000
Silver	ug/m ³	0.0000	0.0000	0.0000	0.0000	0.0000		10
Sodium	ug/m ³	0.6024	0.7443	0.6302	0.2369	0.8363		5,000
Thallium	ug/m ³	0.0002	0.0000	0.0002	0.0000	0.0001		100
Vanadium	ug/m ³	0.0002	0.0002	0.0002	0.0002	0.0002		50
Zinc	ug/m ³	0.0033	0.0018	0.0018	0.0018	0.0032		10
Radionuclides								
Gross Beta	pCi/m ³	0.0185	0.0182	0.0203	0.0192	0.0167		N/A
Gross Alpha	pCi/m ³	0.0075	0.0074	0.0047	0.0047	0.0079		N/A
Beryllium-7	pCi/m ³	0.1403	0.1280	0.1462	0.1493	0.1588		N/A
Potassium-40	pCi/m ³	0.0326	0.0197	0.0180	0.0408	0.0285		N/A
Uranium-total	ug/m ³		0.0000	0.0000	0.0000			200

NOTE: TLV = threshold limit value The TLV is a guideline to assist in the control of health hazards.

TLVs are not legal standards.

N/A = not applicable

* The PM monitor at the CPMS measures only particulate Pb concentrations.

** Values listed are time-weighted averages (TWA's). TWA is the concentration for a normal 8-hour work day and 40-hour week, to which nearly all workers may be exposed without adverse effect.

found above the detection limit—but it was found in the gamma analysis. All radiochemistry data are used in the averaging routine for reporting, regardless of the detection limit for that specific sample. This generally produces more conservative (higher total) concentrations.

Due to the low averages, a relatively small variation between the sites may be misinterpreted as a significant difference. An analysis of variance was performed to determine if concentrations of any analyte were statistically and significantly different at any site. Results of this variance test showed that copper in the soil is statistically less at the MWPM and CWPM sites. These results are consistent with historical results depicting slightly higher copper concentrations at monitors near the Tijeras Arroyo area soils group.

Volatile Organic Compounds (VOCs)

Data recovery for VOC monitoring was 92 percent. Monthly VOC samples were analyzed for 30 VOC species and total non-methane hydrocarbon (TNMHC). Monthly results for compounds detected are reported as averaged concentrations as shown in Table 5-7. These averages are not annual averages due to the method of including the sample only if the compound is detected. This type of averaging is done to prevent diluting the reported average.

The VOCs generally observed at SNL/NM are products or by-products of fossil fuels or found in solvents. An analysis of variance was performed on the monthly results to determine if VOC concentrations of any analyte were statistically and significantly different compared to other sites. Increased construction activity at a few sites coupled with the network configuration changes, discussed below, influenced sampling and variances between the sites in 1998. The only statistically significant

(at the 90 percent level) analyte and site was benzene at the CPMS. This variance is consistent with previous years, as the site is located at an intersection and is across the street from the motor pool.

VOC Sampling Site Changes

The VOC sampling network was reconfigured in 1998 with the removal of two locations and the addition of two locations.

Closed Stations

- **Chemical Waste Landfill (CWL)** - Environmental restoration activities at the CWL commenced September 1998, prohibiting access to the CWL sampling site.
- **Mixed Waste Landfill (MWL)** - Sampling was terminated at the MWL with the scheduled completion of the capping of the landfill coupled with the results of five years of sampling data.

New Stations

- **Corrective Action Management Unit (CAMU)** - The routine sampling site that will take the place of the CWL site is the CAMU site, located to the northwest of the old station. A complete year of data was taken from the CAMU station in 1998.
- **Microelectronics Development Laboratory (MDL)** - A new VOC site was added to monitor conditions near the MDL. The station is situated between the MDL and Robotic Manufacturing Science and Engineering Laboratory (RMSEL). Two samples were taken at the new station in 1998.

TABLE 5-7. VOC Average Concentration by Station Location Compiled from Monthly Results
These averages are not true annual averages due to the method of including the sample only if the compound is detected.

Compound	CPMS (ppbv)	CAMU (ppbv)	CWL (ppbv)	MWL (ppbv)	TA-II (ppbv)
1,1,1-Trichloroethane	5.38	3.71	0.37	12.82	0.12
1,2-Dichloroethane	ND	ND	0.04	ND	0.07
1-Butene/Isobutene	0.28	0.28	0.14	0.17	0.26
2,2,4-Trimethylpentane	0.19	0.10	0.09	0.31	0.10
2-Butanone	0.42	0.92	0.28	0.26	0.59
3-Methylpentane	0.22	0.12	0.09	0.14	0.14
Acetone	5.78	18.10	5.09	4.30	7.34
Benzene	0.46	0.17	0.17	0.25	0.31
Carbon tetrachloride	0.10	0.10	0.09	0.11	0.10
Chlorobenzene	0.05	0.05	0.05	0.05	0.05
Chloromethane	0.52	0.52	0.52	0.51	0.52
Dichlorodifluoromethane	0.55	0.54	0.51	0.53	0.55
Ethylbenzene	0.13	0.07	0.08	0.13	0.09
Halocarbon 113	0.09	0.10	0.09	0.08	0.09
Isohexane	0.34	0.12	0.16	0.26	0.27
Isopentane	2.16	1.67	2.41	1.85	5.31
m/p-Xylene	0.34	0.12	0.16	0.25	0.23
Methylene chloride	0.46	0.30	1.17	0.72	0.39
Methylisobutylketone	ND	0.12	ND	ND	0.09
n-Butane	1.39	0.63	0.67	0.95	1.01
n-Hexane	0.38	0.15	0.37	0.24	0.33
n-Pentane	0.83	0.48	1.41	0.72	1.12
n-Undecane	0.09	0.03	0.10	0.09	0.03
o-Dichlorobenzene	0.06	0.02	ND	0.02	0.03
o-Xylene	0.15	0.06	0.07	0.08	0.10
Tetrachloroethene	0.09	0.11	0.10	0.12	0.12
Toluene	0.82	0.27	0.38	0.46	0.78
Trichloroethene	0.06	0.07	0.07	0.06	0.08
Trichlorofluoromethane	0.29	0.28	0.33	0.28	0.28
TNMHC	22.95	64.24	16.12	69.32	24.21

NOTE: The analytical laboratory refined the equipment used for analyses during the year, resulting in better speciation of compounds. For this reason compounds are included separately and in combination with another analyte in the table.

ND = not detected

TNMHC = total non-methane hydrocarbons

TLV= threshold limit value The TLV is a guideline to assist in the control of health hazards.

TLVs are not legal standards.

*Values listed are time-weighted averages (TWAs) except where marked. TWA is the concentration for a normal 8-hour work day and 40-hour week, to which nearly all workers may be exposed without adverse effect.

** Short-term exposure limit (STEL) is a 15-minute TWA not to be exceeded at any time during the work day.

5.3 RADIOLOGICAL AIR EMISSIONS

The NESHAP Program is conducted under the Environmental and Emergency Management Department. NESHAP compliance support is provided to all SNL/NM source owners subject to radionuclide air emissions regulations. The EPA regulates radionuclide air emissions in accordance with 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." Dose is calculated using the Clean Air Act Assessment Package-1988 (CAP88) computer code (EPA 1995).

The EPA has set a maximum individual dose limit of 10 mrem/yr resulting from the combined radiological emissions produced from any DOE facility. The average dose (based on the national average) a person receives from all radioactive sources—natural and manmade—is 360 mrem/yr. The bulk of this dose comes from natural sources such as radon (53 percent) emitted from earth materials, radioactive elements within the body (11 percent), and cosmic radiation (8 percent).

Compliance Reporting

The *NESHAP Annual Report for CY 1998* was submitted to the EPA, as required, by June 30, 1999 (SNL 1999d [1]). The report contains listed radionuclide emissions from each of SNL/NM's 17 applicable facilities (Figure 5-5) and a summary of the dose assessment results (discussed in Section 5.4). The annual report is also submitted to the DOE. A more comprehensive supplemental document detailing facility emission factors, demographic data, and dose assessment calculations is available to the EPA and the DOE upon request (SNL 1999d [2]). Other NESHAP program documents are listed in Table 5-13 at the end of this chapter.

Radionuclide emissions are described as either point or diffuse sources. Point sources are produced from an exhaust stack or vent, while diffuse sources emanate from broad areas of contamination, such as radionuclide-contaminated soils present at an Environmental Restoration (ER) site. Table 5-8 lists the radionuclides and total curies released from each SNL/NM NESHAP source. In 1998, there were a total of 14 point sources and three diffuse sources (landfills) listed in the NESHAP report. One of the diffuse sources, the Chemical Waste Landfill (CWL), is not a routine NESHAP source. It was evaluated through modeling in 1998 to ensure that any releases were as low as expected. Two of the routine sources, the Hot Cell Facility and the Z Accelerator had no releases in 1998.

NESHAP Compliance Requirements

NESHAP regulation requires direct stack monitoring for facilities, or direct air monitoring of diffuse sources, for any radiological air emission source that has the *potential* to produce a threshold dose at greater than 0.1 mrem/yr to a member of the public. This is termed the "effective dose equivalent" (EDE) to the "maximally exposed individual" (MEI).

Best Management Practices

Currently, there are no facilities at SNL that have the potential to produce a 0.1 mrem/yr dose from its routine operations. Therefore, direct radiological air emission monitoring is not required for any facility at SNL. However, as a "Best Management Practice," SNL performs voluntary stack monitoring at some of its facilities.

Calculating Releases

Releases are calculated from measured facility parameters (e.g. power output for the reactors) periodic monitoring, and/or continuous monitoring. Doses are determined by performing a dose assessment using EPA's CAP88 software package. Parameter input into the computer code includes calculated releases from key facilities, demographic data, and spatial parameters.

FIGURE 5-5. Locations of the 17 Facilities at SNL/NM that Reported Radionuclide Releases in 1998

In 1998, the highest activities found in SNL/NM's atmospheric emissions were primarily the result of argon and tritium. Historically, these are the radionuclides that have generally been the most significant releases over the past 10 years. Figure 5-6 summarizes the annual release in curies from these primary constituents since 1989.

TA-I Sources

There were six radionuclide air emission sources in TA-I in 1998. One was used in the CAP88 dose assessment.

- **Neutron Generator Facility (NGF)** – The NGF is the principal production facility of neutron generators used in nuclear weapons. This facility currently emits only tritium. The facility has two stacks: the Principal Production Facility East Annex and the Tritium Envelope North Wing. NGF emission results were used in CAP88 calculations. This facility had the highest

reported release in 1998 of all 17 NESHAP sources.

- **Metal Tritide Laboratory** – This lab, which, conducts research on tritium materials, released only tritium.
- **Calibration Laboratory** – Calibration on radiation detection equipment resulted in minute releases of tritium.
- **Radiation Laboratory** – Small-scale radiation experiments resulted in the release of released air-activation products and tritium. (Moved from Bldg. 827.)
- **TANDEM Accelerator** – The TANDEM is an ion solid interaction and defect physics accelerator facility. Reported emissions included air activation products, fluorine, and tritium.

TABLE 5-8. Summary of Radionuclide Releases from the 17 NESHAP Sources in 1998

Tech Area	Facility Name	Location	Monitoring Method *	CAP88 Modeling Status	Radionuclides Emitted	Release (Ci/yr)
V	Annular Core Research Reactor (ACRR)	Bldg. 6588	Periodic	CAP88	Argon-41	3.5×10^{-2}
V	Sandia Pulsed Reactor (SPR)	Bldg. 6590	Calculation	CAP88	Argon-41	4.79
V	Hot Cell Facility (HCF)	Bldg. 6580	Periodic	CAP88 – not in 1998	none	0
IV	High-Energy Radioactive Megavolt Electron Source (HERMES III)	Bldg. 970	Periodic	CAP88	Nitrogen-13 Oxygen-15	8.55×10^{-4} 8.55×10^{-5}
IV	Z-Facility (Accelerator)	Bldg. 983	Calculation	CAP88 – not in 1998	none	0
III	Mixed Waste Landfill (MWL) (Diffuse emissions)	TA-III, north	Periodic	CAP88	Tritium	2.94×10^{-1}
III	Chemical Processing Laboratory	Bldg. 6600	Calculation	none	Sodium-22 Americium-241 Uranium-232 Plutonium-241	2.4×10^{-12} 1.0×10^{-13} 1.0×10^{-13} 1.0×10^{-13}
III	Radioactive and Mixed Waste Management Facility (RMWMF)	Bldg. 6920	Periodic	CAP88	Tritium	4.50×10^{-1}
III	Chemical Waste Landfill (CWL) (Diffuse emissions)	TA-III, south	Calculation	CAP88 (not routine)	Tritium Uranium-234 Uranium-235 Uranium-238 Thorium-228 Thorium-231 Thorium-232 Thorium-234 Protactinium-234m Lead-212 Lead-214 Bismuth-212 Bismuth-214 Radium-224 Radium-228 Thallium-208 Actinium-228	1.8×10^{-7} 1.2×10^{-8} 2.7×10^{-9} 1.2×10^{-7} 1.6×10^{-8} 2.7×10^{-9} 1.6×10^{-8} 1.2×10^{-7} 1.2×10^{-7} 1.0×10^{-8} 3.4×10^{-9} 3.5×10^{-8} 3.1×10^{-9} 5.1×10^{-8} 5.0×10^{-8} 2.9×10^{-8} 3.3×10^{-8}
II	Classified Waste Landfill (CIWL)		Calculation	none	Gross Alpha Gross Beta Tritium	1.74×10^{-14} 6.17×10^{-14} 1.93×10^{-11}

TABLE 5-8. Summary of Radionuclide Releases from the 17 NESHAP Sources in 1998 (Concluded)

Tech Area	Facility Name	Location	Monitoring Method *	CAP88 Modeling Status	Radionuclides Emitted	Release (Ci/yr)
II	Explosive Components Facility (ECF)	Bldg. 905	Calculation	none	Tritium	7.80×10^{-4}
I	Integrated Materials Research Laboratory (IMRL)	Bldg. 897	Calculation	none	Carbon-14	3.50×10^{-5}
I	Neutron Generator Facility (NGF) - East Annex, - North Wing Tritium Envelope	Bldg. 870	Calculation	CAP88	Tritium	8.1×10^{-2}
		Bldg. 870			Tritium	7.2
I	TANDEM (Accelerator)	Bldg. 884	Calculation	none	Tritium Carbon-11 Nitrogen-13 Oxygen-14 Oxygen-15 Fluorine-18	1.0×10^{-6} 1.45×10^{-8} 2.46×10^{-5} 6.29×10^{-8} 3.75×10^{-4} 2.26×10^{-6}
I	Radiation Laboratory	Bldg. 805	Calculation	none	Tritium Nitrogen-16 Nitrogen-13 Argon-41	1.0×10^{-5} 2.0×10^{-7} 1.0×10^{-8} 1.0×10^{-9}
I	Metal Tritide Shelf-Life Laboratory	Bldg. 891	Calculation	none	Tritium	5.0×10^{-9}
I	Calibration Laboratory	Bldg. 869	Calculation	none	Tritium	4.80×10^{-5}

NOTE: * Modeling Method: Periodic = Based on Measurements
Calculation = Calculated from Known Parameters

FIGURE 5-6. Summary of Atmospheric Releases of the Most Prevalent Airborne Radionuclides from SNL/NM Facilities Since 1989

- **Integrated Materials Research Laboratory (IMRL)** – The IMRL is used for research and development of new and superior materials for government and industrial needs. Carbon-14 was the only emission released from this facility.

TA-II Sources

In 1998, two sources from TA-II reported radiological releases.

- **Classified Waste Landfill (CIWL)** – This landfill is primarily a source of diffuse tritium and depleted uranium (DU). Continuous air monitoring during 1998 was conducted to monitor offsite releases since the landfill was largely uncharacterized. The air monitoring results are used to show compliance with 40 CFR 61, subpart H. Remediation will continue through 1999.
- **Explosive Components Facility (ECF)** – The ECF conducts destructive testing on neutron generators and reported releases of tritium.

TA-III Sources

Four facilities in TA-III reported NESHAP emissions in 1998. Three of these facilities were used in the CAP88 dose assessment.

- **Radioactive and Mixed Waste Management Facility (RMWMF)** – The RMWMF handles LLW and MW. In 1998, the RMWMF reported only tritium releases. RMWMF emission results were used in CAP88 calculations.
- **Chemical Processing Laboratory** – This lab, located west of TA-V, is used to perform small-scale experiments. In 1998, the facility reported emissions of sodium-22, plutonium-241, americium-241, and uranium-232.
- **Mixed Waste Landfill (MWL)** – The MWL (closed and scheduled for remediation) is a source of diffuse tritium

contamination. In 1992 and 1993, two special studies were conducted to measure the flux of diffuse tritium emissions (Radian 1994). As conditions at this landfill have remained unchanged, the measured flux is assumed to remain fairly constant. The flux value is used to estimate the annual NESHAP emissions. Emission results were used in CAP88 calculations.

- **Chemical Waste Landfill (CWL)** – This landfill is primarily a source of diffuse tritium and depleted uranium (DU). Remediation commenced in 1998. Soil samples were collected and analyzed for radioactive content to quantify the total radioactivity present at that stage of remediation. A worst case analysis was done, which assumed that all radioactivity present was re-suspended into the air. The CWL is not a routine NESHAP source, and therefore was not included in the evaluation of the dose assessment to the MEI

TA-IV Sources

There are two NESHAP facilities in TA-IV. Only one reported NESHAP emissions and was used in CAP88 calculations.

- **High-Energy Radiation Megavolt Electron Source-III (HERMES-III)** – The HERMES-III accelerator is used to test the effects of prompt radiation from a nuclear burst on electronics and complete military systems. This facility produces air activation products, primarily nitrogen-13 and oxygen-15. Emissions results were used in CAP88 calculations.
- **Z Facility** – The Z accelerator is used for research on light ion inertial confinement fusion. In 1998, the facility operated under the energy threshold required to produce air activation products and, therefore, reported zero NESHAP emissions for the year.

TA-V Sources

There are three NESHAP sources in TA-V. Two facilities had reportable NESHAP emissions and both were used in CAP88 calculations.

- **Annular Core Research Reactor (ACRR)** – This reactor is used to perform in-pile experiments to study and model severe reactor accidents. In 1997, conversion began to configure the ACRR to support the Medical Isotope Production Project (MIPP), proposed to produce radio-pharmaceuticals. Argon-41, an air activation product, was the only reported release in 1998. Emission results were used in CAP88 calculations.
- **Sandia Pulsed Reactor (SPR)** – The SPR is used to produce intense neutron bursts for effects testing on materials and electronics. The primary radionuclide emission from the SPR is argon-41, an air activation product. Emission results were used in CAP88 calculations.
- **Hot Cell Facility (HCF)** – The HCF provides full capability to remotely handle and analyze radioactive materials such as irradiated targets. The HCF is undergoing modification to enable processing of molybdenum-99 for the MIPP. No emissions were reported in 1998.

5.4 ASSESSMENT OF POTENTIAL DOSE TO THE PUBLIC

In general, the dose received by a person is dependent on the distance from the source(s), various pathways in the environment (food chain, air, and water), radionuclide half-lives and activities, and meteorological conditions. Historically, radioactive releases from SNL/NM

have been, and continue to be, several orders of magnitude below the EPA's maximum allowable standard of 10 mrem/yr. Radiation protection standards specific to DOE facilities are given in Appendix A.

Dose Calculation

To assess compliance, NESHAP facilities at SNL/NM must submit facility emission data to the NESHAP Program Administrator for input to dose assessment modeling. All annual doses presented in this section were obtained using the EPA CAP88 computer code (EPA 1995). Six facilities (not including the CWL) were used in the dose calculations.

Emission release parameters include stack height, stack diameter, and exhaust velocity. The resulting dose calculation determines the EDE to the MEI. The MEI is defined as a member of the public at any publicly accessible location such as a school, recreational area, place of business, or residence. Conservatively, this includes all non-SNL workers, (excluding SNL contractors who work as "Sandians"), members of the military and their dependents, and other non-SNL personnel working or living on KAFB or near the KAFB perimeter.

The dose calculation identifies the exact location where emissions from all facilities at SNL/NM contribute the highest EDE. CAP88 conservatively assumes that the MEI abides at the receptor location 24-hours-a-day to receive the maximum potential dose.

5.4.1 NESHAP Dose Assessment Input

Emission Sources

In 1997, a programmatic review of the SNL/NM NESHAP Program found the program to be in excess of the requirements of 40 CFR 61, Subpart H. Monitoring is required of radionuclide sources that have a potential EDE to the MEI of greater than 0.1 mrem/yr, however, there are no facilities at SNL/NM that require stack monitoring according to the

regulation. Still, several facilities report emissions based on either periodic stack monitoring and/or calculations based on measured parameters. As discussed earlier, this practice, while not required by regulation, is performed as part of SNL/NM's "Best Management Practices."

As shown in Table 5-8, six facilities are modeled using CAP88 to calculate the EDE to the MEI. In some instances, certain radionuclides have such short half lives (for example, 10 minutes for nitrogen-13 and two minutes for oxygen-15) that decay during transport, significantly reduces the dose contribution at most receptor locations.

Demographic Data

Demographic data includes resident population, the number of beef and dairy cattle, and the utilized food crop area fraction for the 80-km radius study area. There are 80 CAP88 analysis zones (16 wind direction sectors subtended by five concentric equally spaced rings out to a distance of 80 km). The densities for population, cattle, and food crops were calculated as the quotient of the most recent county data and the county land area.

For the 1998 NESHAP calculations, the estimated 1994-1995 State of New Mexico urban and county population data was obtained from the U.S. Geological Survey (USGS) (DOI 1998) and U.S. Census Bureau data (DOC 1998). The beef and dairy cattle density, and the food crop area fraction were calculated using the 1995 agricultural statistics supplied by the New Mexico Department of Agriculture (NMDOA 1998).

15,790	Dairy cattle
32,696	Beef cattle
87.7	Food crops (sq mi)
695,406	Population (within 80-km radius)

Public Receptors

Various receptor locations have been evaluated (in the vicinity of SNL/NM) as suspected locations of maximum exposure to a member of

the public. Offsite receptor locations are located within the Isleta Indian Reservation, the Four Hills subdivision north of the base, the Manzanita Mountains (east mountain residents), and areas near the airport west of the base. A total of 28 receptor locations were evaluated in 1998. The offsite and onsite receptors are listed in Tables 5-9 and 5-10, respectively.

Meteorology

Data from four meteorological CAN towers in the proximity of NESHAP emission sources were used in 1998 (towers CW1, A36, A21, and MW1). Data from each tower consisted of approximately 35,000 hourly observations of wind direction, wind speed, and stability class (inferred from wind and solar insulation data). The data are compiled into a normalized distribution from which all wind and stability frequency-of-occurrence data were derived. The meteorological data are input to a database to create Stability Array (STAR) data files, which are incorporated into the CAP88 computer code for the dose assessment.

5.4.2 Dose Assessment Results

Radiological Dose Modeling

The CAP88 computer code is an EPA-approved modeling system consisting of a set of computer programs, databases, and associated utilities (EPA 1995). The model calculates exposure that can occur through inhalation, ingestion, air emersion, and surface ground-shine pathways.

CAP88 produces a gaussian plume equation that is used to estimate both horizontal and vertical air dispersion. Each calculation can assess up to 36 radionuclides released from one to six stacks. Radionuclide specific parameters include dose conversion factors, decay constants, and dry deposition velocity. The site-specific data used in the model includes meteorological data; beef, dairy, and human populations; radiological inventories from source facilities; facility release parameters; and public receptor locations.

TABLE 5-9. Annual Source-Specific Effective Dose Equivalent (EDE) to Offsite Receptors in 1998

Receptor	ACRR (Bldg. 6588)	SPR (Bldg. 6590)	HERMES III (Bldg. 970)	RMWMF (Bldg. 6920)	Mixed Waste Landfill	NGF (Bldg. 870)	Effective Dose Equivalent (mrem/yr)
Albuquerque City Offices	7.9E-07	1.0E-04	3.7E-09	5.9E-06	8.2E-06	3.5E-04	4.6E-04
East Resident	5.4E-08	4.9E-06	1.0E-11	4.3E-06	5.4E-06	3.1E-04	3.2E-04
Eubank Gate Area (Bldg. 8895)	5.7E-07	6.8E-05	2.0E-08	4.9E-06	6.4E-06	5.3E-04	6.1E-04
Four Hills	5.0E-07	6.3E-05	4.5E-09	4.9E-06	6.4E-06	3.4E-04	4.1E-04
Isleta Bingo	1.2E-07	1.5E-05	4.1E-11	5.0E-06	5.9E-06	3.2E-04	3.5E-04
Northeast Resident	2.2E-07	2.7E-05	5.6E-10	4.8E-06	5.8E-06	3.1E-04	3.5E-04
Seismic Center (USGS)	1.6E-07	2.0E-05	6.9E-11	4.5E-06	5.6E-06	3.1E-04	3.4E-04
Tijeras Arroyo (West)	1.2E-06	1.5E-04	5.1E-09	6.4E-06	9.6E-06	3.6E-04	5.3E-04

NOTE: E Notation denotes the exponent.

TABLE 5-10. Annual Effective Dose Equivalent (EDE) to Onsite Receptors in 1998

Receptor	ACRR (Bldg. 6588)	SPR (Bldg. 6590)	HERMES III (Bldg. 970)	RMWMF (Bldg. 6920)	Mixed Waste Landfill	NGF (Bldg. 870)	Effective Dose Equivalent (mrem/yr)
Airport (Bldg. 760)	1.0E-06	7.9E-05	8.9E-09	7.7E-07	1.3E-06	1.0E-04	1.8E-04
Airport East (Bldg. 1064)	4.8E-07	6.2E-05	6.0E-09	6.6E-07	1.0E-06	8.6E-05	1.5E-04
Bldg. 20706 (USAF)	6.7E-07	8.4E-05	5.2E-08	6.6E-07	1.1E-06	1.7E-04	2.6E-04
Bldg. 24499 (USAF)	5.2E-07	6.2E-05	1.4E-08	5.6E-07	8.7E-07	1.9E-04	2.5E-04
CERF (Bldg. 5701)	4.7E-07	5.5E-05	2.8E-10	8.5E-07	9.9E-07	9.0E-06	6.6E-05
Coyote Canyon Control Center	4.7E-07	5.5E-05	2.7E-10	1.0E-06	6.3E-07	9.4E-06	6.6E-05
Golf Course Clubhouse	2.5E-06	2.9E-04	1.3E-08	1.3E-06	2.9E-06	3.2E-05	3.3E-04
Golf Course Maintenance Area	2.0E-06	2.2E-04	3.1E-08	1.1E-06	2.2E-06	4.4E-05	2.7E-04
ITRI/Lovelace	3.5E-07	4.5E-05	1.6E-10	1.2E-06	8.0E-07	7.8E-06	5.5E-05
KAFB Fire Station #4 (Bldg. 90002)	5.3E-07	6.8E-05	1.3E-10	2.9E-06	1.5E-06	1.1E-05	8.4E-05
KAFB Landfill	1.1E-06	1.2E-04	1.1E-07	8.2E-07	1.5E-06	8.9E-05	2.1E-04
KUMSC	6.2E-06	7.5E-04	7.4E-09	1.8E-06	5.6E-06	3.4E-05	8.0E-04
Loop Housing	4.9E-07	5.9E-05	1.5E-08	5.5E-07	8.6E-07	2.0E-04	2.6E-04
Manzano Offices (Fire Station)	1.3E-06	1.4E-04	1.9E-09	1.4E-06	1.4E-06	1.8E-05	1.6E-04
Maxwell Housing	5.5E-07	7.2E-05	1.6E-09	5.5E-07	1.2E-06	4.4E-05	1.2E-04
Pershing Park Housing	4.1E-07	4.9E-05	7.2E-09	5.0E-07	7.5E-07	1.2E-04	1.7E-04
Riding Club	3.3E-06	3.3E-04	3.9E-09	1.5E-06	2.0E-06	2.3E-05	3.6E-04
Sandia Federal Credit Union	5.8E-07	7.3E-05	2.9E-08	6.1E-07	9.9E-07	3.2E-04	3.9E-04
TOSI	9.0E-07	1.1E-04	2.5E-07	7.7E-07	1.4E-06	1.3E-04	2.4E-04
Zia Park Housing	5.6E-07	7.1E-05	1.5E-08	7.0E-07	1.1E-06	1.4E-04	2.1E-04

NOTE: E Notation denotes the exponent.

Dose assessment results are summarized in Table 5-11 and discussed below.

Dose Results

Individual EDE doses to offsite and onsite SNL/NM receptors are presented in Tables 5-9 and 5-10, respectively. Of the total of 17 NESHAP sources in 1998, emission parameters from seven facilities were used in the CAP88 code to model the cumulative EDE to the MEI.

The EDE to the onsite MEI was 0.000798 mrem/yr (0.00000798 mSv/yr), which is well below the EPA maximum limit of 10 mrem/yr (0.1 mSv/yr). The receptor location was again located at the Kirtland Underground Munitions Storage Complex (KUMSC), northwest of the Sandia Pulsed Reactor (SPR) in TA-V. This dose results primarily from argon-41 released from the SPR.

The offsite MEI, located at the Eubank Gate, was calculated to be 0.00061 mrem/yr (0.0000061 mSv/yr).

A population dose resulting from all SNL/NM radiological emissions was calculated for both KAFB and the regional area. A population dose is not required by NESHAP regulations; however, it provides a useful numerical comparison of the public dose from year to year. The population

dose is attained by multiplying a representative individual dose within a population, with the total population. SNL/NM calculates a population dose for both the KAFB housing areas and the general Albuquerque area population within a 80-kilometer (50-mile) radius.

The Albuquerque regional population dose in 1998 was attained using a single, grid analysis for all SNL/NM sources. Because the analysis area is large, the relatively small distances between radionuclide sources have a minimal impact on the resulting population dose. The population dose was calculated by multiplying 695,406 residents by doses per sector to attain 0.0297 person-rem/yr (0.000297 person-Sv/yr). This dose resulted primarily from argon-41 and tritium.

A population dose for KAFB residents was calculated based on four main housing areas. The total population dose for KAFB was obtained by summing the four areas assuming a total residential population of 5,673. This resulted in an estimated population dose of 0.00114 person-rem/yr (0.0000114 person-Sv). Again, the dose resulted primarily from argon-41 and tritium.

TABLE 5-11. Calculated Dose Assessment Results for Onsite and Offsite Receptors and for Collective Populations

Dose to Receptor	Location	1998 Calculated Dose	NESHAP Standard
Onsite Receptor EDE to the MEI	KUMSC	0.000798 mrem/yr (0.00000798 mSv/yr)	10 mrem/yr (0.1 mSv/yr)
Offsite Receptor EDE to the MEI	Eubank Gate Area East of KAFB	0.00061 mrem/yr (0.0000061 mSv/yr)	10 mrem/yr (0.1 mSv/yr)
Collective KAFB Population ¹	KAFB housing	0.00114 person-rem/yr (0.0000114 person-Sv/yr)	No standard available
Collective Regional Population ²	Residents within an 80-km radius	0.0297 person-rem/yr (0.000297 person-Sv/yr)	No standard available

NOTE: EDE = effective dose equivalent

MEI = maximally exposed individual

KUMSC = Kirtland Underground Munitions Storage Complex

NESHAP = National Emissions Standards for Hazardous Air Pollutants

mSv = millisievert person-Sv = person sievert

¹Based on a population of 5,673 people estimated to be living in permanent on-base housing.

²Based on a population of 695,406 people estimated to be living within an 50-mile (80-km radius).

5.5 AIR QUALITY REQUIREMENTS AND COMPLIANCE STRATEGIES

This section discusses all applicable air quality requirements as they apply to the SNL/NM site and include the requirements discussed under the Ambient Air Program (Section 5.2) and the NESHAP Program (Section 5.3).

Air quality for SNL/NM is governed by regulations promulgated by both the Albuquerque/Bernalillo County Air Quality Control Board (ABC/AQCB) and the Federal government. Radionuclide emissions are administered directly by the EPA under NESHAP-40 CFR 61, Subpart H. Drivers for air quality compliance also include DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990). A complete listing of air quality regulations applicable to SNL/NM is given in Table 5-12.

5.5.1 New Program Directions Under CAAA Title V

Amendments to the Clean Air Act in 1990 (CAAA) contained provisions under Title V requiring all existing "major air emission sources" to obtain an operating permit. A major source is defined as the combined emissions from any facility with the potential to emit 100 tons per year (tpy) or greater of any criteria pollutant, 10 tpy of any hazardous air pollutant (HAP), or 25 tpy of any combination of HAPs. SNL/NM is considered a major source based on its potential to emit nitrogen oxides (NO_x) and carbon monoxide (CO). The intent of Title V is

not to add new requirements, but to pull together existing requirements under one regulation. DOE will eventually submit just one annual report to City of Albuquerque regarding air quality compliance.

DOE submitted SNL/NM's Title V Operating Permit application on March 1, 1996, which included the Steam Plant (a major source in itself) and all other combined sources such as generators and minor units. DOE's Title V permit application was deemed complete on May 1, 1996. The regulatory due date for the permit was March 13, 1998, but it has yet to be issued by the City.

The proposed Title V Operating Permit will integrate all CAAA requirements into one site-wide permit, which may be inclusive of several facilities in the general area, including SNL/NM and DOE's facilities on KAFB.

As discussed in Section 2.3, 20 NMAC 11.02, "Permit Fees," SNL/NM is required to pay air emission fees under Title V. Currently, as the rule reads, SNL/NM is assessed an annual per-ton fee based on its "maximum potential-to-emit" of air pollutants. For example, the steam plant is assessed on the assumption that it will be operating at full capacity year-round. However, a fee can also be paid based on the actual fuel usage in an annual inventory. Under Title V, SNL/NM may be allowed to designate a self-imposed cap on fuel usage and thus plan a more realistic estimate of the actual fuel used. Title V is also expected to limit the need to acquire individual source permits by pre-approving many sources under one permit.

TABLE 5-12. Air Regulations Applicable to SNL/NM

This table shows the relationship between State and Federal regulations and the underlying Clean Air Act.

CAA Title	Federal Regulation	Local Regulation	Subject	Applicable Activities and Facilities
Title I	40 CFR 93 B 40 CFR 51 W	20 NMAC 11.03 20 NMAC 11.04	Conformity (State and Federal Plans)	General Conformity
	40 CFR 58 (Subpart C– Air Programs)		Ambient Air Quality Surveillance	Air Quality Surveillance Program - SLAMS
	40 CFR 50	20 NMAC 11.01	National Primary and Secondary Ambient Air Quality Standards (NAAQS)	Establishes ambient air quality standards for criteria pollutants
	40 CFR 52	20 NMAC 11.02	Permit Fees	Asbestos, inventories, permits, reviews, and registrations
	40 CFR 52	20 NMAC 11.05	Visible Air Contaminants	- FLAME (exempt) - SWISH (exempt)
	40 CFR 52	20 NMAC 11.06	Emergency Action Plan	If formulated by AEHD
	40 CFR 52	20 NMAC 11.07	Variance Procedure	If variance is sought
	40 CFR 52	20 NMAC 11.20	Airborne Particulate Matter (PM)	Disturbing surface over 3/4 acre (e.g., general construction or demolition and sand blasting)
	40 CFR 52	20 NMAC 11.21	Open Burning	- Open burns conducted at the Burn Site, Sled Track, and Cable Facility - Explosive detonations
	40 CFR 51–52	20 NMAC 11.40	Source Registration	Facilities with emissions >1 tpy of HAP or criteria pollutants - FLAME - Explosive Components
	40 CFR 51–52	20 NMAC 11.41	Authority-to-Construct	Potential operating conditions for facilities with emissions >25 tpy or >10 lb/hr or >5tpy of lead or NESHAP-listed pollutant - Hammermill - 4 stand-by generators
	40 CFR 51.100	20 NMAC 11.43	Stack Height Requirements	Good engineering practice
	40 CFR 51	20 NMAC 11.44	Emissions Trading	Applicable if credit taken
	40 CFR 51–52	20 NMAC 11.60	Permitting in Nonattainment Areas	Applicable if > 100 tpy CO
	40 CFR 52	20 NMAC 11.61	Prevention of Significant Deterioration (PSD)	Applicable if > 250 tpy

NOTE: AEHD = Albuquerque Environmental Health Department
HAP = Hazardous Air Pollutant
N/A = not applicable; PM = particulate matter
SLAMS = Standards for state and local air monitoring stations
SWISH = Small WInd SHielded Facility
FLAME - Fire Laboratory Used for the Authentication of Models and Experiments

TABLE 5-12. Air Regulations Applicable to SNL/NM (concluded)

This table shows the relationship between State and Federal regulations and the underlying Clean Air Act.

CAA Title	Federal Regulation	Local Regulation	Subject	Applicable Activities and Facilities
Title I	40 CFR 60 40 CFR 63	20 NMAC 11.65	Volatile Organic Compounds (VOC)	- Fuel use (N/A) - Remediation of solvent contaminated soil - Groundwater treatment
	40 CFR 60	20 NMAC 11.66	Process Equipment	- Hammermill for PM
	40 CFR 60	20 NMAC 11.22	Wood Burning	N/A
	40 CFR 60	20 NMAC 11.63	New Source Performance Standards (NSPS)	Prescribes operating conditions for new or modified NSPS facilities
	40 CFR 60	20 NMAC 11.67	Equipment, Emissions and Limitations (regulates NO ₂ , PM, and SO ₂ from gas-burning and oil-burning equipment)	N/A (the five natural gas-burning boilers at the steam plant produce less than the rated heat capacity threshold of 250 Mbtu/hr)
	40 CFR 60	20 NMAC 11.68	Incinerators	N/A
	40 CFR 60	20 NMAC 11.69	Pathological Waste Destructors	N/A
Title II	40 CFR 85-86	20 NMAC 11.100	Motor Vehicle Inspection	Emission Testing
		20 NMAC 11.101	- Decentralized and Centralized (respectively)	SNL's fleet of over 800 vehicles, inspection and emissions testing
	40 CFR 80	20 NMAC 11.102	Oxygenated Fuels	
		20 NMAC 11.103	Motor Vehicle Visible Emissions	
Title III	40 CFR 61 40 CFR 63	20 NMAC 11.64 <i>nonradionuclides</i>	NESHAP Subpart C – Beryllium (Be) Subpart H – Radionuclides other than radon (EPA regulates directly) Subpart M – Asbestos	A hazardous chemical purchase inventory for CY98 was conducted
Title IV	40 CFR 72-78	20 NMAC 11.62	Acid Rain	N/A
Title V	40 CFR 70-71	20 NMAC 11.42	Operating Permit (Application under Review)	For existing major sources (>100 tpy): - Steam Plant - Generators
Title VI	40 CFR 82	20 NMAC 11.23	Ozone Protection	Limiting the use of Class I and Class II ODSs - Auto air conditioners - Refrigerators - Chillers
Title VII	40 CFR 64	20 NMAC 11.90	Administration, Enforcement, Inspection	Breakdown, abnormal operating condition/ scheduled maintenance
		20 NMAC 11.100	Motor Vehicle Inspection – Decentralized	Emission testing

NOTE: N/A = not applicable
 ODS = ozone depleting substances
 PM = particulate matter

5.5.2 New Air Compliance Activities in 1998

New Air Permit for the Corrective Action Management Unit (CAMU) Chemical Waste Landfill (CWL) Remediation

Site preparation at the CAMU in TA-III began in 1998. SNL/NM applied for an Authority-to-Construct Permit (# 888) for the remediation of the CWL, which began in September 1998. The permit is for the Soil Washing/Soil Stabilization (SW/ST) unit and the Low Temperature Thermal Desorption (LTTD) unit.

5.5.3 Criteria Pollutants

The EPA describes the characteristics and potential health effects of "criteria pollutants" known to be hazardous to human health (Section 5.2.1). For these criteria pollutants, the EPA is empowered by the CAA to:

- Set ambient air quality standards, including motor vehicle emissions
- Require State plans for protection and improvement of air quality
- Institute air quality programs to prevent the nation's air from deteriorating
- Establish hazardous air pollutants (HAPs) control programs

Standards for criteria pollutants are implemented by 40 CFR 50, "National Ambient Air Quality Standards" and 20 NMAC 11.01 "General Provisions." Compliance is ensured through ambient monitoring conducted under the Ambient Air Monitoring Program (Section 5.2). Currently, all ambient air monitoring of criteria pollutants by SNL/NM is voluntary.

New EPA Standard

As discussed in Section 2.3, the EPA revoked the NAAQSs in 1998 for the one-hour standard of 0.12 ppm for ozone (O₃). The City of

Albuquerque has asked (but not yet funded) SNL/NM to assist in a study to determine if local conditions contribute to O₃ production given the ratio of either NO_x or VOCs in the air.

Criteria Pollutant Sources

The significant sources of criteria pollutants at SNL/NM are listed below. The Steam Plant is currently the only "major source" (>100 tpy).

➤ **Steam Plant** – The Steam Plant is used primarily to produce steam heat for buildings in TA-I and KAFB East. As defined by 20 NMAC 11.67, "Equipment Emissions, Limitations," the Steam Plant falls beneath the minimum limits for applicability, and because this is a "grandfathered" source, no permit has previously been required. However, the plant is now subject to the requirements of Title V, since it has the potential to emit greater than 100 tpy of specific air emissions. During 1998, all five boilers at the plant were operational and consumed a total of 718 million standard cubic feet (scf) of natural gas. These boilers can also be run on diesel oil: during 1998, 2,000 gal of diesel oil were used.

In 1998, the Steam Plant Optimization Project continued to reduce the facility's emissions. Boilers, 5 and 6, were studied for retrofit of flue gas recirculation.

➤ **Emergency Generator Plant** – SNL/NM operates four standby diesel generators located in TA-1, each with a 600-kilowatt (kW) capacity. The generators in Bldg. 862 are currently permitted (#150 and #402). For the purpose of Title V compliance, SNL/NM has assumed a maximum usage of 500 hr/yr for each generator. All generator use is based on an annual fuel throughput cap. The generators are exercised monthly and electrically tested quarterly. In anticipation of Title V fuel caps, SNL/NM has proposed a 500 hr/yr per generator usage, which will include these and all other

generators located onsite. In 1998, the four generators used 4,100 gal of diesel oil.

- **Vehicles** – SNL owns 10 vehicles that must meet local emissions testing. SNL/NM's other 800 vehicles are managed by the General Services Administration (GSA). 20 NMAC 11.100, "Motor Vehicle Inspection-Decentralized," requires that the owners of government fleet vehicles or motor pools must submit a vehicle inventory update and inspection plan to the City of Albuquerque at least annually. SNL forwards the results to the City program manager.

- **Open Burns** – The open-burning regulation covers activities such as:

- **Disposal of Explosives by Burning** (avoids the hazards of transport and handling)
- **Aboveground Detonation of Explosives** (over 20 lb)

- **Burning Liquid Fuel** - 2,000 gal or More (single-event research and development activity)

- **Igniting Rocket Motors** (>4,000 lb of fuel)

In addition, the regulation differentiates the permit basis into two categories: multiple-event and single-event. The single-event permit was designed to regulate individual burns having significant impact. Open-burn permits were obtained during 1998 from the City of Albuquerque for each scheduled regulated burn or test in compliance with 20 NMAC 11.21, "Open Burning."

Air Quality Award Nominations

In December 1998, SNL/NM was nominated for a Joint Industry and Government Pollution Prevention Air Quality Award. The New Mexico Facility Managers Network in conjunction with the City of Albuquerque co-hosted the 1998 award ceremony. The Steam Plant Optimization Project was one of the SNL/NM nominated projects.

TABLE 5-13. Important Documents for all Air Quality Programs at SNL/NM

Program Document	Reference
NESHAP PROGRAM	
1. <i>NESHAP Annual Report for 1998</i> (EPA Summary), and	SNL 1999d
2. <i>Radiological Dose Calculation and Supplementation Dose Assessment Data</i>	
<i>Radiological NESHAP Quality Assurance Project Plan (QAPjP)</i>	SNL 1997i
AQC PROGRAM	
Title V Permit Application, # 515 (7-volume document)	no reference
<i>Corporate Ozone Depleting Substances (ODS) Management Program</i> (PG)	SNL 1997j
<i>Air Quality Compliance Quality Assurance Project Plan (QAPjP) for Air Quality Compliance</i>	SNL 1996f
<i>Air Quality</i> (PG)	SNL 1997k
<i>Supporting Documentation for the Hazardous Chemical Purchase Inventory 1998 Reporting Year*</i>	SNL 1999a
CAN PROGRAM	
<i>Inspection and Maintenance Plan for Guyed Structures</i> (meteorological towers)	SNL 1997l
<i>Quality Assurance Project Plan (QAPjP) for Meteorological and Ambient Air Monitoring Program</i>	SNL 1997m

NOTE: * No Toxic Release Inventory (TRI) report was required for CY98. This report was published to document the calculations showing SNL/NM was under the threshold reporting values.

PG denotes a "Program Document" which is a specific type of ES&H document.

Wastewater, Surface Discharge, and Storm Water Monitoring Programs

Effluent monitoring is the collection of samples or direct measurement taken from liquid or gaseous waste stream processes for the purpose of quantifying contaminants and determining regulatory compliance. Effluent monitoring in this chapter is confined to water monitoring activities that include sanitary and industrial discharges, surface discharges, and storm water runoff.

All water quality monitoring is conducted by SNL/NM's Environmental and Emergency Management Department. SNL/NM complies with the water quality regulations established by local, State, and Federal agencies. U.S. Environmental Protection Agency (EPA) standards are implemented at the State and local level by the New Mexico Environment Department (NMED) and the City of Albuquerque (COA). The State and the COA establish water quality standards at least as strict as the Federal standards. SNL/NM also adheres to the wastewater guidelines contained in DOE Orders 5400.1 and 5400.5 (DOE 1990, DOE 1993).

6.1 WASTEWATER DISCHARGE PROGRAM

Wastewater discharged to the public sewer system from SNL facilities is divided into two categories: sanitary discharges and industrial discharges. Sanitary waste streams include

wastewater from restrooms and showers, food service establishments, and other domestic-type activities. Industrial discharges are produced from general laboratory research operations including electroplating, metal finishing, microelectronic development, and photographic processes.

Pollution Prevention

SNL/NM closely monitors its liquid effluent discharges to meet regulatory compliance. However, SNL strives to excel beyond the requirements by reducing toxic constituents in its effluents to "as low as reasonably achievable" (ALARA) levels. The Pollution Prevention (P2) Program continually searches for new ways to reduce pollutants released to the environment by recommending equipment modifications, process improvements, and chemical substitutions, wherever feasible.

6.1.1 SNL/NM and the City Sewer System

Southside Water Reclamation Plant

SNL/NM's sewer system connects to the City's sanitary sewer line at four permitted outfall stations. Effluent leaving these stations must meet the City's wastewater standards for both physical and chemical parameters. The wastewater flows through the Tijeras Arroyo Intercept line and terminates at the Southside Water Reclamation Plant, the largest water treatment facility in New Mexico. Here, solids and bacteria are removed. (The resultant sludge

is tilled into the ground or sold as compost to local nurseries.) The plant is presently undergoing a major expansion to add a Nitrogen Removal Facility as mandated by the EPA. The new facility will allow the City to meet new water quality discharge limits for nitrogen and ammonia, thus significantly improving the quality of wastewater discharged to the Rio Grande. All discharge standards are defined in the City's National Pollutant Elimination Discharge System (NPDES) permit.

Sewage Treatment Process

Organic matter in sewage is broken down through natural biological processes (microorganisms). Wastewater is first run through a settling tank to remove suspended solids and then through an aeration tank where biological breakdown can proceed. This biological treatment process is sensitive to an excess of certain chemicals or metals that can interfere with the effectiveness of the microbes. Industrial wastes that contain an excess of heavy metals, specifically cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc, can be particularly harmful to the biological balance. Cyanide and toxic organic compounds, such as solvents and pesticides, are also injurious to the process. For this reason,

wastewater constituents must be closely monitored.

The City's reporting requirements are defined under its Industrial Wastewater Pretreatment Program. This program specifies the required quality of discharges that the City will accept at its water reclamation plant. SNL/NM received two "Gold Pretreatment Awards" from the COA for its 100 percent adherence to wastewater quality requirements in 1997-1998.

6.1.2. Permitting and Reporting

Primary regulatory drivers for the Wastewater Program are listed in Table 6-1. The COA Public Works Department, Liquid Waste Division, implements EPA's water quality standards under the authority of the City's "Sewer Use and Wastewater Control Ordinance," Section 8-9-44.H. As required, SNL submits semi-annual wastewater reports to the City. Results from the January to June 1998 period were submitted by July 31, 1998; results from the July to December 1998 period were submitted by January 31, 1999.

TABLE 6-1. Primary Regulatory Drivers for the Wastewater Discharge Program

Act or Regulation	Citation	Authority
Clean Water Act (CWA)	Title 33, U.S.C. 1251	EPA
<i>Sewer Use and Wastewater Control Ordinance</i>	Chapter XIII, Article IX Section 8-944.H (1990)	City of Albuquerque
NMWQCC Regulations	20 NMAC 6.2*	NMED
PART 20 – <i>Standards for Protection Against Radiation</i> (addresses radiological levels in wastewater)	10 CFR 20	U.S. Nuclear Regulatory Commission
<i>Radiation Protection of the Public and the Environment</i>	DOE Order 5400.5	DOE

NOTE: *Implements the New Mexico Water Quality Act.

NMWQCC = New Mexico Water Quality Control Commission

SNL's Discharge Control Program

To meet the City's wastewater quality standards, SNL/NM requires all internal organizations producing continuous process discharges—other than sanitary effluent—to obtain prior approval from the Water Quality Group within the Environmental and Emergency Management Department. The Water Quality Group maintains a Discharge Control Program to track facilities, processes, and expected discharges. Internal wastewater permits are written for facility discharges after potential wastewater discharges are reviewed for contaminants, concentrations, and discharge frequencies to determine if the effluent will meet regulatory criteria. These internal permits are reviewed annually to assess if the facility's processes have changed. The facility owner is responsible for alerting the Water Quality Group of any process changes prior to the annual review. (One-time releases are approved on a case-by-case basis.) If pollutants above regulatory levels are detected in the waste stream, the Water Quality Group will conduct an investigation to discover the source of the discharge and implement corrective actions, as needed.

The *SNL/NM Wastewater Sampling and Analysis Plan* (SNL 1996g) describes program objectives, wastewater sampling frequencies, analyte parameters, collection methods, and quality control/quality assurance (QC/QA) criteria. Other important documents to the Wastewater Program are listed in Table 6-2.

6.1.3 Wastewater Monitoring Stations

SNL/NM has six onsite wastewater monitoring stations permitted by the City of Albuquerque as shown in Figure 6-1. The permits detail the requirements of SNL/NM's monitoring program. There are four general stations, from which all wastewater leaves SNL property, and two upline categorical pretreatment stations. The EPA has established categorical pretreatment standards for specified classes of industrial discharges. Station WW007 monitors the wastewater discharged from the acid waste neutralization system at the Microelectronics Development Laboratory (MDL) in TA-I. Station WW009 monitors wastewater generated from the operations at the Advanced Manufacturing Process Laboratory (AMPL), also in TA-I. (WW009 became a zero discharge operation in 1997 and continued at this status for 1998.)

Wastewater Monitoring

All outfall stations are equipped with flow meters and pH sensors to continuously monitor wastewater 24 hours-a-day. Station equipment parameters are listed in Table 6-3. The total combined wastewater discharges to the public sewer from all SNL activities is approximately 800,000 gal per day.

TABLE 6-2. Important Documents for the Wastewater Discharge Program

Program Document	Reference
Semi-annual Reports to the City of Albuquerque (dated July 31, 1997 and January 31, 1998)	No reference
Wastewater Monitoring Program monthly reports	No reference
Section 10H—"Discharges to the Sanitary Sewer," <i>ES&H Manual</i>	SNL 1998h
<i>SNL/NM Wastewater Sampling and Analysis Plan</i>	SNL 1996g
<i>Water Quality</i> (PG)	SNL 1997n

NOTE: PG denotes a "Program Document," which is a specific type of ES&H document.

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FIGURE 6-1. Wastewater Monitoring Station Locations at Seven Locations

TABLE 6-3. SNL/NM Wastewater Discharge Permits and Station Characteristics

	Permit	Waste Stream Process	Flume Size
GENERAL OUTFALL	WW001	All waste streams	3 in. Parshall
	WW006	All waste streams	6 in. Parshall
	WW008	All waste streams	6 in. Parshall
	WW011	All waste streams	6 in. Parshall
CATEGORICAL (Upstream of General Outfalls)	WW007	Microelectronics Development Laboratory (MDL)	45° v-notch Weir
	WW009	Advanced Manufacturing Process Laboratory (AMPL)	2 in. Parshall

NOTE: "All waste streams" include both domestic and industrial discharges. All discharges from the MDL and AMPL flow through General Station WW008 before discharging to the public sewer. WW009 became a zero discharge operation in 1997.

Monthly samples are taken at outfalls to determine compliance with specific regulatory parameters set by the City. Currently, the practice is to sample randomly from a list of potential pollutants. The results are recorded in monthly Wastewater Monitoring Program reports.

The following is a list of SNL/NM's wastewater sample parameters:

- Aluminum
- Arsenic
- Copper
- Chromium
- Lead
- Mercury
- Nickel
- Zinc
- Tritium
- Gross Alpha & Beta
- Gamma Spectroscopy
- Cyanide
- Soluble Fluoride
- Selenium
- Phenolic Compounds
- Silver
- Oil and Grease
- Volatile Organic Compounds (VOCs)
- Semi-VOCs (SVOCs)
- Chemical Oxygen Demand (COD)

Septic Systems

SNL owns three active septic tanks in remote areas for sanitary sewage collection (domestic use). Since these tanks receive no industrial

discharge, they do not require sampling. However, as a matter of good practice, SNL samples the tanks prior to pumping and discharge to the main sewer system.

6.1.4 TA-V Radiological Screening

Several research reactors in TA-V have the potential to produce radiologically-contaminated process wastewater. To ensure that all wastewater from these facilities meets regulatory standards, liquid effluent is separated into two streams: reactor and non-reactor wastewater. All non-reactor sanitary wastewater discharges directly to the sanitary sewer; reactor water is channeled to the Liquid Effluent Control System (LECS) where it can be screened for radiological contaminants. "Reactor process wastewater," is defined as any effluent to a drain that is generated from a TA-V building or facility which uses, processes, or stores radioactive material.

The LECS system consists of three 5,000-gallon tanks and an ion exchange and filter system. The LECS is monitored 24 hours-a-day and is

equipped with alarms to alert personnel to the presence of radioactive materials or high water levels. During 1998, a temporary tank (3,000 gal) was installed to handle additional tritiated water obtained from the ACRR during core modifications. This water will be evaporated in 1999, at the RMWMF.

6.1.5 Summary of Monitoring Results

Laboratory analysis results for 1998 wastewater samples showed SNL/NM was in compliance with the City's "Sewer Use and Wastewater Control Ordinance." Permits for wastewater monitoring stations are listed in Table 2-3. All permit conditions were met except for Station WW011 (Permit 2069K-2). On September 10, 1998, a sample taken by the City at this station was found elevated for molybdenum. The value was 0.391 mg/L, which was slightly above the permitted standard of 0.25 mg/L. The cause of the exceedence was linked to custodial procedures. The cleaning procedures were changed and subsequent samples were within normal limits.

LECS Sampling

Samples are taken about once a month (depending on how much water has been collected) and sent to an EPA-approved laboratory for analysis of gross alpha and gross beta activities, tritium, and gamma spectroscopy. If no significant activity is detected (as defined by the regulations), the water is released to the sanitary sewer system. However, if radioactivity levels are detected above the limits, the water must be held for an alternative method of disposal. Short-lived radioisotopes may be allowed to decay in place (over a matter of days or weeks) until the activity has reached insignificant levels, at which time the water can be safely discharged to the sewer system. All water discharged from the LECS in 1998 met regulatory standards for radiological levels in wastewater.

Sampling by the State and Local Authorities

Every quarter the COA and SNL split samples at selected wastewater stations. The New Mexico Environment Department (NMED) also took quarterly samples in 1998. All samples are taken as 24-hour flow proportional composites and are sent for analysis to EPA-approved contract laboratories for analyses. During 1998, COA staff toured SNL facilities to inspect for compliance with the discharge requirements.

6.2 SURFACE DISCHARGE PROGRAM

All discharges to the ground surface are evaluated for compliance with New Mexico Water Quality Control Commission (NMWQCC) regulations as implemented by the NMED's Groundwater Bureau. The primary drivers are listed in Table 6-4. The Surface Discharge Program also follows the requirements of DOE Orders 5400.1 and 5400.5 (DOE 1990, DOE 1993). Important documents for the program are listed in Table 6-5.

6.2.1 Surface Discharge Approval and Permitting

Surface discharges at SNL can only be made after consultation with, and approval by, SNL/NM's Environmental and Emergency Management Department. This department assists facility owners in meeting surface discharge requirements set forth by the State and documenting all requests and discharges. Any source contaminants present in the water must meet strict guidelines before water can be released to roads, open areas, or impoundments. Even uncontaminated water must go through the request process, since large volumes of water discharged in the wrong place, such as in a previously contaminated area, could increase infiltration rates.

TABLE 6-4. Primary Regulatory Drivers for the Surface Discharge Program

Regulation	Citation
Clean Water Act (CWA)	Title 33, U.S.C. 1251 (<i>Monitoring & Reporting Requirements</i>)
Oil Pollution Prevention	40 CFR 112
NMWQCC Regulations	20 NMAC 6.2

In 1998, 23 individual requests for surface discharges were made; all but two were approved. All approved discharges to the ground surface in 1998 were in compliance with New Mexico water quality standards. Discharges that do not meet surface water quality standards are sent to the sanitary sewer system authority for approval and disposal.

6.2.2 Surface Discharge Releases in 1998

Two releases to the surface occurred in 1998:

- **Diesel Spill** - On December 2, 1998, a small quantity of diesel fuel (residual contents in a tank) was released to the ground surface, after a portable steel fuel tank tipped over and rolled. Approximately 15 ft³ of contaminated dirt was removed and disposed. The spill was contained and there was no significant impact to the environment.

- **Chemical Spill** - On January 26, 1998, a forklift spilled 350 lb of sodium hydroxide (NaOH) and water to the ground near Bldg. 858. The spill was contained and cleaned up and there was no significant impact to the environment. (Details are given in Section 2.5.)

6.2.3 Pulsed Power Evaporation Lagoons

There are two large lined discharge lagoons at the Pulsed Power Development Facilities in TA-IV. The lagoons are used to contain and evaporate large quantities of storm water, which collects in secondary containments around the facility's oil storage tanks. Additionally, runoff water derived from condensation and cleaning accumulates in several indoor floor trenches. Visible oil (the primary contaminant) is skimmed off before the water is pumped to the lagoons for evaporation. Lagoon I is a 137,500-gal capacity rectangular pond, 50 ft by 70 ft in area and 11 ft deep. Lagoon II is a 127,000-gal capacity trapezoidal shaped pond, approximately 40 ft by 70 ft in area and 8 ft deep.

Due to the ongoing nature of the discharges to the lagoons and the large volumes of water involved, a formal plan is registered with NMED (Discharge Plan DP-530). The plan also contains the necessary permit. The permit

TABLE 6-5. Important Documents for the Surface Discharge Program

Program Document	Reference
<i>Sampling and Analysis Plan for the Pulsed Power Development Facilities, Buildings. 981, 983, and 970, for Lagoons 1 and 2</i>	SNL 1996h
Section 10 F - "Oils, Greases, and Fuels," <i>ES&H Manual</i>	SNL 1997f
Section 10T - "Surface and Storm Water Discharges," <i>ES&H Manual</i>	SNL 1997o
<i>Oil Spill Prevention Control and Countermeasure (SPCC) Plan</i>	CDM 1995
<i>Discharge Plan Modification and Renewal, DP-530, SNL/NM</i>	NMED 1998, revised
<i>CY98 Biennial Report, DP-530</i>	SNL 1998g

requires that water levels be measured annually and water quality analysis be performed every two years. The frequency was changed in 1998; previously it was required that water levels be measured twice a year and samples be taken annually. The DP-530 Permit was rewritten on May 1, 1998 to reflect the changes.

1998 Sampling Results

All permit requirements for the lagoons were met in 1998. Results were sent to the NMED and recorded in the CY 1998 Biennial Report (SNL 1998g).

- **Water Levels** – In June 1998, Lagoon I was measured at 5 percent of capacity; Lagoon II was 8 percent of capacity.
- **Water Quality Measurements** – Water quality sampling was conducted in July 1998. Due to the limited surface area (less than 1,000 sq ft) and depth, grab samples from the surface are considered representative for water quality analysis. Direct measurements were also made of pH and specific conductance at the time of sampling. Parameters measured, as required by the permit, include total dissolved solids (TDS), chloride, sulfates, and various other major cations and anions. No analytes were found over the permit limits.

6.3 STORM WATER PROGRAM

SNL/NM has implemented its Storm Water Program in compliance with its National Pollutant Discharge Elimination System (NPDES) permit to protect “U.S. Surface Waters” as defined in the Clean Water Act (CWA). By this definition, it has been determined that the Tijeras Arroyo—although dry except during storm events—is a “U.S. Surface Water.” The arroyo has significant

water-carrying capacity and flows through SNL/NM before emptying into the Rio Grande about 14 km (8.7 mi) to the west. Therefore, at SNL/NM, any runoff from storm drain conduits, channels, other arroyos, ditches, or surface flow, which drains to Tijeras Arroyo, is defined as a discharge point and is subject to NPDES Permit conditions. The primary drivers for SNL/NM’s Storm Water Program are listed in Table 6-6. Currently, NMED and EPA jointly provide oversight for the Storm Water Program.

Storm Water Program documents are listed in Table 6-7.

6.3.1 NPDES Permit

The EPA requires an NPDES Storm Water Permit for all industrial facilities that have processes defined in the Standard Industrial Classification (SIC) codes listed in Appendix A of 40 CFR 122. SNL/NM has four “primary industrial” activities as defined in the regulation:

1. **Construction** – This applies to construction projects or other activities at SNL that disturb over five acres of ground.
2. **Electronics Manufacturing** – This applies to the large outdoor acid tanks located at the Microelectronics Development Laboratory (MDL).
3. **Hazardous Materials Handling** – This specifically applies to the Hazardous Waste Management Facility (HWMF) where hazardous chemical waste is stored, packaged, and shipped.
4. **Scrap Yards and Equipment Areas** – This applies to SNL’s storage yards and material recycling areas such as the Reapplication Yard.

TABLE 6-6. Primary Regulatory Drivers for the Storm Water Program

Regulation	Citation
National Pollutant Discharge Elimination System (NPDES) Regulations	40 CFR 122-125
Guidelines Establishing Test Procedures for the Analysis of Pollutants	40 CFR 136
NMWQCC Regulations (New Mexico Water Quality Act)	20 NMAC 6.2

TABLE 6-7. Important Documents for the Storm Water Program

Program Documents	Reference
<i>Results of 1998 Storm Water Sampling</i> (will be incorporated in the Storm Water Pollution Prevention Plan [SWP3] when sampling is completed)	SNL 1999l
<i>Storm Water and Non-Storm Water Discharge Sampling and Analysis Project Plan for SNL/NM</i>	SNL 1996i
Section 10T—"Surface and Storm Water Discharges," <i>ES&H Manual</i>	SNL 1997o
<i>Storm Water Pollution Prevention Plan (SWP3)</i>	SNL 1997p

All four of the above categories were applicable to SNL in 1998. Number 3 and 4 required quarterly monitoring beginning in the 4th quarter of 1998. Monitoring will be completed in the 3rd quarter of 1999. SNL had one construction permit in 1998 for construction of the Processing and Environmental Technology Laboratory (PETL); construction should be completed in 2000.

6.3.2 Permitted Areas

Storm water monitoring stations are shown in Figure 6-2. Currently, only TA-I, TA-II, and TA-IV have the capacity to generate storm water runoff that discharges directly to Tijeras Arroyo.

Some facilities at SNL/NM are not subject to storm water runoff regulations and permitting. For example, storm water that falls on TA-III, TA-V, and all areas south of the Arroyo del

Coyote watershed, does not drain into Tijeras Arroyo. The runoff from these areas infiltrates to the ground due to the relatively flat terrain and highly permeable soil. There are, however, several areas in the canyons on the east side of the base that do connect to Tijeras Arroyo by upstream feeder arroyos. However, test facilities in these areas are not subject to permitting since no NPDES-listed industrial activities are conducted there.

6.3.3 The Storm Drain System

Storm water runoff at SNL/NM drains from paved streets, dirt roads, landscaped areas, buildings, and industrial sites and is diverted to culverts, channels, and arroyos. Depending on the surface contaminants present, the runoff may pick up vehicle exhaust residues, engine oils, air

99_6-2.ai

FIGURE 6-2. Storm Water Monitoring Station Locations at Three Locations

pollutant deposits, heavy metals from various sources, and pesticides and fertilizers.

Storm Water Containment Structures

SNL/NM limits the potential contaminants in storm water by limiting storm water contact with chemical and storage containers and carefully controlling general runoff, especially in areas of:

- Waste, chemical, and oil storage and handling,
- Construction sites, and
- Environmental Restoration (ER) areas.

Some facilities may be equipped with large storm water catch basins such as the Hazardous Waste Management Facility (HWMF) and the Radioactive and Mixed Waste Management Facility (RMWMF). Secondary containments are also provided around oil and chemical storage areas to directly contain any spills and to prevent storm water runoff from container areas. The collected runoff is evaporated in designated basins, approved for surface discharge, or sent to the sanitary sewer for disposal.

6.3.4 Storm Water Program Activities

Inspection and Maintenance

Routine inspections of ditches and arroyos are required under the NPDES permit. Results of these inspections are attached to the *Storm Water Pollution Prevention Plan* (SWP3) (SNL 1997p). SNL/NM conducts “dry weather inspections” to detect any illicit discharges. The discharge of any pollutant to “Waters of the U.S.,” without specific permitting, is prohibited by the Clean Water Act (CWA). In general, only storm water is allowed in the storm drain system. However, in certain circumstances discharges other than storm water may be made to the storm drain system—if it is first reviewed for water quality compliance with the NPDES permit—such as for testing fire hydrants. Any such permitted discharges would fall under the

approval authority of SNL’s Surface Discharge Program. During storm water events, “wet weather inspections” are conducted quarterly, assuming there is sufficient runoff in a particular quarter. This is done to check for broken levees, floating debris, and to note water characteristics, such as clarity, foaminess, and color.

The storm drain system is also inspected routinely for excessive vegetation, sediment, and debris. Storm channels are cleared on an annual basis, or as necessary. (Storm drains were cleaned out in 1998.)

Several other environmental programs at SNL/NM work cooperatively with the Storm Water Program to ensure that storm water runoff meets or exceeds regulatory standards. These include the Pollution Prevention (P2) Program, the Environmental Restoration (ER) Project, and program activities conducted under the Oil Spill Prevention Control and Countermeasures (SPCC) Plan (CDM 1995).

Construction Site Monitoring

SNL/NM mitigates potential storm water pollution from construction sites (or disturbed areas) by implementing the use of silt fences, storing chemicals in secondary containments, and adhering to strict guidelines to prevent contaminant migration from various construction materials and processes. If the construction site is over five acres, the activity must be permitted under the NPDES Construction Storm Water regulations. Construction projects affected by NPDES regulations must have individual Storm Water Pollution Prevention Plans that are specific to each site. Once the construction project has been completed, the land must be stabilized before the permit can be terminated. Stabilization may be accomplished through one or more methods such as: (1) constructing drainages/diversions, (2) reseeding open areas, (3) xeriscaping and other landscaping, and (4) asphaltting to prevent the transport of residual pollutants and erosion.

6.3.5 Storm Water Monitoring Stations

SNL/NM conducted storm water monitoring at Stations 4 and 5, the two stations listed on the NPDES permit. Station 5 monitors runoff from the majority of SNL/NM's industrial activities including the HWMF and the MDL. Station 4 primarily monitors runoff from SNL/NM's Reapplication Yard. Additionally, Station 2, which is not required on the permit, is used to collect rainfall data. Like all stations it monitors rainfall and flow, since this is the criteria needed for defining a storm. Rainfall data is submitted to the National Weather Service.

6.3.6 Storm Water Monitoring Results

The Multi-Sector General Permit requires sampling four times per year, every two years, weather permitting. Due to Albuquerque's semi-arid climate and high infiltration rates, precipitation rarely produces adequate runoff for monitoring in the months of October through March. In general, most storm water sampling occurs during the rainy season from April through September. After a rainfall of sufficient intensity and duration (as defined in the regulation), storm water runoff flowing through each station is collected by grab sampling. The discharge is collected in the first 30 minutes of the runoff event (to allow for the sampling of any residues picked up in the soil upstream of the station).

Due to low rainfall in 1998, water from only one storm was of sufficient volume to meet sampling criteria (Station 5 on July 3, 1998).

1997 Results

Last year (1997), storm water collection was also hampered by a lack of rainfall, and sampling did not start till mid-year when the NPDES permit became effective. The limited 1997 results showed iron and zinc over the standards in the one sample. However, this was probably due, in part, to faulty sample collection in which too much sediment was collected with the runoff due to the placement of the sampler intake at the bottom of the channel.

1998 Results

Table 6-8 shows the 1998 results for Station 5. Several analytes exceeded the standards in 1998. As in 1997, these results were also derived from a single sampling point. Meaningful conclusions cannot be drawn until more data is collected. Only then can SNL adequately evaluate past exceedences. Also it should be noted that minerals eroding from the Manzano Mountains may be naturally high in certain metals, which may cause samples to exceed limits. If the sampler intake is placed too close to the bottom of the channel, sediments will be added with the results of the water (total sample), thereby skewing the results. This potential cause would have to be ruled out in future studies. However, if specific analytes continue to show high values each year, an investigation will be initiated.

State of New Mexico Sampling

The State, which conducted its own sampling in 1998, plans to conduct additional sampling in 1999. NMED installed a sampling station at TA-1 to monitor runoff from ER Site 30. NMED was concerned about potential high polychlorinated biphenyl (PCB) values. Two events were sampled and analyzed; the results showed negative detection for PCB.

TABLE 6-8. 1998 Storm Water Sampling Results from Station 5

Parameter	Station 5	Permit Limit
METALS (mg/L)		
Ammonia	ND	19
Cyanide	ND	0.0636
Aluminum	9	0.75
Arsenic	0.005	0.16854
Barium	0.209	1.0
Cadmium	0.007	0.05
Chromium	0.004 J	0.5
Copper	0.0108	0.0636
Iron	6.05	1.0
Lead	0.009 J	0.0816
Magnesium	5.27	0.0636
Manganese	0.125	-
Mercury	ND	0.0024
Nickel	ND	-
Selenium	ND	0.2385
Silver	ND	0.0318
Zinc	0.053	0.065
NON-METALS (mg/L)		
Nitrate + Nitrite	0.75	0.68
Total kjeldahl nitrogen	ND	-
Oil and grease	ND	-
Chemical oxygen demand (COD)	47	120
Total suspended solids	197	100
RADIOLOGY (pCi/L)		
Gross alpha	8.62	-
Gross beta	12.2	-
EXPLOSIVES* (mg/L)		
HMX	ND	none
RDX	ND	none
1,3,5-trinitrobenzene	ND	none
1,3-dinitrobenzene	ND	none
Tetryl	ND	none
Nitrobenzene	ND	none
2,4,6-trinitrotolunene	ND	none
4-Amino-2,6-dinitrotoluene	ND	none
2-Amino-4,6-dinitrotoluene	ND	none
2,6-dinitrotoluene	ND	none
2,4-dinitrotoluene	ND	none
2-nitrotoluene	ND	none
4-nitrotoluene	ND	none
3-nitrotoluene	ND	none

NOTE: J = Detected below the reporting limit or is an estimated concentration
 B = Detected in the blank above the effective minimum detection limit (MDL)
 ND = not detected

*There are no set limits for explosive constituents. Sandia performs this parameter check at the request of the State of New Mexico.

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Groundwater Monitoring and Protection Programs

This chapter describes the groundwater monitoring activities conducted at SNL/NM during 1998. Groundwater monitoring activities reported are those associated with two programs at SNL/NM: the Groundwater Protection Program (GWPP) and the Environmental Restoration (ER) Project. Regulations specific to the two task areas are shown in Table 7-1.

The Groundwater Surveillance Task Group is the groundwater monitoring function of the GWPP. This task performs site-wide water quality and water level measurements. SNL/NM conducts groundwater monitoring to determine the impact, if any, on local groundwater quality and quantity as a result of its operations, and to demonstrate compliance with all Federal, State, and local groundwater requirements.

The ER Project is concerned with the determination of the nature and extent of groundwater contamination, if any, at specific sites at SNL/NM where past activities resulted in environmental contamination. In areas where contaminant migration has reached groundwater levels, the extent of the contaminant plume is being characterized through systematic water level and water quality sampling.

The specific task areas performed for 1998 groundwater monitoring are illustrated in Figure 7-1. All groundwater results determined by the Groundwater Surveillance Task and the ER Project Task are summarized in this chapter with respect to water level and water quality results. The first section of this chapter describes water levels and general groundwater

trends. The second half of the chapter describes water quality and presents a summary of contaminants found in concentrations above Federal and State standards or DOE guidelines, as applicable.

7.1 OVERVIEW OF SNL/NM'S GROUNDWATER PROGRAMS

All groundwater protection and surveillance activities at SNL/NM are the responsibility of the GWPP and the ER Project.

Groundwater Protection Program (GWPP)

The Groundwater Surveillance Task collects annual water quality samples. Groundwater level measurements are collected monthly and quarterly (depending on the location) and are used to infer the direction and rate of groundwater flow at KAFB. Water quality data are used in baseline hydrogeochemical characterization and groundwater contamination detection monitoring. Wells in the GWPP network are selected to provide representative water samples for areas of SNL/NM based on historical water quality data. Figure 7-2 shows the network of wells used to monitor water quality and water levels. In 1998, 13 wells and one spring were sampled for water quality. Water levels were measured in 102 wells (GWPP, ER, KAFB IRP, and City of Albuquerque). Some wells in the GWPP serve both functions.

Groundwater surveillance at SNL/NM is conducted in accordance with the requirements of Department of Energy Order 5400.1, *General Environmental Protection Program* (DOE 1990). The GWPP has formulated its surveillance activities to conform with groundwater regulations defined in 40 CFR 265, Subpart F, under the Resource Conservation and Recovery Act (RCRA).

Environmental Restoration (ER) Project

The ER Project collects groundwater level and water quality data at sites identified as having the potential for groundwater contamination associated with past hazardous waste disposal activities. These sites are managed in accordance with RCRA requirements detailed in Table 7-1.

ER site investigations are conducted as part of the site-specific activities under the Hazardous and Solid Waste Amendments (HSWA) permit for SNL/NM. The HSWA requires that the RCRA process for investigating operating disposal facilities be applied to non-operating facilities. That is, investigations are carried out

at the facilities using the RCRA facility investigation (RFI) process. RFI activities have been conducted in accordance with RFI work plans. These preliminary activities have been designed to determine the amount and extent of any potential contamination. Once the RFI process is complete, corrective measures can be initiated as needed.

Currently, there are five general ER areas with groundwater issues:

- Chemical Waste Landfill (CWL)
- Mixed Waste Landfill (MWL)
- Technical Area-V (TA-V)
- Burn Site (an active test facility)
- Sandia North (includes TA-I and TA-II)

Each area conducts groundwater monitoring in accordance with site-specific sampling and analysis plans.

The following gives a brief description of the general contamination present and the number of active monitoring wells located at each site:

FIGURE 7-1. Organizational Structure of Groundwater Monitoring Activities in 1998

- **Chemical Waste Landfill** – The principal groundwater contaminant at this site is trichloroethene (TCE). TCE was disposed of in unlined pits at the landfill up until 1985 when the landfill was closed and came under RCRA regulation for past disposal sites. The only other groundwater contaminant identified above regulatory limits in 1998 was nickel. Elevated nickel concentrations are commonly associated with corrosion of stainless steel well screens and, in this case, do not reflect groundwater contamination from surface sources. In 1998, samples were collected quarterly from monitoring wells in accordance with the requirements of the CWL Closure Plan (SNL 1992). There are 14 monitoring wells at the CWL; nine were sampled in 1998. Three wells were converted to vapor extraction wells to remove TCE from the soil as part of the voluntary corrective measures (VCM) implemented at the site.
- **Mixed Waste Landfill** – The MWL is contaminated with tritium at the surface resulting from the past disposal of reactor coolant water. However, to present, no contaminants associated with prior site operations have been detected in the groundwater. All five monitoring wells located at this site were sampled in 1998.
- **TA-V** – Contaminants present include primarily volatile organic compounds (VOCs) such as TCE. Elevated nitrate above regulatory limits has been detected in one of the wells. There are nine wells in the TA-V area. The TA-V monitoring wells also include those that monitor the Liquid Waste Disposal System (LWDS) site. All nine wells were sampled in 1998.
- **Sandia North** – This area includes ER sites in TA-I and TA-II. Sandia North is unique among ER sites in the existence of perched water zones elevated above the regional groundwater system. Groundwater contamination includes TCE and nitrates, both of which have been detected at concentrations exceeding drinking water criteria. There are 23 monitoring wells in the Sandia North area including 12 new wells installed in 1998. Of these, 11 are regional aquifer wells and 12 are perched water zone wells. Eleven wells were sampled in 1998.

TABLE 7-1. Regulations Specific to the Groundwater Protection Program and the ER Project

Regulation	Citation	Note
<i>Regulations Specific to the GWPP</i>		
Groundwater and Surface Water Protection	20 NMAC 6.2	New Mexico water quality standards
Drinking Water	20 NMAC 7.1	New Mexico water quality standards
National Primary Drinking Water Regulations	40 CFR 141	Federal standards
<i>Regulations Specific to ER Sites</i>		
RCRA (groundwater monitoring at interim sites)	40 CFR 265, Subpart F	In accordance with the CWL Closure Plan
Corrective Action for Solid Waste Management Units (SWMU)*	40 CFR 264, Subpart F, Section 264.101	Applies to all ER sites, excluding CWL, under RCRA's SWMU Corrective Action requirements
<i>General Environmental Protection Program</i>	DOE Order 5400.1	Groundwater surveillance guidelines

NOTE: *As required by the Hazardous and Solid Waste Amendments (HSWA) Module to the RCRA Permit.

- **Burn Site** – Due to elevated nitrate levels that were discovered in the Burn Site production well at Lurance Canyon, groundwater investigations were initiated in 1997. One deep well (to bedrock) and two underflow piezometer were installed. The underflow piezometer have been dry, but will detect any subsurface flow if conditions change. At present, this is the only ER site in the canyons where groundwater contamination is suspected. The ER project is currently working with the New Mexico Environment Department (NMED) to define additional groundwater investigation activities at the Burn Site. Samples were taken in April, June, and August from the deep monitoring well. Nitrate was detected in this well in the April sampling.

7.2 GROUNDWATER QUALITY ANALYSES RESULTS

This section summarizes the analytical results for groundwater water quality monitoring activities conducted by the Groundwater Surveillance Task and the ER Project. Due to the volume of data obtained from the analyses conducted at each location, only results that exceeded one or more of the standards or guidelines referenced in Table 7-2 are presented. Appendix A gives specific values for water quality standards. The sampling frequency performed under each task during 1998 is listed in Table 7-3. All Groundwater results are detailed in the *Groundwater Protection Program Fiscal Year 1998 Annual Groundwater Monitoring Report, SNL/NM* (SNL 1999n).

TABLE 7-2. Guidelines Used for Groundwater Quality Sample Comparisons

Regulation/Requirements	Limits
National Primary Drinking Water Standards (this is an enforceable health standard) (40 CFR 141)	MCL
New Mexico Water Quality Control Commission Standards for Groundwater	MAC
DOE Drinking Water Guidelines for Radioisotopes (DOE 1993) (Derived Concentration Guides)	DCG

NOTE: MCL = maximum contaminant limit
 MAC = maximum allowable concentration
 DCG = derived concentration guide

7.2.1 Groundwater Surveillance Task Water Quality Results

The Groundwater Surveillance Task collects groundwater samples on an annual basis. In 1998, samples were taken from 13 monitoring wells and one natural spring during the annual March/April sampling event. Analysis included volatile organic compounds (VOCs), various metals, non-metallic inorganic substances (including nitrates, major ions, total organic carbon [TOC] and phenolics), selected radioisotopes (lead-214, potassium-40, radium-226 and -228), isotopes of uranium, and total alpha and beta emissions. Also, at the time of sampling, field measurements were taken for temperature, specific conductivity, turbidity, oxidation reduction potential (or redox [Eh]), and alkalinity.

Groundwater quality results are compared with the State of New Mexico's maximum allowable concentrations (MACs) and primary drinking water standards maximum contaminant limits (MCLs) for nonradioactive analytes. DOE's derived concentration guides (DCGs) and primary drinking water standards, where established, are used as a measure of comparison for radioisotopes.

TABLE 7-3. Sampling Frequency for Groundwater Quality Monitoring at SNL/NM During FY98

	Sampling Period	GWPP	ER Project Sites				
			CWL	MWL	TA-V	Sandia North	Canyons Area
Fiscal Year 1998	Oct 97			✓			
	Nov 97		✓		✓		
	Dec 97					✓	
	Jan 98						
	Feb 98		✓ (annual)		✓		
	Mar 98	✓		✓		✓	
	Apr 98						✓
	May 98		✓		✓ (annual)		
	Jun 98					✓	✓
	Jul 98						
	Aug 98		✓				✓
	Sep 98				✓	✓	
	Oct 98			✓*			
FY 99	Nov 98		✓*		✓*		
	Dec 98					✓*	

NOTE: *Results from late year sampling are not included in SNL's Fiscal Year 98 Annual Groundwater Monitoring Report.

Volatile Organic Compounds (VOCs)

There were no VOCs detected over the given regulatory criteria. Trace concentrations of tetrachloroethene, 1,2 dichloroethene were detected at Coyote Springs significantly below maximum standards. Chloroform and vinyl chloride were detected in trace amounts in two other wells, also well below established standards for drinking water. The source of the trace VOCs is not clear.

Major Ions, Phenolics, and Total Organic Carbon (TOC)

Non-metallic inorganic constituents analyzed in groundwater samples included:

- Alkalinity
- Bromide
- Chloride
- Cyanide (total)
- Fluoride
- Nitrate plus nitrite (as nitrogen)
- Phenolics (total)
- Sulfate
- Total organic carbon (TOC)

There were no exceedences of any of these non-organic parameters during 1998.

Metals

Analyses were performed on all the samples for the following metals:

- Aluminum
- Antimony
- Barium
- Calcium
- Cobalt
- Iron
- Magnesium
- Mercury
- Potassium
- Silver
- Thallium
- Zinc
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Nickel
- Selenium
- Sodium
- Vanadium

The analyses were conducted on the filtered samples except for mercury (liquid), which was analyzed for the total concentration.

Beryllium, chromium and nickel were found in three separate wells (two wells and one spring)

above the MCL standards set for drinking water. The wells and results are given in the callout boxes that follow.

Beryllium – Beryllium was again found at Coyote Springs at concentrations consistent with the previous years' analysis.

Beryllium MCL = 0.004 mg/L		
Well	Concentration	Period
Coyote Springs	0.0064 mg/L	Mar/Apr 98

Chromium – Chromium was detected in the sample from the EOD Hill Well just over the established MCL. The source of the chromium is unknown; there are no materials in the well itself that could be contributing chromium to the sample.

Chromium MCL = 0.1 mg/L		
Well	Concentration	Period
EOD Hill	0.14 mg/L	Mar/Apr 98

Nickel – Nickel was detected again at a well near the southern perimeter of KAFB. Elevated nickel concentrations in wells are often the result of corrosion of stainless steel well screens. This is likely the case for presence of nickel in this sample.

Nickel MCL = 0.1 mg/L		
Well	Concentration	Period
SFR-3P	0.21 mg/L	Mar/Apr 98

Radionuclides and Activities

Gamma spectroscopy was performed with a high-purity germanium gamma spectroscopy system on all samples. Potassium-40, and lead-212 and -214 were detected with activities greater than the associated minimum detectable activity (MDA) in some groundwater samples.

Analysis results are compared to the EPA MCLs and DOE guidelines. DOE guidelines are calculated from the published derived concentrations guides (DCGs). All of the

detects are an order of magnitude (10 times) less than the DOE criteria for drinking water. However, the reader should note that there is a high degree of measurement uncertainty in the activities reported.

Isotopic Analysis – Samples were also analyzed for gross alpha, gross beta, radium-226 and -228, and isotopes of uranium.

Uncorrected gross alpha results exceeded the MCL of 15 pCi/L at four wells. However, the MCL value is already corrected for the contributions of natural radon and uranium activities. Likewise, when these activities are subtracted from the results, all samples were below the MCLs. Uranium and radon activity result from the natural radioactive decay that is present in some rocks, particularly igneous rocks.

Radium values exceeded the MCL in the EOD Well. The established MCL for radium includes the activities of both radium-226 and -228.

Radium-226 plus Radium-228 MCL = 5 pCi/L		
Well	Concentration	Period
EOD Hill	7.5 pCi/L	Mar/Apr 98

Uranium isotopic analyses included uranium-234, -235/236, and -238. Activities for uranium-234 exceeded DOE Guidelines in three wells. All three wells are located east of the Tijeras Fault zone where bedrock is naturally high in uranium. The highest value seen at EOD Hill well is consistent with values measured in previous years.

Uranium-234 DOE Guideline = 20 pCi/L		
Well	Concentration	Period
EOD Hill	61.6 pCi/L	Mar/Apr 98
SFR-2S	21.4 pCi/L	Mar/Apr 98
TRE-1	23.8 pCi/L	Mar/Apr 98

In converting the activities of uranium isotopes to concentration values using the specific

activities for each isotope, the resulting concentration for uranium at EOD Hill is 0.17 mg/L. This is well below the maximum allowable concentration (MAC) of 5.0 mg/L established by the NMWQCC.

7.2.2 ER Project Water Quality Results

ER water quality sampling occurred at wells located at the Chemical Waste Landfill (CWL), Mixed Waste Landfill (MWL), TA-V, Sandia North, and the Burn Site Area. Results for each area are presented below.

Chemical Waste Landfill

The ER Project performed its annual groundwater sampling at the CWL in February 1998. This full-suite sampling included the parameters listed in 40 CFR 264, Appendix IX for metals, VOCs, and other general chemistry parameters. Quarterly monitoring was conducted in November 1997, and May and August of 1998 and included only metals and VOCs. Analytes and the frequency of sampling are specified in Appendix G of the Chemical Waste Landfill Closure Plan (SNL 1992).

Groundwater samples were collected from six wells including three nested wells with upper and lower completions (hence, nine sampling results are reported).

Volatile Organic Compounds (VOCs)

All VOCs detected were at concentrations below established MCL, where applicable, except for trichloroethene (TCE). Although last year TCE was discovered above standards in four wells, only one well in 1998 had TCE concentrations in excess of the MCL (5 µg/L).

TCE <i>MCL = 5 µg/L</i>		
Well	Concentration	Period
CWL-MW5L	11 µg/L	Nov 1997

Additional VOCs detected at or above laboratory quantitation limits included tetrachloroethene below the established MCL. Bis(2-Ethylhexyl)phthalate was measured at 79 µg/L, however, there is no established standard for this compound.

Metals

All groundwater samples collected from CWL monitoring wells in FY 1998 were analyzed for 40 CFR 264 Appendix IX metals plus iron, as listed below:

- Arsenic
- Beryllium
- Cadmium
- Cobalt
- **Iron**
- Mercury
- Selenium
- Tin
- Vanadium
- Antimony
- Barium
- Chromium
- Copper
- Lead
- Nickel
- Silver
- Thallium
- Zinc

Nickel – In FY98, nickel was the only metal detected at concentrations above the established standards. Two CWL monitoring wells had nickel present—one of the wells was consistently high for nickel in all sampling periods. Last year, in 1997, four wells had nickel over the MCL, with a high of 2.71 mg/L detected in CWL-MW4. In FY98, the highest value was less than half of that in the same well (1.22 mg/L). Elevated nickel in wells is likely the result of corrosion of the stainless steel well screens.

Nickel <i>MCL = 0.1 mg/L</i>		
Well	Concentration	Period
CWL-BW3	0.145 mg/L	Nov 1997
CWL-MW4	0.748 mg/L	Nov 1997
CWL-MW4 (dup)	0.700 mg/L	Nov 1997
CWL-MW4	0.949 mg/L	Feb 1998
CWL-MW4	1.3 mg/L	May 1998
CWL-MW4	1.22 mg/L	Aug 1998

General Chemistry

Additional parameters analyzed included chlorinated pesticides, polychlorinated biphenyls, herbicides, dioxins, furans, total cyanide, and total sulfide. Total cyanide was detected at a concentration of 0.0257 mg/L in the sample collected from CWL-MW5U but was not detected above the laboratory quantitation limit in the duplicate sample. Based on this duplicate sample and on historical data, this result is considered a laboratory error.

Mixed Waste Landfill

All five MWL monitoring wells were sampled by the ER Project in October 1997 and March/April of 1998. Samples were analyzed for VOCs, 40 CFR 264 Appendix IX metals, nitrate plus nitrite, and radionuclides.

Volatile Organic Compounds (VOCs)

VOCs were not detected above established MCLs during FY98. Toluene was detected below the laboratory quantitation limit in samples from one well at 4.4 µg/L. Toluene is a common laboratory solvent and the results are believed to be laboratory contamination of the sample.

Nitrate plus Nitrite

Nitrate plus nitrite was detected above the MCL of 10 mg/L in groundwater at the MWL in FY98.

Metals

Metal analysis was conducted for the following:

- Arsenic
- Cadmium
- Lead
- Nickel
- Silver
- Barium
- Chromium
- Mercury
- Selenium

Nickel and Chromium – The presence of both of these metals are believed to be due to the corrosion of the stainless steel well screen. Both metals were detected in one monitoring well slightly above the established MCL of 0.1 mg/L.

Chromium		
MCL = 0.1 mg/L		
Well	Concentration	Period
MWL-MW1	0.326 mg/L	Apr 1998
MWL-MW1 (split)	0.26 mg/L	Apr 1998

Nickel		
MCL = 0.1 mg/L		
Well	Concentration	Period
MWL-MW1	0.538 mg/L	Apr 1998
MWL-MW1 (split)	0.50 mg/L	Apr 1998

Radionuclides

The radiochemical analyses included gross alpha and beta, tritium, strontium-90, and gamma spectrometry. Radionuclide activities did not exceed the DOE guidelines and are comparable with previous years' results. Tritium values were reported above the critical value but below the MDA in MWL-MW2 and MWL-MW3. These activity values are about 100 times less than the regulatory criteria and are bracketed by large error bars.

Technical Area V

The ER Project performed quarterly groundwater sampling at all nine TA-V monitoring wells in September 1997, and February/March, May/June, and September of 1998. A full suite parameter analysis was done in May/June. Samples were analyzed for VOCs, SVOCs, metals, various inorganic compounds. Quarterly samples were analyzed for VOCs, nitrate plus nitrite only.

Volatile Organic Compounds (VOCs)

Two VOCs were detected in TA-V monitoring wells in 1998. TCE was detected in LWDS-MW1 in March 1998. Six samples were taken

from the same well at different levels (vertical profiling). All results were higher than the established MCL of 5 µg/L. These TCE values are slightly higher than last years' results, which ranged from 14 to 18.7 µg/L.

TCE MAC = 100 µg/L (Vertical Profile Results) MCL = 5.0 µg/L		
Well	Concentration	Period
LWDS-MW1	22 µg/L	Mar 1998
LWDS-MW1	20 µg/L	Mar 1998
LWDS-MW1	21 µg/L	Mar 1998
LWDS-MW1	21 µg/L	Mar 1998
LWDS-MW1	20 µg/L	Mar 1998
LWDS-MW1	20 µg/L	Mar 1998
LWDS-MW1	19 µg/L	Jun 1998

Methylene chloride was detected in TAV-MW1. However, because this compound is a common laboratory contaminant and was not detected last year, the result is believed to be due to sample mishandling at the laboratory.

Methylene Chloride MCL = 5.0 µg/L		
Well	Concentration	Period
TAV-MW1	6.8 µg/L	Mar 1998

Nitrates

Nitrate plus nitrite (reported as nitrogen) was detected in one well during the September 1998 sampling period. The value was only slightly over the MCL of 10.0 mg/L. Results from the November 1997 sampling are not reported since the results were skewed by a laboratory error.

Nitrate plus Nitrite MCL = 10.0 mg/L		
Well	Concentration	Period
AVN-2	10.3 mg/L	Sep 1998

Metals

Metal analysis was conducted for the following:

- Arsenic
- Beryllium
- Calcium
- Lead
- Mercury
- Selenium
- Sodium
- Barium
- Cadmium
- Chromium
- Magnesium
- Potassium
- Silver

In addition, the following metals were added to the above list for samples taken from TAV-MW3, TAV-MW4, and TAV-MW5 in February 1998.

- Aluminum
- Cobalt
- Iron
- Nickel
- Vanadium
- Antimony
- Copper
- Manganese
- Thallium
- Zinc

No metals were detected in any TA-V well in concentrations that exceeded MCLs.

Sandia North

The ER Project performed quarterly groundwater sampling at 17 of the 23 Sandia North wells in December 1997, and March, June, and September of 1998. Sandia North wells are either regional (deep wells screened within the regional aquifer) or perched (shallow wells screened in perched water zones). Samples were analyzed for VOCs, metals, nitrate plus nitrite, inorganics, total organic carbon (TOC), and radiochemical analysis (gross alpha and beta, uranium isotopes, tritium, and gamma spectrometry).

Volatile Organic Compounds (VOCs)

TCE concentrations were detected in two perched water zone wells and one regional well above the MCLs. Similar to past years, WYO 1 (regional) and WYO-2 (perched) were slightly above the MCL of 5 µg/L in more than one

sampling period. TA2-W-26 (perched), a new well installed in 1998, was also over the MCL.

TCE MCL = 5 µg/L MAC = 100 µg/L		
Well	Concentration	Period
WYO-1	5.1 µg/L	Dec 1997
WYO-1 (dup)	5.4 µg/L	Dec 1997
WYO-1	6.8 µg/L	Mar 1998
WYO-1	6.3 µg/L	Jun 1998
WYO-1	6.8 µg/L	Sep 1998
WYO-2	5.9 µg/L	Dec 1997
WYO-2	6.4 µg/L	Mar 1998
WYO-2	7.0 µg/L	Jun 1998
WYO-2	6.3 µg/L	Sep 1998
TA2-W-26	9.6 µg/L	Mar 1998
TA2-W-26	9.0 µg/L	Jun 1998
TA2-W-26	7.4 µg/L	Sep 1998

Nitrates

Nitrate was consistently detected in the perched well, TA2-SW1-320, above the MCL of 10 mg/L. TA2-W-19, which was below the MCL for nitrate last year, had an analytical result of 26 mg/L in 1998.

Nitrate plus Nitrite (as N) MCL = 10 mg/L		
Well	Concentration	Period
TA2-SW1-320	22 mg/L	Dec 1997
TA2-SW1-320	26.5 mg/L	Jun 1998
TA2-SW1-320	21.9 mg/L	Sep 1998
TA2-W-19	26 mg/L	Mar 1998

Metals

RCRA metals as listed below were not detected above the EPA MCL for any of Sandia North's wells.

- Arsenic
- Cadmium
- Lead
- Selenium
- Barium
- Chromium
- Mercury
- Silver

Burn Site

One well, CYN-MW1D, was sampled at the Burn Site at quarterly intervals. The sample was analyzed for VOCs, SVOCs, diesel, gasoline, explosives, and various metals.

Volatile Organic Compounds (VOCs)

Low levels of petroleum hydrocarbons were present at each quarterly sampling. However, all results were well below established MCLs. Explosive results were non-conclusive.

Nitrates

Nitrate was slightly elevated over the MCL at 12 mg/L.

Nitrate plus Nitrite (as N) MCL = 10 mg/L		
Well	Concentration	Period
CYN-MW1D	12 mg/L	Apr 1998

Metals

There were no metals detected over MCLs at the Burn Site.

7.3 WATER LEVEL TRENDS

Water levels are measured monthly and quarterly in wells at and in the vicinity of SNL/NM facilities and ER sites by the Groundwater Protection Program (GWPP), the Environmental Restoration (ER) Project, KAFB Installation Restoration Program (IRP), and the City of Albuquerque (COA). A total of 102 monitor wells were measured by these four agencies as follows:

- 31 GWPP wells
- 38 KAFB wells
- 42 ER wells
- 4 COA wells

7.3.1 Hydrogeological Background Information

Water Level Measurement

Water levels are measured to establish groundwater gradients and infer the direction of groundwater flow. This information is vital to understanding the migration of contaminants in groundwater and their potential impacts. Water level information, with respect to the regional water table in the KAFB area, can be categorized into three general areas as shown in Figure 7-3.

Water level information is also necessary to determine the useful life of existing monitor wells. Since well screens penetrate only a limited distance below the water table, the continuing decline of the water table will render some of these wells useless in the near future when the screens no longer intercept the water table. Selected water data from these wells were used to construct a potentiometric surface map for groundwater flow determination (Figure 7-4).

Middle Rio Grande Basin

The dynamics of water table fluctuations, as reflected by water levels in individual wells, are a balance of the water recharge to the groundwater system (e.g., precipitation and the Rio Grande), the withdrawal from the system (production wells), and the properties of the aquifer materials. The Middle Rio Grande Basin, most of which is filled with Santa Fe Group deposits is the principal drinking water source for Albuquerque and the vicinity.

The Middle Rio Grande Basin is defined on the east by the north-south chain of mountains extending from the Manzano to the Sandia Mountains uplifted along a series of faults. In the vicinity of KAFB, the Tijeras fault approximates the east boundary division between the basin and the uplifted east blocks of the Manzanita Mountains.

Groundwater levels east of the basin within the mountains is encountered about 350 ft higher than within the basin. The aquifer system in the mountains is not very well understood due to the complex geology and few wells from which to characterize the system. Groundwater tends to occur sporadically. For example, in drilling for water, many east mountain residents have discovered that a dry well may be encountered next to a very productive one.

Water Level Trends

Hydrographs are representations of water level fluctuations over time. In general, the hydrographs from KAFB wells indicate water levels have been declining as a result of water supply pumping from COA and KAFB water supply wells. The primary aquifer, within the upper unit of the Santa Fe Group, shows a rate of decline at between 0.5 ft to over 2 ft per year. Most of the COA and KAFB water supply wells produce from coarser-grained layers of the upper and middle units of the Santa Fe Group.

USGS Rio Grande Basin Study

The U.S. Geological Survey (USGS) is currently conducting a study of the Middle Rio Grande Basin to improve the understanding of the water resources of the basin. In 1995, the USGS published the results of a two year study on the Santa Fe Group and the hydrogeology of the Albuquerque area (Thorn, McAda, and Kernodle, 1993). The study found that the quantity of water in the aquifer was significantly less than previously estimated.

7.3.2 Groundwater Withdrawal on KAFB

Water used for SNL/NM operations is provided by wells owned and operated by KAFB. The wells produce from the upper unit of the Santa Fe Group. In addition, KAFB purchases some of its water from the COA (12,396,000 gal in 1998). The distribution system on KAFB is interconnected and SNL/NM's water use is not currently metered. During FY98, KAFB

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pumped approximately 1.2 billion gallons (1,211,389,000 gal) of groundwater from water supply wells. The highest level of production from KAFB wells was in August (164,983,000 gal); the lowest was in November (28,569,000 gal). Water withdrawal from these wells has effected the water levels in some nearby SNL wells.

7.3.3 Water Levels at KAFB

Vicinity of TA-III Water Level Trends

Wells in this group are located in TA-III and TA-V. In general, wells in this area do not show significant seasonal fluctuations but do show relatively steady declines (0.6 ft/yr) that are consistent with basin-wide declines.

- **Chemical Waste Landfill** – The depth to the water table at the CWL ranges from 482–495 ft below ground level. Eight CWL wells were measured in 1998, including three nested wells, which have upper and lower completions. Upper levels are screened at the water table; lower levels are screened below the water table. Nested wells indicated a downward vertical gradient of approximately 0.07 foot per foot within top 50 ft of saturation. Wells screened at the water table showed a slight increase in water levels during the winter of 1998.
- **Mixed Waste Landfill** – Four wells were measured monthly in 1998. Water levels in MWL monitor wells declined an average of 0.7 ft/yr (the long term trend is 0.78 ft/yr.) There were, however, minor increases at times due to barometric pressure changes.
- **West side of TA-III** – Five wells were measured quarterly west of TA-III. One well has a rate of decline of 1.7 ft/yr; another showed 1.9 ft/yr. Both are much higher rates than observed in other wells in the vicinity.

Sandia North Water Level Trends

Sandia North wells are located in TA-II, the south side of TA-I, along the middle Tijeras Arroyo, including the golf course, and the former KAFB sanitary waste lagoons. There are several perched water zones located in the Sandia North area (Figure 7-4). The lateral extent of these perched zones are currently under investigation. Wells in the area are completed in either the regional aquifer or the perched zones.

- **Sandia North** – Perched water in the Sandia North area is encountered between 270 ft and 320 ft, while the regional aquifer occurs at about 540 ft. Regional aquifer wells show consistent, significant declines as a result of basin-wide declines and show some seasonal fluctuations coincident with water supply pumping by KAFB. (Perched wells do not show influences from production pumping.)

Twenty monitor wells were measured monthly: 10 perched wells and 10 regional wells. Several wells showed no decline on average, although had cyclic variations of up to 3 ft/yr. Generally, regional aquifer wells tend to rise from winter through spring and then decrease through the summer. A total of 12 new monitor wells were installed in the Sandia North area in FY98.

- **Tijeras Arroyo Golf Course** – Perched zones encountered at the golf course may be the result of irrigation but may also be connected to the perched water-bearing zone observed in the Sandia North area to the north. Four wells encounter this perched zone at about 130 ft below the surface. Golf course wells showed a general increase in water levels, increasing an average of 1.98 ft/yr since 1991. Again, this may be the result of irrigation, but it may also be receiving recharge from the northwest.

- **Tijeras Arroyo** – The wells near the Tijeras Arroyo generally show steady water level declines ranging from no perceptible change to 2 ft/yr. All wells show minor fluctuations apparently in response to KAFB pumping.
- **KAFB Lagoon** – Three wells were measured during FY98 at three monitor wells at the site of the former KAFB sewage lagoons. Several KAFB water supply wells are located in this area and pumping affected several monitor wells, which showed fairly steep declines in water levels averaging 2.56 ft/yr. Water levels are nearing the bottom of the screened interval in all the wells, which will soon render them unsuitable for water level measurements. A new well was installed at the eastern edge of the lagoons during FY98.

East of the Tijeras Fault Complex Water Level Trends

- **East of the Tijeras Fault Complex** – The area “East of the Tijeras Fault Complex” includes wells along the southern boundary of KAFB, within Coyote and Lurance canyons, and near the Lovelace Respiratory Research Institute (LRRI). Because the aquifer(s) on the east side of the Tijeras Fault complex are not connected to the regional aquifer in the basin, they are not affected by basin wide declines. Recharge sources (mountain fronts) in the region east of the fault complex influence water levels on a seasonal basis reflecting variations from precipitation and runoff. The magnitude of water level changes over the period of one year is generally not more than 0.3 ft.
- **Locations Near Fault Boundaries** – Wells located along the South Fence Road (SFR) were installed to assess the effects that the faults have on groundwater flow. Six SFR wells were measured in FY98. Water levels within this aquifer were fairly stable; the three year trend showed an average increase

of 0.2 ft/yr. All SFR wells are remote from the perimeter of influence (draw-down) of any production wells and therefore do not show variations associated with pumping schedules. Variations reflect changes in recharge due to precipitation.

Wells in the mouth of Lurance and Coyote Canyons are set in a variety of hydrogeologic conditions such as various bedrock types and conditions and shallow alluvium. The well at the mouth of Lurance Canyon (Greystone Well) shows marked response to recharge and fluctuates up to 2 ft/yr.

- **TA-V** – Water levels were measured and recorded monthly in all nine TA-V monitor wells during FY98. All wells at TA-V showed some variability from month to month, during the year (barometric pressure fluctuations), but in general water levels declined at 1.5 ft/yr to almost 2 ft/yr, a faster rate than historical averages, which have been 0.67 ft/yr.

City of Albuquerque Water Level Trends

Four wells were measured near the Eubank Landfill. Although measurements are not taken at regular intervals, one well does show a long-term decreasing trend of 0.44 ft/yr.

7.4 POTENTIOMETRIC SURFACE

A potentiometric surface map (Figure 7-4) was constructed using September 1998 static water level measurements from SNL/NM, KAFB, and COA monitoring wells. The data was obtained from wells that penetrate different depths into the aquifer and have different lengths of

screened interval. A few wells exhibit artesian conditions. However, most wells used are screened in the upper unit of the Santa Fe Group. The map represents the top surface of the water table of the regional aquifer system showing the horizontal groundwater gradients. (Groundwater flow is perpendicular to equipotential contours.)

The potentiometric surface along the western edge of the map is still problematic because of the lack of accessible monitor wells in the area. New wells have been installed that will help to better define the data in the future.

Apparent Groundwater Flow Direction

Within the upper unit of the Santa Fe Group aquifer system, west of the Tijeras fault complex, the apparent horizontal direction of groundwater flow is west and northwest. This is in contrast to the southwesterly direction reported by Bjorklund and Maxwell (1961). This change in flow direction is a result of groundwater pumping in excess of recharge by KAFB and nearby COA water supply wells. Pumping from these well fields has created a groundwater cone of depression along the western and northern boundaries of KAFB. The ellipsoidal shape of this depression, extending as

far south as the Isleta Pueblo, is probably a result of preferential flow through highly conductive ancestral Rio Grande deposits that are the primary aquifer material in this area.

Potentiometric contours on the northern portion of KAFB indicate a primarily northern flow direction. Locally, pumping from water supply wells can change the groundwater flow direction and the hydraulic gradient on a seasonal basis.

East of the Tijeras Fault Complex

As discussed earlier, groundwater is encountered 400 ft higher east of the Tijeras fault complex than groundwater in the basin. As can be seen from the potentiometric map, groundwater flows southwest through Lurance Canyon and then to the west across the Tijeras fault zone. Groundwater flow on the mountain side of the fault system is complex and controlled by topography and aquifer lithology, which includes rock type and porosity as well as the degree of fracturing present in the bedrock. The hydraulic gradients are higher within fractured bedrock than in more conductive alluvial fan deposit aquifers.

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FIGURE 7-4. Potentiometric Surface Map for the Regional Groundwater System at SNL/KAFB, September 1998

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Quality Assurance

SNL/NM is committed to providing quality work for sampling and analysis procedures to ensure the validity and accuracy of all monitoring data as well as the general conduct of its environmental program operations. The activities described in this chapter are conducted under SNL's Environment, Safety and Health (ES&H) Center (7500). Overall Quality Assurance (QA) criteria for all DOE projects, including environmental programs, are enumerated in DOE Order 414.1, *Quality Assurance* (DOE 1998c).

8.1 CORPORATE LEVEL QUALITY ASSURANCE

Integrated Safety Management System (ISMS)

ISMS was developed by DOE to systematically integrate safety into management and work practices at all levels to ensure that DOE-related missions are accomplished while protecting the public, the worker, and the environment. The DOE ISMS homepage can be viewed at the following address:

<http://enterprise.eh.doe.gov/ism/>

ISMS principals are represented by a green star, which identifies the five critical elements of project planning, implementation, and feedback:

- Plan Work
- Analyze Hazards
- Control Hazards
- Perform Work
- Feedback and Improve

Before work at SNL can begin, the associated hazards within each program area must be evaluated. Safety standards and requirements are established to the level of hazard protection required, to provide adequate assurance that the public, the workers, and the environment will be protected from potentially adverse consequences. All potential hazards are documented using Preliminary Hazard Screenings (PHSS) and Hazard Analyses (HAs) for every facility and activity where potential hazards to workers or the environment are present.

The 7500 Center Quality Policy (ESHCP 0014) was developed in 1998 to integrate ISMS and QA. All 7500 projects and programs must contain the necessary elements of ISMS as an integral part of their programs. It is the responsibility of each Department Manager and Project Leader to ensure that their projects are carried out with the applicable ISMS and QA principles.

8.2 ENVIRONMENTAL PROGRAM QUALITY ASSURANCE

Environmental Sampling

Environmental samples are collected through various programs and analyzed for radiological and nonradiological contaminants. Some sampling is specifically required by regulations to demonstrate compliance, while other sampling activities that are not a regulatory requirement are carried out in accordance with DOE orders. The following sampling activities directly support regulatory compliance:

- **Wastewater** sampling is conducted at permitted outfall stations to meet City of Albuquerque (COA) discharge requirements.
- **Storm water** runoff sampling is conducted at two stations to meet U.S. Environmental Protection Agency (EPA) requirements.
- **Environmental Restoration (ER)** groundwater sampling is required by EPA under Resource Conservation and Recovery Act (RCRA) permit requirements.
- **Waste** sampling is performed, as necessary, to characterize radioactive and hazardous waste. This fulfills several regulatory requirements including the necessity to meet Department of Transportation (DOT) regulations before waste can be shipped offsite for permanent disposal.

The following sampling activities are not directly required by law but are conducted to meet DOE objectives. Data obtained may be used to support related compliance activities:

- **Terrestrial surveillance** monitoring gathers data from surface water, sediment, soil, and vegetation samples.
- **Groundwater** quality sampling is conducted to determine general groundwater quality at wells site-wide (in addition to ER site sampling).
- **Ambient air** sampling is not required by regulation, however, results are compared against EPA standards for criteria pollutants.
- **Air emission** sampling from nonradioactive emission sources may be periodically performed on a case-by-case basis to supply data for various modeling exercises.

Sample management protocol is directed by the Sample Management Office (SMO). SMO provides sample tracking and collecting guidelines to ensure consistent quality of analysis results. SMO is responsible for shipping and receiving samples to and from offsite analytical laboratories. The SMO Program is discussed in Section 8.3

Environmental Program Description Documents

Environmental program areas have developed Program Documents (PGs) and Quality Assurance Project Plans (QAPjPs) to provide the following high-level program overviews:

- Program goals outline the required scope of work;
- Program objectives describe how goals will be met;
- Project descriptions highlight important program functions;
- Roles and responsibilities identify who will meet program objectives; and

- Interfaces describe important customers and supporting agencies working with the program.

These documents are supplemented with specific procedures and other supporting documents, as necessary. All ES&H Center 7500 SNL/NM employees and contractors are individually responsible for ensuring that environmentally-related activities performed by them are carried out in accordance with applicable policies and procedures set forth in these documents. Specifically, program participants must adhere to the QA protocol within each program area by ensuring the following criteria are met before activities commence: (1) project requirements are defined in program plans and procedures and are understood by personnel doing the work; (2) the proper level of training has been completed and project personnel fully understand and are familiar with the work processes; and (3) the qualification of personnel has been verified through task leaders and/or management.

Assessments of Environment, Safety and Health (ES&H) programs are performed routinely by self-assessments, internal SNL independent assessment organizations, and outside agency audits.

8.3 ENVIRONMENTAL SAMPLING AND ANALYSIS

Environmental sampling is conducted in accordance with program-specific sampling and analysis plans (SAPs) or work plans, each of which contain the applicable QA elements. These program-specific documents are prepared and implemented in accordance with the *Sample Management Office (SMO) Quality Assurance Plan (QAP)* (SNL 1996j) and meet appropriate regulatory guidelines (EPA, State, and local) for conducting sampling and analysis activities.

SMO Roles and Responsibilities

SMO provides guidance and support for field activities conducted by SNL/NM organizations. The overall adherence and compliance of any sampling and analysis activity, however, is the responsibility of each particular project.

Before field work commences, project leaders and SMO coordinators confer to ensure that the requirements of the sampling plan are established and communicated to the analytical laboratory. This step ensures that the data quality objectives (DQOs) (such as minimum detection limits) stated in the plan will be achievable by the laboratory before the project begins. An analysis request and a chain-of-custody form are filled out for samples once the project begins. The SMO office assigns a unique control number with which the sample will be labeled and documented in the sample collection log. SMO is responsible for QA and quality control (QC) at the point of sample relinquishment by the field team into the custody of SMO staff. Information about the quantities and types of samples processed through the SMO are available in the SMO Sample Tracking Analytical Results (STAR) database.

Project Specific Sample Analysis Plans (SAPs)

Each program involved in environmental monitoring and sampling has developed or follows a relevant SAP. The specific elements present in most plans include the following:

- Descriptions of sampling procedures (mechanics of the process) applicable to each activity (such as describing the handling of samples, their preservation, labeling, and event documentation);
- A list of EPA-approved sample collection equipment, appropriate sample containers, and container decontamination procedures; and
- A schedule for the collection of QC samples, at defined frequencies, to estimate

sample representativeness and potential contamination acquired during the sampling and handling process.

Selection of a Contract Laboratory

All offsite contract laboratories are selected based on an appraisal (pre-award audit) as described in the *SMO Quality Assurance Plan* (SNL 1996j). All previous and candidate laboratories must employ EPA test procedures wherever possible; if not available, other suitable and validated test procedures are to be used. Laboratory instruments must be calibrated in accordance with established procedures and methods. All calibrations must be verified before instruments can be used in an analysis. Once a laboratory has passed the initial appraisal and has been awarded a contract, it is thereafter audited annually by the SMO. Technical and QA audits are coordinated by the SMO.

Contractor laboratories are required to participate in DOE and EPA programs for blind-audit check sampling to monitor the overall precision and accuracy of analyses routinely performed on SNL/NM samples.

Quality Control (QC) Measures

The QC process guarantees the quality of data generated by each analytical laboratory. Various field QC sample methods are used during the sample collection process to assess the quality of the data outcome. Errors that can be introduced into the sampling process include possible sample contamination in the field or the laboratory, some of which are unavoidable. Additionally, the variability present at each sample location can also affect results.

QC samples are submitted to contractor laboratories in accordance with project-specific DQOs and SAPs. Depending on the type of investigation, one or more of the following QC sampling measures may be performed:

- **Replicate samples** – Two environmental samples are collected from the same area

and submitted to the laboratory to assess the overall variability of data associated with a particular sampling location.

- **Split samples** – A known homogeneous sample is divided and analyzed to compare precision of laboratory results.
- **Field blank sampling** – An unused (blank) sample is taken to measure conditions known to be present and associated with the field location—such as contributions which may be present in the ambient air during soil sampling. Blank samples assess the quality and unavoidable contamination present in the sampling process.
- **Equipment blank sampling** – Rinse water is collected off sampling equipment to determine what contaminants may be contributed from the field equipment itself (e.g., from the filter or collection vessel).
- **Trip blank sampling** – A sample is prepared in the lab and carried through the entire sampling process (for example, a deionized water sample) to identify baseline volatile organic compound (VOC) contaminants that may be present from routine laboratory chemicals or other potential sources of contaminants.
- **Double blind sampling** – A sample with known concentrations of analytes is prepared and submitted to the laboratory to assess the precision and accuracy of the laboratory's stable chemistry analyses.

With each SNL/NM sample batch, QC samples are concurrently prepared at defined frequencies and analyzed for each constituent of interest to measure analytical accuracy, precision, contamination, and the matrix effect associated with each analytical measurement.

QC sample results are compared to statistically established control criteria. Analytical results

generated concurrent with QC sample results are considered acceptable. If analytical results exceeded control limits, the results are not acceptable and corrective action is initiated. Reanalysis is then performed for all samples in the analytical batch.

QC sample data results are included in analytical reports prepared by subcontract laboratories for SNL/NM.

8.4 1998 SAMPLE MANAGEMENT OFFICE (SMO) ACTIVITIES

In 1998, the SMO processed a total of 12,100 samples in support of SNL/NM projects, which included environmental monitoring (air and water), waste characterization, demolition and decontamination (D&D), and ER. Of these, 3,218 were for environmental monitoring and surveillance projects. A total of 1,539 QC samples were submitted to monitor overall contract laboratory performance in 1998; 1,329 of these were for environmental monitoring and surveillance projects.

SMO Sample Handling

SMO handled the following types of samples in 1998:

- Radioactive Waste
- Hazardous Waste
- Solid Waste
- D&D Materials
- Air
- UST Sludges and Liquids
- Soil
- Groundwater
- Wastewater Effluent
- Surface Water
- Storm Water
- Drinking Water
- Air Filter Swipes

The contract labs work to both an SNL statement of work and the *DOE/AL Model Statement of Work* (DOE 1997c).

Inter-laboratory Comparisons

SMO contract laboratories participate in inter-laboratory comparison programs of the EPA's Environmental Monitoring Systems Laboratory (EMSL). Results in 1998 met expectations. This EPA program is being phased out and will be replaced by a yet unidentified equivalent program.

DOE Assessment Programs include the Mixed Analyte Performance Evaluation Program and the inter-laboratory Quality Assurance Program (QAP). The SMO contract laboratories have a history of achieving a 90 percent or better success rate during these comparisons.

Laboratory QA

SMO initiated onsite data package assessments and validation at the EPA-approved laboratories used by SNL. Data packages (usually representing an wide array of analysis procedures) are requested at the time of the onsite visit; the labs are not notified in advance which data packages will be assessed. The handling history of the data package is carefully reviewed from receipt to completion by retracing each step through documentation files. Specific checks for documentation completeness, proper equipment calibration, and batch QA data were made. These assessment focus on data defensibility and regulatory compliance.

In 1998, four labs were used by SNL/NM for data analysis:

- **ACCULABS:** Golden, Colorado
- **General Engineering Labs (GEL):** Charleston, South Carolina
- **QUANTERA:** St. Louis, Missouri; Santa Ana, California; Richland, Washington
- **CORE Labs:** Denver, Colorado; Casper, Wyoming; and Houston, Texas

Blind Audit Checks

In 1998, EPA performed semi-annual QC double blind audit checks of the contract laboratories. The labs routinely score above 90 percent proficient.

QC double blind check samples were submitted quarterly and consisted of soils containing trace metals, cyanides, and a variety of organic compounds. All check samples were prepared in batch quantities and subjected to "round-robin analyses." The round-robin method allows several laboratories to perform analyses for selected parameters on the same sample batch. In this way, a statistical result can be calculated to verify analyte concentrations.

Results of each set of check sample analyses were documented in *Quarterly Performance Evaluation Reports* for each laboratory. Results included average percent recoveries for each suite of samples analyzed, the relative range of actual recoveries, and the relative percent differences for each analyte tested. Each laboratory was given a proficiency rating based on the results.

The resulting data were used to assess each contract laboratory's performance using relative percent difference and percent recovery for respective indicators of precision and accuracy. Review of laboratory performance data generated in 1998 indicated that the majority of analytes tested by the SNL/NM analytical laboratories were within EPA (or interlaboratory round-robin) prescribed control limits. All reports, including laboratory results and audit corrective action responses are filed within SMO.

QA Audits

SMO conducted audits of several of its contract laboratories. Using the centralized QA program criteria established by the Characterization Management Program of DOE/AL, SMO identified numerous concerns. All concerns have since been corrected or are near close out.

There were no external audits or appraisals conducted of the SMO Program in 1998.

Data Validation and Records Management

Sample collection, control documentation, and measurement data were reviewed and validated for each sample collected. Analytical data reported by test laboratories were reviewed for laboratory and field precision, accuracy, completeness, representativeness, and comparability with respect to the data quality objectives (DQOs) of the particular program. Data were reviewed and validated at a minimum of three levels:

- By the analytical laboratory, where the data were validated in accordance with the laboratory's QA plan and standard operating procedures;
- By a knowledgeable member of the SNL/NM SMO staff who reviewed the analytical reports and corresponding sample collection and control documentation for completeness and laboratory contract compliance; and
- By the SNL/NM project leader responsible for program objectives and regulatory compliance and the project-specific data quality requirements.

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- DOE 1996d** U.S. Department of Energy, *Comprehensive Emergency Management*, DOE Order 151.1. U.S. Department of Energy, Washington, DC (Change 2, August 21, 1996).
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- DOE 1993** U.S. Department of Energy, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5. U.S. Department of Energy, Washington, DC (February 8, 1990, change 2, January 7, 1993).
- DOE 1991** U.S. Department of Energy, *Planning and Preparedness for Operational Emergencies*, DOE Order 5500.3A. U.S. Department of Energy, Washington, DC (1991, change 1, February 27, 1992).
- DOE 1990** U.S. Department of Energy, *General Environmental Protection Program*, DOE Order 5400.1. U.S. Department of Energy, Washington, DC (1988, change 1, June 21, 1990).
- DOE 1988** U.S. Department of Energy, *Radioactive Waste Management*, DOE Order 5820.2A. U.S. Department of Energy, Washington, DC (September 26, 1988).

EXECUTIVE ORDERS

- EO 11988** *Floodplain Management* (Signed May 24, 1977; 42 FR 26951, 3 CFR, 1977 Comp., p. 117; Amended by Executive Order 12148, July 20, 1979; 44 FR 43239, 3 CFR, 1979 Comp., p. 412).
- EO 11990** *Protection of Wetlands* (Signed May 24, 1977; 42 FR 26961, 3 CFR, 1977 Comp., p. 121).
- EO 12843** *Procurement Requirements and Policies for Federal Agencies for Ozone Depleting Substances.*
- EO 12856** *Federal Agency Compliance With Right-to-Know Laws and Pollution Prevention Requirements* (Signed August 3, 1993; 58 FR 41981, August 6, 1993).
- EO 12873** *Federal Acquisition, Recycling and Waste Prevention.* (Signed October 20, 1993; 58 FR 54911, October 22, 1993; amended by EO 12995, March 25, 1996; 61 FR 13645, March 28, 1996).
- EO 12902** *Energy Efficiency and Water Conservation at Federal Facilities.* (Signed March 8, 1994).

NEW MEXICO REGULATIONS

20 NMAC 4.1	<i>(FFCA Act implemented) incorporates by reference 40 CFR 260-270.</i>
20 NMAC 5	<i>Underground Storage Tanks (USTs).</i>
20 NMAC 6.2	<i>New Mexico Water Quality Control Commission (NMWQCC) regulations.</i>
20 NMAC 7.1	<i>Drinking Water.</i>
20 NMAC 9.1	<i>(Biohazardous waste).</i>
20 NMAC 11.01	<i>National Primary and Secondary Ambient Air Quality Standards.</i>
20 NMAC 11.02	<i>Permit Fees.</i>
20 NMAC 11.03	<i>Conformity (State and Federal Plans).</i>
20 NMAC 11.04	<i>Ambient Air Quality Surveillance.</i>
20 NMAC 11.05	<i>Visible Air Contaminants.</i>
20 NMAC 11.06	<i>Emergency Action Plan.</i>
20 NMAC 11.07	<i>Variance Procedure.</i>
20 NMAC 11.20	<i>Airborne Particulate Matter.</i>
20 NMAC 11.21	<i>Open Burning (regulated burns).</i>
20 NMAC 11.22	<i>Wood Burning.</i>
20 NMAC 11.23	<i>Stratospheric Ozone Protection.</i>
20 NMAC 11.40	<i>Source Registration.</i>
20 NMAC 11.41	<i>Authority-to-Construct.</i>
20 NMAC 11.42	<i>Operating Permit (application under review).</i>
20 NMAC 11.43	<i>Stack Height Requirements.</i>
20 NMAC 11.44	<i>Emissions Trading.</i>
20 NMAC 11.60	<i>Permitting in Nonattainment Areas.</i>
20 NMAC 11.61	<i>Prevention of Significant Deterioration.</i>
20 NMAC 11.62	<i>Acid Rain.</i>
20 NMAC 11.63	<i>New Source Performance Standards.</i>
20 NMAC 11.64	<i>NESHAP Subpart C, H, and M.</i>

NEW MEXICO REGULATIONS (Concluded)

- 20 NMAC 11.65 *Volatile Organic Compounds.*
- 20 NMAC 11.66 *Process Equipment.*
- 20 NMAC 11.67 *Equipment, Emissions and Limitations.*
- 20 NMAC 11.68 *Incinerators.*
- 20 NMAC 11.69 *Pathological Waste Destructors.*
- 20 NMAC 11.90 *Administration, Enforcement, Inspection.*
- 20 NMAC 11.100 *Motor Vehicle Inspection – Decentralized and Centralized.*
through 11.101
- 20 NMAC 11.102 *Oxygenated Fuels Motor Vehicle Visible Emissions.*
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APPENDIX A

ENVIRONMENTAL REGULATIONS AND STANDARDS

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Overview

Radiation Protection

The U.S. Department of Energy (DOE) has established radiation protection standards for the public to control and limit radiation doses resulting from activities at DOE facilities. Sandia National Laboratories/New Mexico (SNL/NM) is the DOE facility specific to this discussion. Public areas are defined as any location that is accessible to non-DOE facility employees (e.g., excluding Sandia employees and contractors), such as Kirtland Air Force Base (KAFB) personnel and the surrounding community. Radiation protection standards are provided in DOE Order 5400.5, *General Radiation Protection of the Public and the Environment* (DOE 1993). Environmental monitoring requirements for DOE operations are given in DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990). In addition to these quantitative standards, the overriding DOE policy is that exposures to the public shall be maintained "as low as reasonably achievable" (ALARA).

DOE Order 5400.5 limits the total annual effective dose equivalent (EDE) of all potential exposure pathways to the public (including air, water, and the food chain) to 100 millirem per year (mrem/yr). The Order lists the Derived Concentration Guides (DCGs) for radionuclides in water and air that could be continuously consumed or inhaled (365 days/year). This is a conservative approach that assumes that a member of the public resides at the location continuously. Table A-1 lists the DCGs pertinent to activities at SNL/NM and to this report.

- **Water Pathways** – DOE drinking water guidelines are based on an annual EDE not to exceed 4 mrem/yr. Guideline values for drinking water are calculated at 4 percent of ingested water using DCG values for specific nuclides.
- **Air** – DOE facilities are required to comply with U.S. Environmental Protection Agency (EPA) standards for radiation protection as given in National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H, specific to radionuclides emitted from DOE facilities (with the exception of radon). This rule mandates that air emissions from DOE facilities shall not cause any individual of the public to receive an EDE of greater than 10 mrem/yr from air pathways. Table A-2 summarizes the public radiation protection standards that are applicable to DOE facilities.

Resource Conservation and Recovery Act (RCRA)

Table A-3 lists the 40 CFR 265, Subpart F, parameters required for groundwater monitoring analysis, implemented under RCRA. Table A-4 gives the EPA interim primary drinking water standards (40 CFR 265, Appendix III) for the groundwater monitoring parameters. At SNL/NM, this regulation applies to Environmental Restoration (ER) sites.

TABLE A-1. Derived Concentration Guides (DCGs) for Selected Radionuclides*

Nuclide	Ingested Water		Inhaled Air [†]	
	DCG (μCi/ml)	f ₁ Value**	DCG (μCi/ml)	Solubility Class
Tritium (water)	2 x 10 ⁻³	--	1 x 10 ⁻⁷	W
Cesium-137	3 x 10 ⁻⁶	1	4 x 10 ⁻¹⁰	D
Uranium, total (U _{tot}) §	5 x 10 ⁻⁶	--	1 x 10 ⁻¹³	Y

NOTE: μCi/ml = microcuries per milliliter

* DOE Order 5400.5, Change 2, January 7, 1993 (DOE 1993).

[†]DCG for tritium in air is adjusted for skin absorption.

** F₁ value is the gastrointestinal absorption factor.

§ A conversion from microcuries per milliliter (μCi/ml) to micrograms per liter (μg/L) may be made using:

$$\mu\text{g} / \text{L} = X \mu\text{Ci} / \text{ml} \frac{[1.49 \times 10^9 \mu\text{g} / \text{L}]}{[1 \mu\text{Ci} / \text{ml}]}$$

TABLE A-2. Radiation Standards for Protection of the Public in the Vicinity of U.S. Department of Energy Facilities

General Dose Limits

All Pathways^{*}

The effective dose equivalent (EDE) for any member of the public from all routine DOE operations[†] (natural background and medical exposures excluded) shall not exceed the values given below:

	<u>Effective Dose Equivalent (EDE)</u>	
	<u>mrem/yr</u>	<u>mSv/yr</u>
Primary limit	100	1

Air Pathway^{**}

	<u>Effective Dose Equivalent (EDE)</u>	
	<u>mrem/yr</u>	<u>mSv/yr</u>
Maximum offsite residence	10	0.10

NOTE: *DOE Order 5400.5, Chapters I and II (DOE 1993).

[†]Routine DOE operations means normal planned activities, including remedial actions and naturally occurring radionuclides released by DOE processes and operations.

^{**}40 CFR 61, Subpart H for radionuclides, National Emission Standards for Hazardous Air Pollutants (NESHAP).

TABLE A-3. Groundwater Monitoring Parameters Required by 40 CFR 265, Subpart F*

Contamination Indicator	Groundwater Quality	Appendix III† Drinking Water Supply
pH	Chloride	Arsenic
Specific Conductivity	Iron	Barium
Total Organic Halogen (TOX)	Manganese	Cadmium
Total Organic Carbon (TOC)	Phenol	Chromium
	Sodium	Fluoride
	Sulfate	Lead
		Mercury
		Nitrate (as N)
		Selenium
		Silver
		Endrin
		Lindane
		Methoxychlor
		Toxaphene
		2,4-D
		2,4,5-TP Silvex
		Radium
		Gross Alpha
		Gross Beta
		Coliform Bacteria
		Turbidity

NOTE: *Resource Conservation and Recovery Act (RCRA).

†40 CFR 265, Appendix III.

TABLE A-4. U.S. Environmental Protection Agency Primary Drinking-Water Supply Standards

Inorganic Parameter	MCL*	Units
Antimony	0.006	mg/L
Arsenic†	0.05	mg/L
Barium†	2.0	mg/L
Beryllium	0.004	mg/L
Cadmium†	0.005	mg/L
Chromium†	0.1	mg/L
Cyanide	0.2	mg/L
Fluoride	4.0	mg/L
Mercury†	0.002	mg/L
Nickel	0.1	mg/L
Nitrate (as N)	10	mg/L
Nitrite (as N)	1	mg/L
Total Nitrate and Nitrate (as N)	10	mg/L
Selenium†	0.05	mg/L
Thallium	0.002	mg/L

NOTE: *MCL = Maximum Contaminant Level (40 CFR 265, Appendix III)

† Total metals (unfiltered sample).

TABLE A-4. U.S. Environmental Protection Agency Primary Drinking-Water Supply Standards
(continued)

Organic Parameter	MCL*	Units
Alachlor	0.002	mg/L
Atrazine	0.003	mg/L
Benzene**	0.005	mg/L
Carbofuran	0.04	mg/L
Carbon tetrachloride**	0.005	mg/L
Chlordane	0.0002	mg/L
1,1-Dichloroethylene**	0.007	mg/L
1,1,1-Trichloroethane	0.2	mg/L
1,2-Dichloroethane**	0.005	mg/L
Cis-1,2-Dichloroethylene**	0.005	mg/L
1,2-Dichloropropane**	0.005	mg/L
Ethylbenzene**	0.7	mg/L
Ethylene Dibromide	0.00005	mg/L
Hepatachlor	0.0004	mg/L
Heptachlor epoxide	0.0002	mg/L
Lindane	0.0002	mg/L
Methoxychlor	0.04	mg/L
Polychlorinated biphenyls	0.0005	mg/L
Pentachlorophenol	0.001	mg/L
Toxaphene	0.003	mg/L
2,4,5-TP	0.005	mg/L
Benzo[a]pyrene	0.002	mg/L
Dalapon	0.2	mg/L
Di(2-ethylhexyl)adipate	0.4	mg/L
Di(2-ethylhexyl)phthalate	0.006	mg/L
Dinoseb	0.007	mg/L
Diquat	0.02	mg/L
Endothall	0.1	mg/L
Endrin	0.002	mg/L
Glyphosate	0.7	mg/L
Hexachlorobenzene	0.001	mg/L
Hexachlorocyclopentadiene	0.05	mg/L

TABLE A-4. U.S. Environmental Protection Agency Primary Drinking-Water Supply Standards
(Concluded)

Organic Parameter	MCL*	Units
Oxamyl (Vydate)	0.2	mg/L
Para-Dichlorobenzene**	0.075	mg/L
Picloram	0.5	mg/L
Simazine	0.004	mg/L
Trichloroethylene**	0.005	mg/L
Monochlorobenzene**	0.1	mg/L
O-Dichlorobenzene**	0.6	mg/L
Styrene**	0.1	mg/L
Tetrachloroethylene**	0.005	mg/L
Toluene**	1	mg/L
Trans-1,2-Dichloroethylene**	0.1	mg/L
Xylenes (total)**	10	mg/L
Dichloromethane**	0.005	mg/L
1,2,4-Trichlorobenzene**	0.07	mg/L
1,1,2-Trichloroethane**	0.005	mg/L
2,3,7,8-TCDD (Dioxin)	3 x 10 ⁻⁸	mg/L
Vinyl chloride	0.002	mg/L

NOTE: mg/L = milligrams per liter; ml = milliliters;

*40 CFR 265, Appendix III.

**MCL standard only applies to community water systems for populations of 10,000 or more, which add chemicals (i.e., disinfectant) to the water in any part of the drinking water treatment process.

REFERENCES

- DOE 1990: U.S. Department of Energy, *General Environmental Protection Program*, DOE Order 5400.1. DOE, Washington, DC (1988; change 1, June 21, 1990).
- DOE 1993: U.S. Department of Energy, Chapter I, *General Radiological Protection of the Public and the Environment*; Chapter II, *Requirements for Radiation Protection of the Public and the Environment*; and Chapter III, *Derived Concentration Guides for Air and Water*. DOE Order 5400.5. DOE, Washington, DC (February 8, 1990, change 2, January 7, 1993).
- EPA 1998: CFR Part 141 - National Primary Drinking Water Regulations (July 1, 1998).

Regulations

Resource Conservation and Recovery Act (RCRA) of 1976. Public Law 94-580, 1976, 90 Statute 2795.

40 CFR 61, Subpart H for radionuclides. *National Emission Standards for Hazardous Air Pollutants (NESHAP)*.

40 CFR 141, 1975. *National Primary Drinking Water Regulations*, as amended January 15, 1992.

40 CFR 265, 1980. *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, as amended December 23, 1991.

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APPENDIX B

**1998 Annual Site Environmental Report
for the
Kauai Test Facility
Operated by Sandia National Laboratories**

ACKNOWLEDGEMENTS

This report was written with contributions from Alonzo Lopez, Joan Harris, Hans Oldewage, Heidi Herrera, Adrian Jones, John Copland, and Steve Lautenschleger. Dianne Duncan and Rebecca Sanchez of the Environmental and Emergency Management Department compiled and edited the document.

Kauai Test Facility

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ABBREVIATIONS

Acronyms and Abbreviations

AEGIS	(not an acronym; it means "shield")
AIRF	American Indian Religious Freedoms Act
ARPA	Archeological Resources Protection Act
AWS	AEGIS Weapon System
BMDO	Ballistic Missile Defense Organization
CASTOR	(a type of rocket)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/AL	U.S. Department of Energy, Albuquerque Operations Office
DOE/KAO	U.S. Department of Energy, Kirtland Area Office
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Orders
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ER	Environmental Restoration
ES&H	Environment, Safety, and Health
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FFCAct	Federal Facilities Compliance Act
FONSI	finding of no significant impact
FTU	Flight Test Unit
HCRR	Hawaiian Code of Rules and Regulations
HST	Hawaiian Standard Time
KTF	Kauai Test Facility
MW	mixed waste
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	No Further Action
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSPS	New Source Performance Standards
NSP	Non-covered Source Permit
PCB	polychlorinated biphenyl
PMRF	Pacific Missile Range Facility
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RQ	reportable quantity
SARA	Superfund Amendments and Reauthorization Act
SDI	Strategic Defense Initiative
SDWA	Safe Drinking Water Act
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SPCC	Spill Prevention Control and Countermeasures (Plan)
STARS	Strategic Targeting System
TALOS	(a type of rocket)
TSCA	Toxic Substances Control Act
TTV	Target Test Vehicle
UST	underground storage tank

Night Launch of a STARS Rocket

Sandia National Laboratories (SNL) operates the Kauai Test Facility (KTF) as a rocket preparation, launching, and tracking facility for the U.S. Department of Energy (DOE), as well as in support of other U.S. military agencies. The KTF exists as a facility within the boundaries of the U.S. Department of Defense (DoD) Pacific Missile Range Facility (PMRF). KTF is located on the island of Kauai at the north end of the PMRF, near Nohili Point (Figure B-1). This site environmental report for the KTF has been prepared as required by DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990).

B.1 FACILITIES AND OPERATIONS

KTF has been an active rocket-launching facility since 1962. SNL's Kauai Test Facility and Range Interfaces Department manages and conducts the rocket-launching activities at KTF. The site is primarily used for testing rocket systems with scientific and technological payloads, advanced development of maneuvering re-entry vehicles, scientific studies of atmospheric and exoatmospheric phenomena, and Ballistic Missile Defense Organization (BMDO) programs. Nuclear devices have never been launched from KTF nor have radiological materials been used at KTF.

The first facilities at KTF were constructed in the early 1960s to support the National Readiness Program. The most recent construction, completed in 1994, added four buildings to support DOE and Strategic Defense Initiative (SDI) launches. From 1992 to 1998, there have been 12 launches.

The KTF launcher field was originally designed to accommodate 40 launch pads, but only 15 pads were constructed. Of these, 11 have had their launchers removed. Beyond the implementation of portions of the original plan,

two additional launch pads were constructed: Pad 41 at Kokole Point, and Pad 42, the Strategic Targeting System (STARS) launch pad. The launcher field site has a number of permanent facilities used to support rocket operations. In addition to rocket launch pad sites, KTF facilities include missile assembly areas, data acquisition and operations facilities, a maintenance shop, and a trailer compound for administration and technical support personnel. Other features at KTF include extensive radar tracking and world-wide radio communication access to other DoD facilities.

The administrative area of KTF, known as the Main Compound, is located within a fenced area near the North Nohili access road from PMRF. Inside the fenced compound, a number of trailers and vans are connected together with a network of concrete docks and covered walkways. The majority of these temporary facilities are used during operational periods to support the field staff at KTF. During non-operational periods, general maintenance continues and dehumidifiers remain in operation (to protect equipment). Additionally, there are a number of permanent buildings, most of which are in use year-round to support and maintain KTF facilities (Helgesen 1990).

B.2 1998 ROCKET LAUNCHES

Two rocket launches from the KTF were executed in 1998. Both of these launches were covered by the KTF Environmental Assessment (EA), published in July 1992 (DOE 1992).

- **Red Crow Launch** – The Red Crow Program launch occurred on April 17, 1998 at 07:05 Hawaiian Standard Time (HST) carrying a payload of three experiments to the exoatmosphere. This was a two-stage TALOS/CASTOR-I sounding rocket. The first stage consisted of a Hercules TALOS MK11 Mod 2 rocket motor and the second stage, a Thiokol XM-33 CASTOR I rocket. SNL conducted the launch as part of the

FIGURE B-1. Map of the Pacific Missile Range Facility (PMRF) and the Adjacent Area
The Kauai Test Facility (KTF) is to the north, near Nohili Point

BMDO's program to characterize the performance of missile countermeasures and to collect data to aid countermeasure development.

- **Target Test Vehicle (TTV-1)** – On November 20, 1998 at 02:30 HST, the first of several planned launches occurred to test the performance of the Target Test Vehicle (TTV-1). TTV-1 is to be used as a surrogate target in the development of Navy's Theater Ballistic Missile Defense System. This first test flight demonstrated the operation of TTV-1 and the ability of the Navy's AEGIS Weapon System (AWS) to track the target. The objective of the subsequent flights will be to intercept this surrogate target in the exoatmosphere with the Navy's SM-3 intercept missile. The TTV is a single stage booster consisting of the M56A (second stage motor of the Minute Man I). Launch services were provided by Orbital Sciences Corporation; SNL provided the range support services.

B.3 DEMOGRAPHICS

KTF employs 13 permanent onsite personnel—two work directly for SNL and 11 are SNL contractors. During operational periods, when rocket launches occur, an additional 15 to 130 persons from the U.S. mainland are employed at KTF (DOE 1992). The closest population center to KTF is the town of Kekaha (population 3,300), which is 8 miles from the site.

B.4 COMPLIANCE SUMMARY

The following list of statutes provide an overview of compliance status of SNL's operations at KTF in 1998. Table B-1 lists the applicable permits in place at KTF.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA, also known as Superfund, addresses areas of past spills and releases. KTF has no current Environmental Restoration (ER) areas located onsite.

Background: In 1995, a site inspection was performed at KTF to determine compliance with CERCLA requirements. Three ER sites were identified at that time. Based on the site inspection report (SNL 1995A), the EPA informed the Albuquerque Operations Office (DOE/AL) on September 30, 1996 that a No Further Action (NFA) determination had been made. This confirmed that KTF met all CERCLA requirements and no additional sampling or remediation would be necessary at the three areas.

EPA designated ongoing oversight of KTF to the Hawaii Department of Health Hazard Evaluation and Emergency Response Office. The EPA recommended continued reevaluation for environmental contamination due to the launching facility present. Exhaust and explosions continue to be the main source of metals and other hazardous releases.

Superfund Amendments and Reauthorization Act (SARA)

SARA Title III requires chemical inventory information and threshold quantity reporting as directed by the Emergency Planning and Community Right-to-Know Act (EPCRA), Sections 311 and 312. All required information has been submitted to the State of Hawaii.

Resource Conservation and Recovery Act (RCRA)

In 1994, KTF reached "small quantity hazardous waste generator" status as defined by RCRA, and therefore, obtained an EPA Identification Number. However, the volume of waste generated in 1998 qualified the KTF to maintain "conditionally exempt small quantity generator" status.

Emergency Destruction of Rocket Motors

SNL obtained a special permit from the Environmental Protection Agency (EPA), Region IX, to destroy three rocket motors at the PMRF. The three rockets identified were two Mk12 Mod 0 "Terriers" and one "Nike Hercules." The method was deactivation by open detonation. The "emergency request" was made because the motors were not safe for transport and disposal to an offsite facility. (The rockets were determined by DOE to be unsafe during their inspection of SNL's explosive components being stored at PMRF's explosive storage magazine.)

DOE notified the State in a letter and then applied for and was issued an "Emergency Disposal Permit" by the EPA on October 20, 1998. This was pursuant to 40 CFR 270.61 of RCRA.

The detonations took place on October 28, 1998, in a vacant area near the Main Compound at the PMRF. The Navy Explosive Ordnance Disposal (EOD) Mobile Unit Team from Pearl Harbor performed the detonations, one at a time. The method of destruction involved digging a pit for each rocket motor and packing 100 lb of C4 explosive into each hole. The rockets were buried to a depth that would limit shrapnel from being expelled more than a short distance. After the event, the area was inspected for residual debris. The small amount of debris that remained was removed by the EOD and was either recycled or disposed of as solid waste by PMRF personnel. Subsequent soil samples taken from the area indicated no hazardous waste constituents above regulatory limits.

Federal Facilities Compliance Act (FFCA Act)

The FFCA Act addresses the disposition of mixed waste (MW) at Federal facilities. No radioactive waste of any kind has been generated or stored at KTF and, therefore, this statute is not applicable to the site.

National Environmental Policy Act (NEPA)

NEPA requires that all Federal facilities address environmental and cultural impacts in

appropriately detailed documentation before initiating projects. Acts and Executive Orders (EOs) directly related to NEPA compliance include the following:

- Endangered Species Act (ESA)
- National Historic Preservation Act (NHPA)
- Archeological Resources Protection Act (ARPA)
- American Indian Religious Freedoms Act (AIRF)
- Executive Order 11990, *Protection of Wetlands*
- Executive Order 11988, *Floodplain Management*

The DOE, Kirtland Area Office (DOE/KAO) coordinates NEPA compliance at KTF with SNL.

In accordance with NEPA, a comprehensive Site-wide Environmental Assessment (EA) was completed for KTF in 1992 (DOE 1992), which resulted in a Finding of No Significant Impact (FONSI), issued on July 17, 1992. This EA is the current NEPA document covering all rocket-launching activities at KTF. Additionally, an Environmental Impact Statement (EIS) specific to the STARS Program is in place for rocket launches of this type (DoD 1992).

Two NEPA Checklists were submitted to DOE/KAO for determination on proposed actions at KTF in 1998:

- TTV rocket launch (The checklist for the Red Crow rocket launch was submitted in 1997.)
- Emergency destruction of three rocket motors

In 1998, Sandia continued to support the PMRF in the development of their programmatic *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement*

(EIS) (DoD 1998). A Record of Decision was signed in April 1999 by the Department Assistant Secretary of the Navy.

Clean Air Act (CAA) and Clean Air Act Amendments (CAAA) of 1990

Ambient air quality is regulated by Hawaii's Code of Rules and Regulations (HCRR), Title 11, Chapter 59 (11-59-4) under the jurisdiction of the Hawaii Department of Health, Air Pollution Control Department. Currently, there are no facilities at KTF that require air permits or compliance with the New Source Performance Standards (NSPS), "Prevention of Significant Deterioration (PSD)," or 40 CFR 161, "National Emission Standards for Hazardous Air Pollutants" (NESHAP). Within the boundaries of PMRF, no Federal air emission permits are held either by DOE for KTF, or by DoD for PMRF. However, the two electrical generators at KTF are permitted for operation by the State of Hawaii under a "Non-covered Source Permit" (NSP) (SNL 1996a).

Rocket launches are mobile sources and do not require reporting of reportable quantity (RQ) releases.

According to EPA requirements, the 1998 Annual Fee and Monitoring Report was submitted to the State of Hawaii on February 22, 1999. The State of Hawaii waived the air emission fees (\$500) for 1998. KTF was in compliance with all air quality regulations in 1998.

Clean Water Act (CWA)

There were no compliance issues with respect to any State or Federal water pollution regulations in 1998. The KTF facility has three septic tanks onsite, which currently do not require permits from the State of Hawaii.

A National Pollutant Discharge Elimination System (NPDES) permit is not required due to the lack of significant storm water runoff or wastewater discharging beyond the site boundary into "waters of the U.S.," as defined in the regulation. However, this is not to say that there is no runoff. The EPA has expressed some concern with storm water runoff washing off the launcher pads and discharging to the ocean. Some of the downstream pathways include habitat for several Federally-designated endangered or threatened species. The EPA has therefore requested that environmental sampling be performed at these areas in the future.

TABLE B-1. Permits in Place at KTF

Type	Permit Number	Date Issued	Expiration Date	Regulatory Agency
Resource Conservation and Recovery Act (RCRA)	HI-0000-363309	Sep 23, 1994	Not specified	EPA Region IX and Hawaii Dept. of Health
RCRA	HIP-0000-45104	Oct 20, 1998	One time only - Oct 28, 1998	EPA Region IX and Hawaii Dept. of Health
Diesel Generators (air emission)	NSP-0429-01-N	Oct 25, 1993 Re-issued Sep 15, 1998	Sep 2003	State of Hawaii

NOTE: PTO = Permit to Operate

Underground Storage Tank (UST) – KTF has one UST in inventory. There were no issues or changes in status for this tank during 1998. The UST Program follows the guidelines stated in the Spill Prevention Control and Countermeasures (SPCC) Plan (NFEC 1997).

Safe Drinking Water Act (SDWA)

The SDWA does not apply directly to SNL activities at KTF because all drinking water is obtained through PMRF's facilities.

Toxic Substances Control Act (TSCA)

TSCA regulates the distribution of polychlorinated biphenyls (PCBs) and asbestos. The transformers on the KTF site have been tested and are free of PCBs, and there are no asbestos issues at the site.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA controls the distribution and application of pesticides including herbicides, insecticides, and rodenticides. All pesticide use at KTF follows EPA requirements.

Releases and Occurrences

There were no accidental releases or other environmental occurrences at KTF in 1998.

B.5 ENVIRONMENTAL PROGRAM ACTIVITIES

This section describes three environmental programs: the National Environmental Policy Act (NEPA) Program, the Environmental Restoration (ER) Project, and the Spill Prevention Program.

National Environmental Policy Act (NEPA) Program Activities

In completing the KTF EA in 1992, several environmental baseline surveys were conducted and are summarized below:

- ♦ **Green Sea Turtle Survey Report** – This survey found at least 32 green sea turtles (*Chelonia mydas agassizi*) in five locations at KTF. The study concluded that constructing an additional launch pad and conducting further launches, similar to those conducted at KTF since 1962, most likely will not have any quantifiable negative effects on green sea turtles inhabiting waters near KTF (IT 1990a).
- ♦ **Botanical Survey Report** – This survey identified four major vegetation types at KTF and recommended that vehicles be kept off the beaches and dunes. The report recommended moving the entire *Ophioglossum concinnum* colony (a Category 1^a proposed endangered fern) to a compatible area within PMRF because of the colony's proximity to a beach access road and its location in a frequently-mowed kiawe/koahale vegetation zone (IT 1990b).
- ♦ **Ornithological and Mammal Survey Report** – This survey determined relative population densities of bird species and identified mammalian species at KTF. Based on mitigations implemented and other commitments made in the KTF EA, no adverse impacts are expected for birds or mammals as a result of KTF operations (IT 1990c).
- ♦ **Soil Sampling Report** – Sampling was undertaken to delineate the extent and concentration of lead, aluminum, and beryllium in the soil at KTF and to determine whether the concentrations pose a risk to human health or the environment. The soil sampling results were used to estimate the potential for future soil contamination or human exposure from use of KTF as a launch facility (IT 1990d).
- ♦ **Archaeological Survey and Sampling** – No significant cultural resources were found at the surface level on KTF, during this

^aCategory 1 is a species for which biologic vulnerability exists to the point of support of proposal to list as endangered or threatened.

study. However, subsurface testing at one area indicated a potential for buried cultural resource materials (Gonzalez and Berryman 1990).

Environmental Restoration (ER) Project Activities

KTF has no ER sites. The three previous sites were taken off the list after the EPA made the determination of No Further Action (NFA) on September 30, 1996. The status was granted after a site inspection and a follow up report (SNL 1995a). No additional assessment or sampling is required at KTF relative to these ER sites. This, however, does not preclude that other environmental sampling activities will take place at KTF.

Spill Prevention Control and Countermeasures Plan (SPCC)

SNL cooperates with the Navy's *Spill Prevention Control and Countermeasures (SPCC) Plan, Pacific Missile Range Facility* (U.S. Navy 1991), which is applicable to the 10,000-gallon above-ground fuel tank inside the Main Compound. KTF has only one UST in its inventory.

B.6 ENVIRONMENTAL SURVEILLANCE AND MONITORING ACTIVITIES

Environmental Surveillance

Terrestrial surveillance monitoring of soils and surface water was not conducted in 1998. Currently, environmental sampling is conducted on a periodic and "as needed" basis due to the limited activities at KTF. Past sampling results, last performed in 1994, indicate that any contamination present is minimal and is not migrating. Sampling was performed in January 1999 under the protocols defined in the Environmental Sampling Plan (SNL 1996b). Results will be reported in next year's ASER.

Terrestrial samples taken at KTF are limited to soil and vegetation samples. Because of the

high permeability of the dune sands on which KTF is sited, there is no perennial surface water and few established drainages onsite; therefore, surface water and water-deposited sediment samples are not being collected.

Routine groundwater sampling is not performed because the groundwater is unacceptable for consumption or irrigation of any kind (DOE 1992). KTF is located only slightly above sea level; the water table consists of a brackish non-potable water layer lying above seawater. Groundwater samples were taken at several previous ER sites in 1994 using temporary wells; no contamination was detected. Future sampling will be dependent on resource availability and demonstrated need.

Summary of 1994 Soil Sampling Results and Additional 1995 Analyses

In July 1994, SNL Environmental Surveillance staff from SNL, New Mexico (SNL/NM) collected 32 soil samples within a 6-mile radius of the site —19 from onsite and perimeter locations and 11 from offsite locations. The specific objective of the 1994 sampling was to provide limited baseline data for the radiological and nonradiological (toxic metal) concentrations of the soil in and around KTF. Results of the 1994 sampling activity and further data analysis performed the following year were published in the appendix of the 1994 and 1995 SNL/NM Site Environmental Reports (SNL 1995b, SNL 1996c).

Radiological results showed no statistical difference between onsite and offsite samples, supporting the historical process knowledge that no radioactive contaminants have been dispersed at the site.

Sitewide nonradiological results showed elevated concentrations for the following metals:

Barium	Chromium
Cobalt	Copper
Iron	Lead
Magnesium	Nickel
Silicon	Strontium
Zinc	

However, many of the elevated metals were only marginally above offsite locations. Only iron, magnesium, silicon, zinc, and nickel showed significantly higher results as compared to offsite data.

Further analysis of the nonradiological (metals) data was conducted in 1995 to provide a planning basis for future sampling activities (Shyr et al. 1996, SNL 1996c). Of the metals reported as elevated, iron, magnesium, and silicon were removed from discussion because these occur naturally in high concentrations in the native soil (volcanically-derived) and have a low health impact.

Zinc and lead showed significantly higher concentrations than offsite. The highest value for zinc was 3,100 parts per million (ppm), however, this was only 10 percent of the proposed RCRA action level (23,000 ppm). Lead concentrations were high at two onsite locations. One location with results of 110 ppm was slightly above the RCRA toxicity level (100 ppm). Because lead is an expected pollutant generated during the launch of some rocket systems, lead contamination was addressed in the KTF EA (DOE 1992). If KTF is decommissioned in the future, samples will be collected to determine if lead present in soils will require remediation.

Wastewater Monitoring

KTF produces only sanitary sewage, which is directed into five wastewater systems—three septic tanks and two French drains—in accordance with Hawaii Underground Injection Control regulations. The septic systems are periodically pumped by licensed State-certified contractors and inspected by State officials. The limited quantity of sewage released does not impact any protected waters and, as noted earlier, there are no drinking water wells in the area of KTF. Currently, septic tanks do not require permitting or sampling. Sampling is performed as a “Best Management Practice” on an “as needed” basis. The last sampling occurred in June 1993 (IT 1994).

Air Emission Monitoring

Based on effluent air monitoring results of the STARS Flight Test Unit 1 (FTU-1) in February 1993 (EPA 1993) and the CDX rocket launch in the summer of 1992 (SNL 1992), it was determined that rocket launches at KTF were not a significant source of air pollutants—launches are infrequent and emissions recorded did not exceed Federal and State standards (DoD 1994). Because the STARS type rocket produces the greatest air emissions and remained within acceptable limits, it can be assumed that future launches of this type will also be within acceptable limits. Therefore, no further air emission monitoring is planned at this time. If a new rocket type is launched from KTF that differs in emission substance from the STARS rocket, or air emission requirements change, funding for future monitoring will be requested.

Meteorological Monitoring

Onsite meteorological instruments are used during test periods to characterize atmospheric transport, diffusion conditions, and stability classes. Due to the infrequency of launches, no formal meteorological monitoring plan is in place for KTF. Climatic information representative of KTF is obtained from the PMRF.

Noise Monitoring

In accordance with the Quiet Communities Act of 1978 (42 U.S.C. 4901 et seq.), noise monitoring was conducted in February 1993 during the STARS FTU-1 launch to confirm the determination made in the STARS EIS that noise produced from the largest launch would be below maximum acceptable levels (SNL 1993). Data collected in the nearest town of Kekaha indicated that levels were no louder than noise generated from passing vehicles on a nearby highway.

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- Clean Air Act (CAA) of 1955, as amended. Title 42 U.S.C. 7401.
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