SANDIA REPORT

SAND94–2631 • UC–607
Unlimited Release
Printed October 1994

Sandia Lightning Simulation Facility Building 888 Hazards Assessment Document

Zeferino Banda, Project Leader
Brent Barnett, Author

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
for the United States Department of Energy
under Contract DE-AC04-94AL85000

Issued by Sandia National Laboratories, operated for the United States Department of Energy by Sandia Corporation.

Available to DOE and DOE contractors from
Office of Scientific and Technical Information
PO Box 62
Oak Ridge, TN 37831

Prices available from (615) 576-8401, FTS 626-8401

Available to the public from
National Technical Information Service
US Department of Commerce
5285 Port Royal Rd
Springfield, VA 22161

NTIS price codes
Printed copy: A05
Microfiche copy: A01

SAND94-2631
Printed October 1994
Unlimited Release
UC 607

Sandia Lightning Simulation Facility
Building 888
Hazards Assessment Document

Project Leader: Zeferino Banda
Author: Brent Barnett

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185

Sandia Contract No. AJ-5463

Abstract

The Department of Energy Order 5500.3A requires facility-specific hazards assessments be prepared, maintained, and used for emergency planning purposes. This hazards assessment document describes the chemical and radiological hazards associated with the Sandia Lightning Simulation Facility, Building 888. The entire inventory was screened according to the potential airborne impact to onsite and offsite individuals. The air dispersion model, ALOHA, estimated pollutant concentrations downwind from the source of a release, taking into consideration the toxicological and physical characteristics of the release site, the atmospheric conditions, and the circumstances of the release. The greatest distance at which a postulated facility event will produce consequences exceeding the Early Severe Health Effects threshold is 23 meters. The highest emergency classification is a Site Area Emergency. The Emergency Planning Zone is 65 meters.

Distribution List

1	MS	9018	Central Technical Files, 8523-2
5	MS	0899	Technical Library, 13414
1	MS	0619	Print Media, 12615
2	MS	0100	Document Processing, 7613-2 for DOE/OSTI, 7613-2
1	MS	0175	Risk Management, Al Bendure, 7258
3	MS	0175	Risk Management, Zeferino Banda, 7258
2	MS	0407	Emergency Planning, Steve Ross, 7311
3	MS	0865	Electromagnetic Test & Analysis Department, James F. Novak, 2753
1	MS	1054	S&H Project Office, William D. Burnett, 7701
3	MS	1037	Risk Management, Brent Barnett, 7258
2	MS	1113	Protective Force Department, Sam Ortega, 7435
2	MS	1113	Protective Force Department, Matt Umstead, 7435

Distribution List

1	MS	9018	Central Technical Files, 8523-2
5	MS	0899	Technical Library, 13414
1	MS	0619	Technical Publications, 13416
1	MS	0619	Print Media, 12615
2	MS	0100	Document Processing, 7613-2 for DOE/OSTI, 7613-2
1	MS	0175	Risk Management, Al Bendure, 7258
3	MS	0175	Risk Management, Zeferino Banda, 7258
2	MS	0407	Emergency Planning, Steve Ross, 7311
3	MS	0865	Electromagnetic Test & Analysis Department, James F. Novak, 2753
1	MS	1054	S&H Project Office, William D. Burnett, 7701
3	MS	1037	Risk Management, Brent Barnett, 7258
2	MS	1113	Protective Force Department, Sam Ortega, 7435
2	MS	1113	Protective Force Department, Matt Umstead, 7435

EXECUTIVE SUMMARY

This hazards assessment provides an evaluation of the chemical and radiological hazards at the Sandia Lightning Simulation Facility (SLS, Building 888) as mandated by the Department of Energy (DOE) Order 5500.3A, Planning and Preparedness for Operational Emergencies.

The hazards assessment process developed scenarios and estimated consequences for those chemical and radiological materials determined to be hazardous. The results were used to develop the following information for use in Sandia National Laboratories/New Mexico (SNL/NM) Emergency Management Program for the SLS.

- The greatest distance at which a postulated facility event will produce consequences exceeding the Early Severe Health Effects threshold is 23 m. (This event involves the release of 1 cylinder of fluorine.)
- The highest emergency classification is a Site Area Emergency.
- The recommended protective response actions for a release of fluorine in the SLS are evacuation and accounting for personnel.
- The Emergency Planning Zone is 65 meters.

CONTENTS

APPENDICES

TABLES

ILLUSTRATIONS

KEY to ABBREVIATIONS

AACL	Administrative Access Control Laboratory
ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ALOHA	Aerial Locations of Hazardous Atmospheres
CAMEO	Computer-Aided Management of Emergency Operations
CFR	Code of Federal Regulations
CRD	Confidential Restricted Data
CTF	Coyote Test Field
D_{ESHE}	Distance at which Early Severe Health Effects are reached
DOE	Department of Energy
DOT	Department of Transportation
EAL	Emergency Action Level
EMG	Emergency Management Guide
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EPZ	Emergency Planning Zone
ERPG	Emergency Response Planning Guidelines
ESHE	Early Severe Health Effects
FEMA	Federal Emergency Management Agency
GVW	Gross Vehicle Weight
HTSF	Hydrogen Trailer Storage Facility
HWMF	Hazardous Waste Management Facility
KAFB	Kirtland Air Force Base
LEPC	Local Emergency Planning Committee
MV	Megavolt
MSDS	Material Safety Data Sheets
NFPA	National Fire Protection Agency
NOAA	National Oceanic and Atmospheric Administration
PAG	Protective Action Guide
PCB	Poly Chlorinated Biphenyls
PHA	Preliminary Hazard Assessment
ppm	Parts Per Million
RFI	Radio Frequency Induction
SLS	Sandia Lightning Simulation Facility
SNL/NM	Sandia National Laboratories/New Mexico
SOP	Safety Operating Procedures
TA-I	Technical Area-I
TA-II	Technical Area-II
TA-III	Technical Area- III
TA-IV	Technical Area-IV
TA-V	Technical Area-V
TLV	Threshold Limit Value
TWA	Time Weighted Average

1.0 INTRODUCTION

The purpose of the hazards assessment process is to document the impact of the release of hazards at the Sandia Lightning Simulation (SLS) Facility that are significant enough to warrant consideration in Sandia National Laboratories' operational emergency management program. This hazards assessment is prepared in accordance with the Department of Energy Order 5500.3A[1] requirement that facility-specific hazards assessments be prepared, maintained, and used for emergency planning purposes.

This hazards assessment provides an analysis of the potential airborne release of chemicals associated with the operations and processes at the SLS. The main objective of the laboratory is to test nuclear weapon designs and safety-critical components for conformance to nuclear safety requirements. Other duties include supporting studies of lightning's interaction with materials and structures and testing electronic components, military missiles, aircraft, and communications equipment. The focus of the hazards assessment is the airborne release of materials because this requires the most rapid, coordinated emergency response on the part of the SLS, SNL/NM, collocated facilities, and surrounding jurisdiction to protect workers, the public, and the environment.

A key objective of the DOE's emergency management program is to ensure that all DOE facilities and operations develop and maintain emergency planning, preparedness and response capabilities, as well as effective public and interagency communications, to minimize consequences to workers and the general public from events involving the release of hazardous materials. If planning and preparedness for emergencies is to be adequate and appropriate, then the hazards that are specific to each facility and operation must first be identified and understood. The hazards assessment herein provides the technical basis for such planning.

The SLS facility is a pre-fabricated, reinforced concrete structure that covers approximately 100 square meters. The SLS consists of a one-story office area, a high-bay area, generator room, laser room, a Radio Frequency Induction (RFI)-tight data acquisition support room, an insulating oil pump and filter room, and a machine shop.

All chemical and radioactive materials within the SLS have been identified. The entire inventory was screened according to the potential to affect onsite and offsite individuals. Those materials that were determined hazardous were fully characterized, accident scenarios developed, and consequences estimated. The resultant consequences were utilized to determine the appropriate emergency planning zone, emergency classes, and emergency action levels.

2.0 SITE AND FACILITY DESCRIPTION

2.1 SNL/NM Site

Sandia National Laboratories/New Mexico (SNL/NM) is located approximately 10 kilometers east of downtown Albuquerque, New Mexico, in the foothills of the Manzano Mountains (see Illustrations 2.1-1 and 2.1-2). SNL/NM is surrounded by Kirtland Air Force Base (KAFB) and has co-use agreements on some portions of Air Force property. KAFB is located on two broad mesas that are bisected by the Tijeras Arroyo, an east-west trending canyon. These mesas are bounded by the Sandia and Manzano Mountains (Cibola National Forest) to the east and the Rio Grande to the west. Regional elevations range from a low of 1,500 meters at the Rio Grande to a high of 3,255 meters at Sandia Crest. KAFB is at a mean elevation of 1,630 meters.

SNL/NM is operated for the Department of Energy (DOE). It consists of five technical areas (TAs) and remote test areas situated in the eastern half of the 210 square kilometer KAFB military reservation (see Illustration 2.1-3). Adjacent to and physically combined with the KAFB installations is the Albuquerque International Airport, in what constitutes a large joint military and commercial transportation complex. Landing and takeoff patterns for the various runways at the airport facilities are not expected to affect SNL/NM operations. The runway of most concern is the east-west runway.

2.2 Weather and Climate

SNL/NM temperatures are characteristic of high-altitude, dry, continental climates. Sunshine is a predominant feature of SNL/NM and occurs approximately 75 percent of daylight hours. Maximum daytime temperatures during the winter of 1988 averaged near 10°C (50°F); summer daytime maximum temperatures averaged less than 32°C (90°F) except in July when the maximum average reached 34°C (93°F).[2] Temperature extremes below -27°C (-17°F) or above 41°C (105°F) occur infrequently.[3]

The average annual precipitation for SNL/NM is 21 centimeters; half of this precipitation occurs from July through September in the form of convective thundershowers. Winters are typically dry with less than five cm of precipitation normally recorded in a given month. This includes occasional snowstorms with accumulations of 20-to-30 centimeters of snow. The maximum observed precipitation in 24 hours occurred in September, 1983, when 5.7 centimeters of rain was recorded. The total annual precipitation of 33 centimeters for 1988 was 12 centimeters above the 30-year average of 21 centimeters. The average annual relative humidity recorded from 1951 to 1980 was about 43 percent, with the average humidity dropping to less than 20 percent in April, May, and June.

Strong winds, often accompanied by blowing dust, occur mostly in late winter and early spring. Wind speeds reach a maximum velocity of 28 knots on an average of 46 days per year. Every two years, a one-minute duration gust of 52 knots is expected.[4] The average hourly wind velocity at the Albuquerque International Airport recorded from 1951 to 1980 ranged from 6.7 knots in December to 9.6 knots during April.[5] The annual surface wind speed and direction for SNL/NM Technical Area I are depicted in Illustration 2.2-1. Rapid nighttime ground cooling produces strong temperature inversions as well as drainage winds that flow out of the mountains during evening hours.[6]

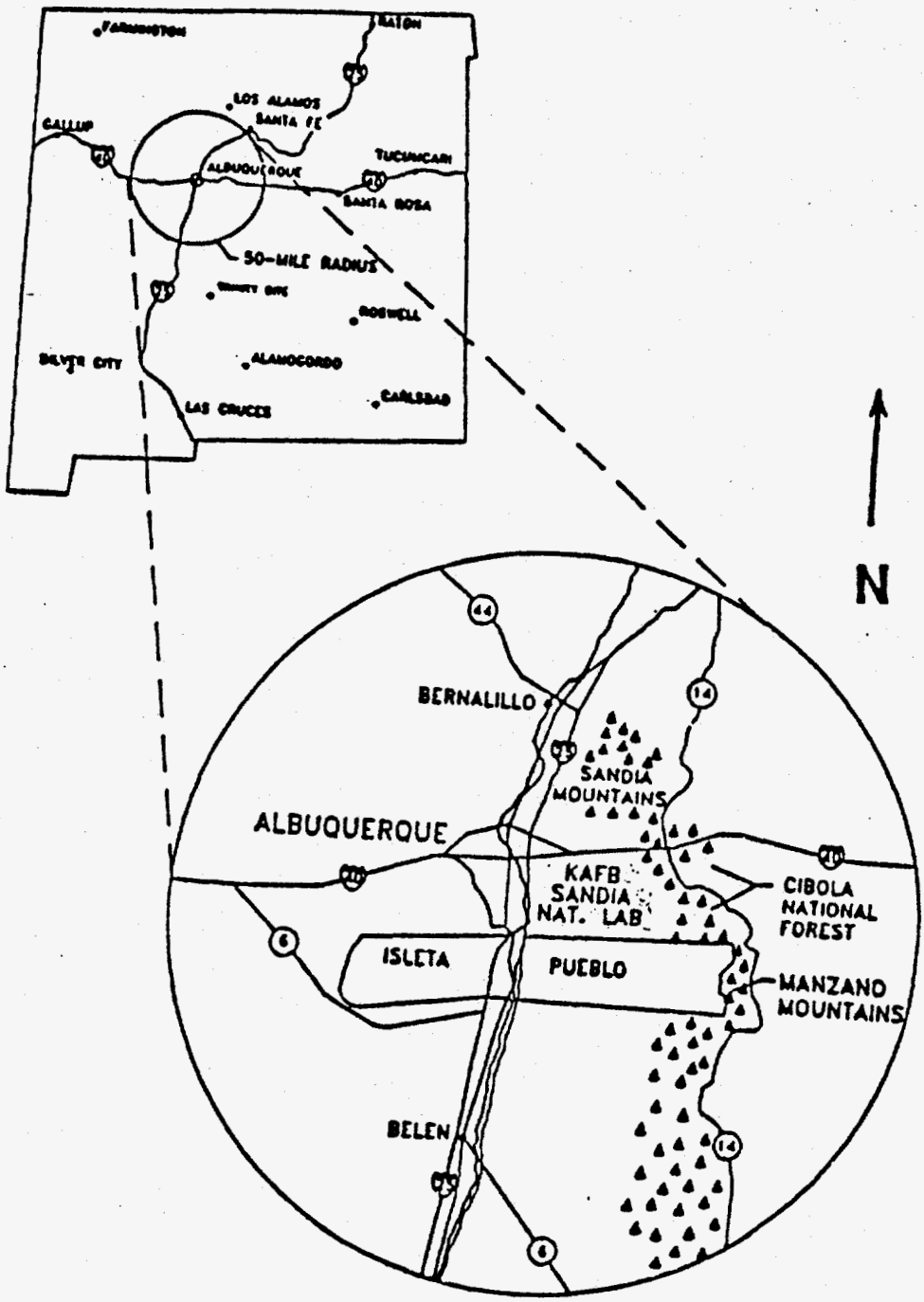


Illustration 2.1-1 General Location Map, Sandia National Laboratories, Albuquerque, NM

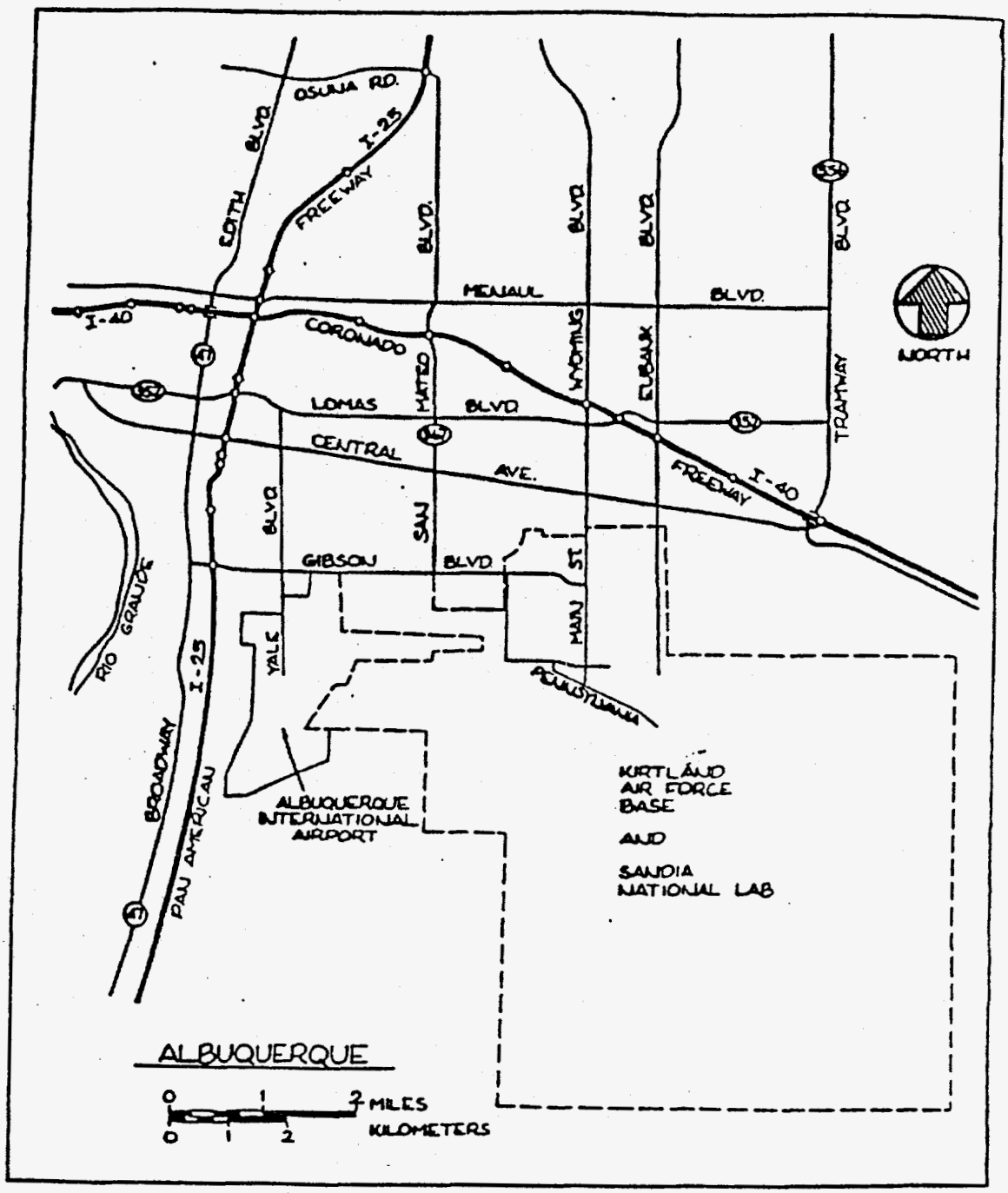


Illustration 2.1-2 Location Map for Sandia National Laboratories/New Mexico

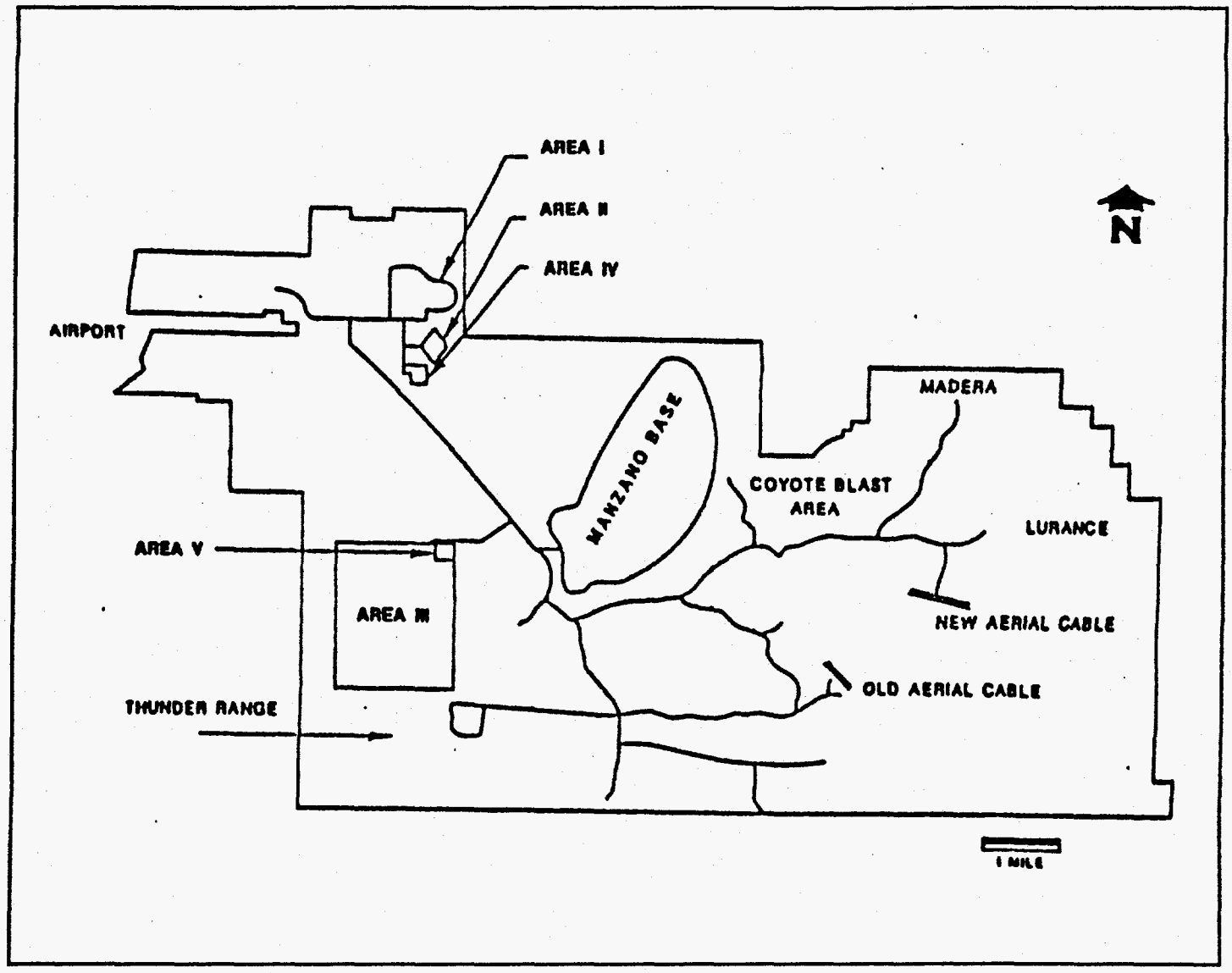


Illustration 2.1-3 SNL/NM Technical Areas

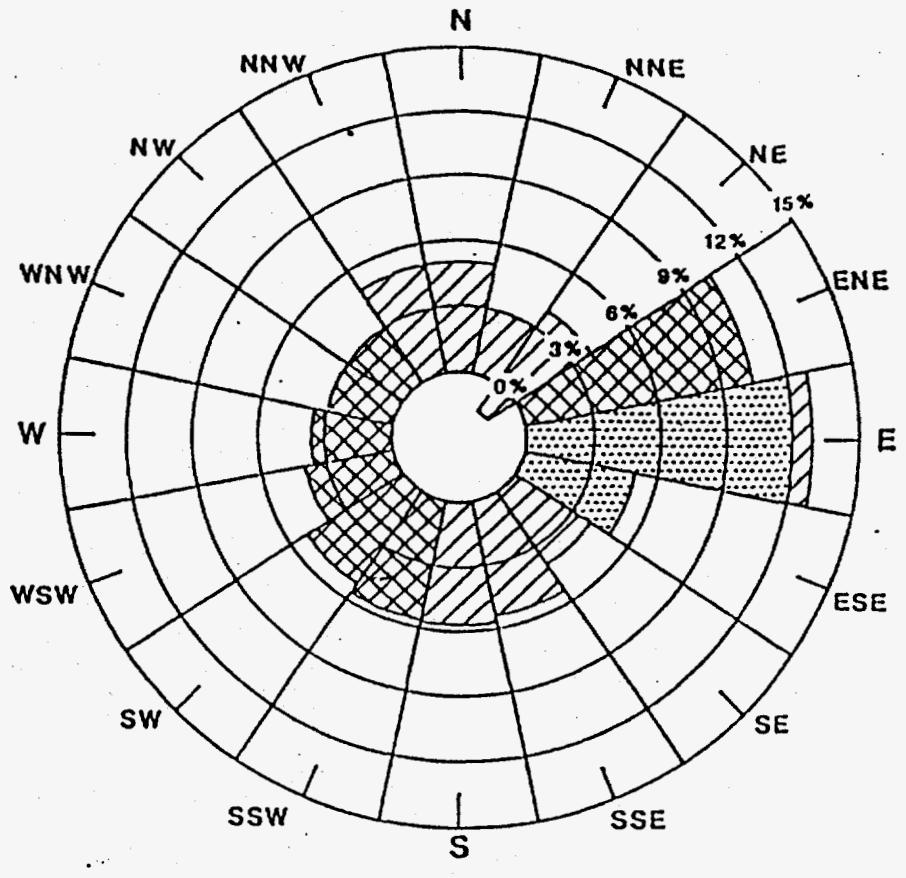


Illustration 2.2-1 Annual Surface Wind Speed and Direction, Technical Area I

Tornado occurrences within the state of New Mexico vary from a minimum annual frequency of 0.2 to a maximum of 1.1.[7] Statistically, the highest frequency has been observed in the eastern half of the state. For the western half of the state, generally demarcated by the Rio Grande and the mountain ranges that parallel it on the east side, tornado frequencies are 0.3 or less. In the Albuquerque area, which lies west of the Sandia and Manzano Mountains, only two tornadoes have been reported in more than a 20-year span. These occurred within the center of the city of Albuquerque in the years 1985 and 1987 and are officially listed in the climatological records of the National Weather Service as "small tornadoes." Damage was light and no official wind readings are available.

In addition, one funnel cloud has been observed in the same 20-year period. This was reported in the Four Hills area of Albuquerque about 2 kilometers to the east of Technical Area I on KAFB, but it was not observed to touch down and accordingly, it did not cause any reported damage. Based on the climatological records available, Albuquerque can be classified as a region of low occurrence with an annual frequency of 0.1 or less.

2.3 Air Quality

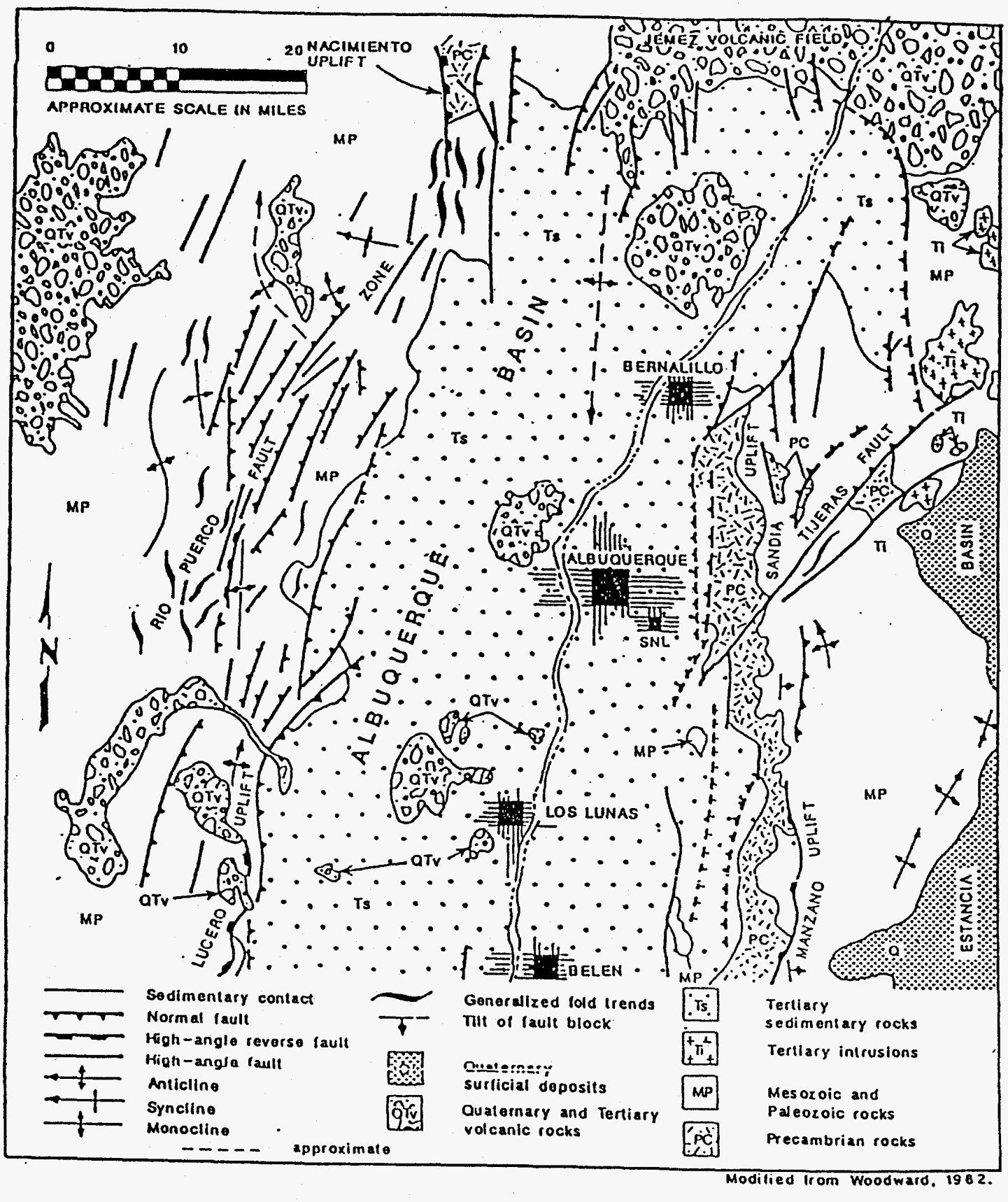
The air quality at SNL/NM is strongly influenced by the presence of the Albuquerque metropolitan area to the north and west.

SNL/NM is situated in the Rio Grande Valley, which is flanked by the Sandia and Manzano Mountains on the east and the Puerco Plateau on the west. This protects the Rio Grande Valley from many passing storms and reduces much of the air flow that would carry air pollution away from the metropolitan area.[8] During many winter nights, the air in the metropolitan area becomes very stable and still, creating a temperature inversion which traps the pollutants emitted into the colder air at ground level. During the winter months, Albuquerque occasionally exceeds the ambient standards for carbon monoxide. Air quality has been improving, with fewer violations of the standards being reported over the past few years basically because of implementation of the Albuquerque/Bernalillo Air Pollution Control Program.[9]

2.4 Geology: Surface and Subsurface Features

SNL/NM is located in the Rio Grande Rift Valley of the Basin and Range physiographic province. The Rio Grande Rift is a structural feature that trends north-south from southern Colorado to El Paso, Texas.[10] The SNL/NM area is situated on the East Mesa in the east-central portion of the Albuquerque-Belen basin segment of the rift (Illustration 2.4-1). The basin is bounded on the east by the fault-block Sandia and Manzano Mountains, which consist of Precambrian granites, schist, gneisses, quartzite, and metavolcanics; on the west by the Lucero uplift and Puerco plateau; on the north by the Nacimiento uplift; and on the south by the Socorro Channel.

Large-scale faulting, deepening of the basin and tilting of the mountains in the late Miocene period have resulted in a differential vertical movement of 6,000 to 7,000 meters on the eastern basin border.[11] Both concurrent with and subsequent to the structural changes, the basin began to fill due to a complex mixture of eolian, channel, debris flow, levee, and flood plain-type mechanisms[12] resulting in a complex sequence of gravel, sand, silt, clay, and caliche deposits known as the Santa Fe Formation. The basin, which consists primarily of Tertiary and Quaternary deposits, is estimated to be 1,200 to 1,500 meters thick (Illustration 2.4-2).



Modified from Woodward, 1982.

Illustration 2.4-1 Tectonic Map of the Middle Rio Grande Depression

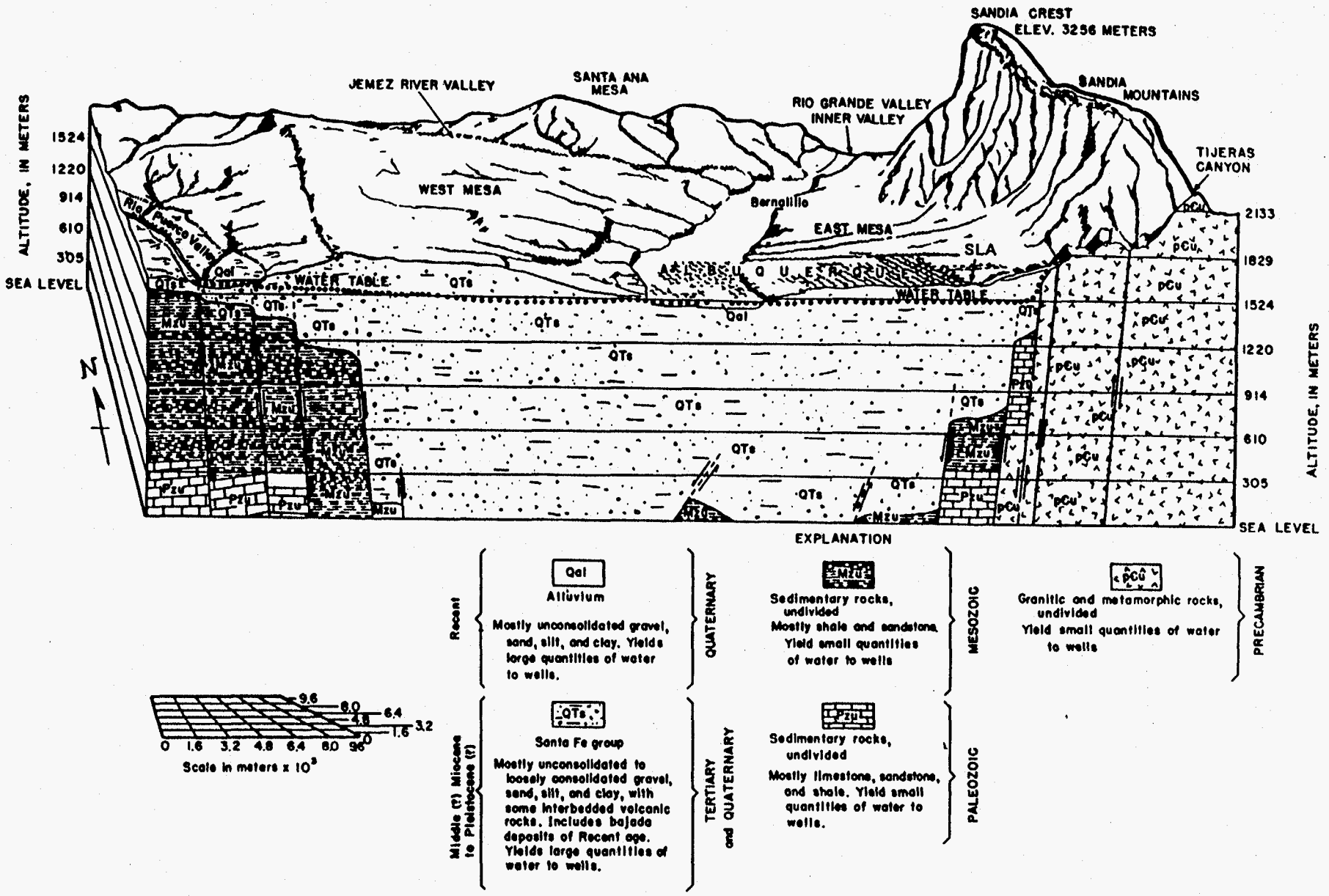


Illustration 2.4-2 The Basin, SNL/NM

The East Mesa is characterized by alluvial and colluvial deposits formed due to runoff from the mountains onto alluvial fans or stream channels. The soils are the Embudo gravel, fine, sandy loam and the Wink fine, sandy loam, both of which are part of the Maurez-Wink Association.[13] The Embudo soils are deep, moderately alkaline, well-drained soils that formed in alluvium derived from decomposed, course-grained, granitic rocks on old alluvial fans.[14] The Wink soils are deep, calcareous, and moderately alkaline, well-drained soils that formed in old, unconsolidated alluvium modified by wind.[15] Runoff from both these soils is medium with moderate water erosion hazard and the shrink-swell potential for both is low.[16]

The Rio Grande Rift between Albuquerque and Socorro is the most seismically active area in New Mexico. Seismic records date back to 1849, when the first reported earthquake occurred in Socorro; however, complete instrumental records are available only after 1962.[17] Instrumental data since 1960 indicate a maximum probable local magnitude shock (M_L) within a 100-year period of 4.2 to 4.9 on the Richter scale.[18] SNL/NM seismic activity research is being conducted as mandated by DOE Order 5480.28, Natural Phenomena Hazards Mitigation.[19]

The SNL/NM area is located in Seismic Risk Zone 2B (Illustration 2.4-3) in which moderate damage from earthquakes (corresponding to Intensity VII of the Modified Mercalli Intensity Scale of 1931) may be expected to occur.

The largest recorded earthquakes in the Albuquerque-Socorro area have been measured at 4.7 on the Richter scale. An earthquake of this magnitude occurred on January 4, 1971, with the epicenter in the Albuquerque area. Minor damage to buildings was reported by the University of Albuquerque (now St. Pius High School); however, no damage to SNL/NM buildings was reported.

Two other earthquakes with magnitudes of approximately 4.7 on the Richter scale occurred on November 28, 1970, and January 4, 1990, near the town of Bernardo, New Mexico, 104 kilometers south of Albuquerque. Damage to the Bernardo area was the only damage reported.

The fault zones along the eastern and western sides of the Albuquerque-Belen Basin were active in Miocene times and appear to have become stable since the mid-Pleistocene. Present seismic activity shows little correlation with the Albuquerque area fault zones, but is concentrated more with the mountains west of Socorro, 120 kilometers south of KAFB.

Numerous small volcanic centers occur along a line paralleling the axis of the Albuquerque basin to the west of the metropolitan area. The volcanoes include five small cones and 13 nubbins, the largest of which protrude about 54 meters above the ground surface. At least eight flows (andesite and basalt) occurred in the volcanic field, which was active only for a short period approximately 190,000 years ago.

2.5 Water Resources

2.5.1 Surface Water

The East Mesa has a generally west-southwestward ground surface slope ranging from about 47 meters per kilometer near the mountains to 3.8 meters per kilometer near the river. The distance from the foot of the mountains to the river varies from 4.8 kilometers in the northern part of the mesa to 14.5 kilometers in the southern part of the mesa.[20]

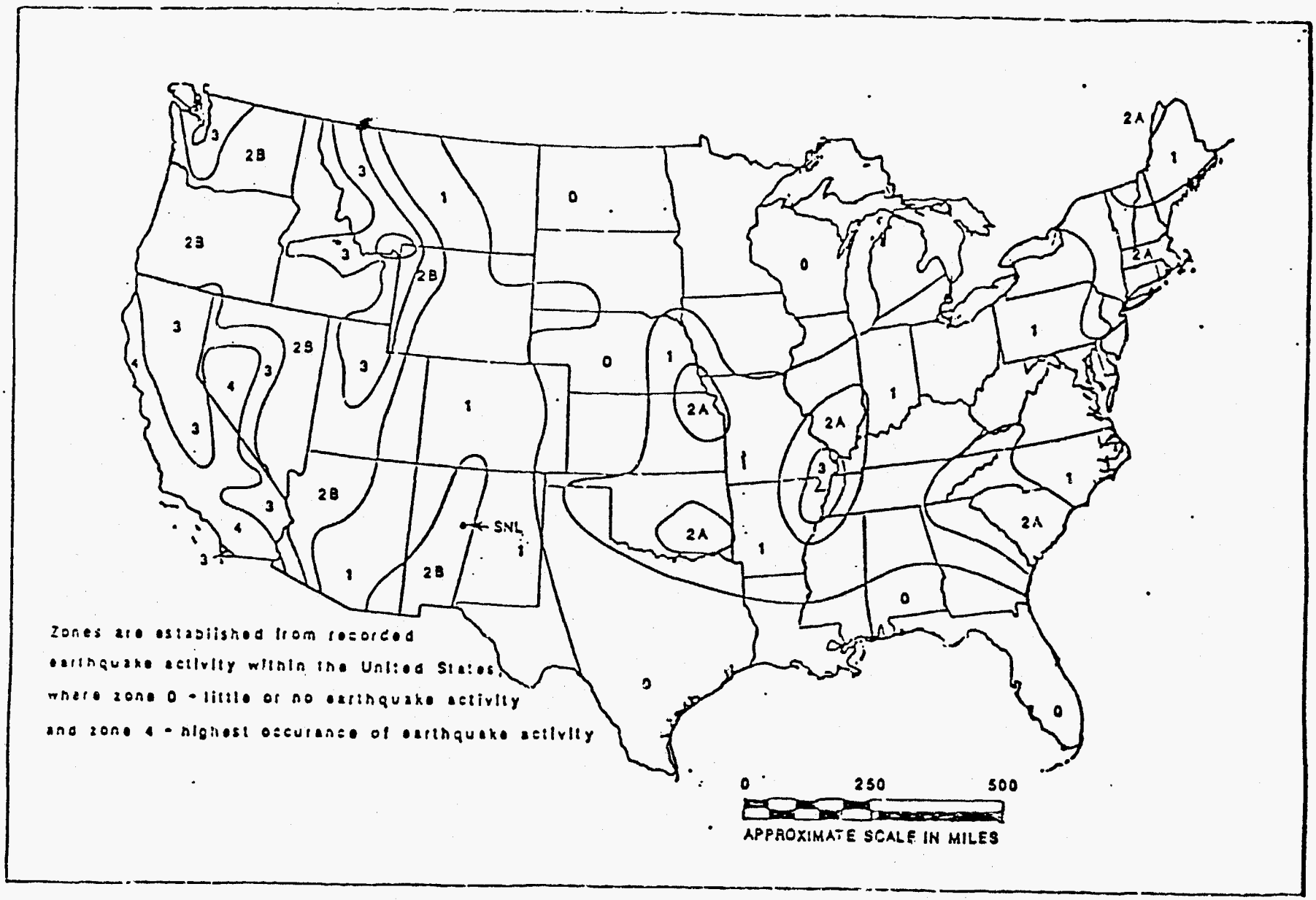


Illustration 2.4-3 Seismic Risk Zone 2B, SNL/NM

Tijeras Arroyo, the major drainage of the East Mesa area, originates in the mountains and joins the Rio Grande at approximately 16 kilometers south of Albuquerque, cutting across the eastern part of KAFB. In addition, numerous small drainages emerge from the mountains onto the mesa. In general, very little of this surface water reaches the Rio Grande[21] because most surface water runoff enters the permeable deposits of the Quaternary-Tertiary alluvium or is evaporated or transpired.

During heavy precipitation, the elevated interfluvial regions drain by sheet flow into small gullies and rivulets. This water is carried by natural or artificial flow paths into Tijeras Arroyo and eventually reaches the Rio Grande. Occasional flooding is likely within these gullies and arroyos. The Army Corps of Engineers has estimated that a 100-year flood will reach a crest of approximately 1572 meters. The 24 meter walls of the Tijeras Arroyo are adequate to protect SNL/NM against flooding.

2.5.2 Subsurface Water

The major subsurface reservoir beneath the Albuquerque area (including SNL/NM) is composed of basin fill material of the Rio Grande (for deposits and alluvial material of Quaternary and Tertiary age) with a depth to bedrock of nearly 1.6 kilometers throughout most of the basin (Illustration 2.4-2). The alluvial aquifer is bounded on the west by the Lucero uplift and on the east by the Sandia-Manzano Mountains.[22]

Groundwater in the alluvial aquifer generally occurs under unconfined conditions and flows in a southward direction under an overall gradient of approximately 2 meters per kilometer. The transmissivity of the alluvial aquifer is estimated to be 2,480 square meters per day , and storativity (quantity of water that the aquifer will release from or the quantity that will be taken into storage per unit surface area of the aquifer per unit of head) is approximately 0.2 . The groundwater flow velocity is approximately 6 meters per year.[23] The water table beneath SNL/NM on the East Mesa is approximately 150 meters beneath the surface, and groundwater generally flows in a southwestern direction towards the axis of the Rio Grande alluvial basin.

The alluvial aquifer is recharged principally by the Rio Grande. The aquifer also receives recharge at the base of the mountains where small canyons open onto alluvial fans and the alluvium is relatively coarse. Relatively little water percolates into the aquifer through the unsaturated zone, as most runoff from precipitation ultimately flows into drainages and into the Rio Grande, or is lost through evapotranspiration.

The greatest water level changes from 1960 to 1978 in the Albuquerque area were recorded on the east side of the Rio Grande. In the future, water levels will continue to decline on both the east and west sides of Albuquerque due to increased population. Total decline of the water table by the year 2000 will probably not exceed 37 meters of fresh-water saturation in the aquifer beneath the Albuquerque area.[24]

2.6 Flora and Fauna

The vegetation in this area is typical of an arid grassland. While more than 50 grasses may be found within this grassland association and the surrounding area, only a small number of species are abundant. The homogeneous nature of the vegetation does not support a high diversity of wildlife. Small mammals, reptiles, and birds are the most abundant species found. No species of federally listed endangered or threatened plants or animals have been observed at SNL/NM. The New Mexico Energy, Minerals and Resources Department[25] lists two state endangered species of cacti as potentially occurring in the area—the grama grass cactus and Wright's fish-hook cactus. The New Mexico Game and Fish Department's *Handbook of Species Endangered in New Mexico* lists four animal species that may occur

in Bernalillo County. However, these species are not expected to reside at SNL/NM because of specific habitat requirements.

2.7 Demography

SNL/NM is on KAFB, which is located in Bernalillo County, New Mexico. The population of Bernalillo County in 1990 was 480,577.[26] KAFB is bordered on the north and west by densely populated residential areas of the City of Albuquerque. To the east of KAFB is the Four Hills residential area of Albuquerque. Albuquerque had a population of 384, 736 in 1990.[27] To the south of KAFB is the Isleta Indian Reservation, which had a population of 2,915 in 1990,[28] and Valencia County. Valencia County is a rural and sparsely populated area. The most recent population figure for Valencia County is 45, 235.[29] KAFB itself houses up to 7,830 residents in barracks and detached or semi-detached family houses. As of 1990, the residential population of KAFB was 5,761. The total estimated population within a 80 kilometer radius of SNL/NM is 632,500.

2.8 Description of SLS and Boundaries

The Sandia Lightning Simulation Facility, Building 888, is located in the Southeastern part of Technical Area I (TA-I) between 14th street and 17th street. The SLS resides in a DOE security area and is enclosed within a chain link fence. The fenced "safety area" prevents casual pedestrian traffic near potentially hazardous places such as chemical storage buildings and mechanical storage buildings. One must have a DOE security clearance or an escort and an unclassified badge (red badge) to enter the building.

The SLS contains an office area, laser room, generator room, an RFI-tight Data Aquisition Support (DAS) room, an insulating oil pump and filter room, and a machine shop. The SLS also contains two outside storage buildings used for the storing of mechanical equipment. A third temporary storage unit is used to store hazardous waste for a period of no more than 45 days.

The SLS facility boundary is defined as the building walls (Illustration 2.8-1). However, to employ a definitive distance for use in emergency classification, a conservative radial 30 meter facility boundary was established. This is the approximate distance from the nearest hazard source to the fence on the west side of the building. This 30 meter facility boundary is utilized in Section 6.0 for determining the emergency classification.

The SLS site boundary is defined as a radial 65 meters and is also used in Section 6.0 for determining the emergency classification (Illustration 2.8-2). This was established in consonance with emergency planning practices as the large populations of the trailers are beyond the 65 meter site boundary and are considered offsite. As stated in the Emergency Management Guide, areas subject to access by the general public must be considered offsite unless it is assured that those areas can be evacuated and access control can be established within (1) hour of any emergency declaration.[30] The conservative 65 meter SLS site boundary allows for such an evacuation and controlled access in the time required.

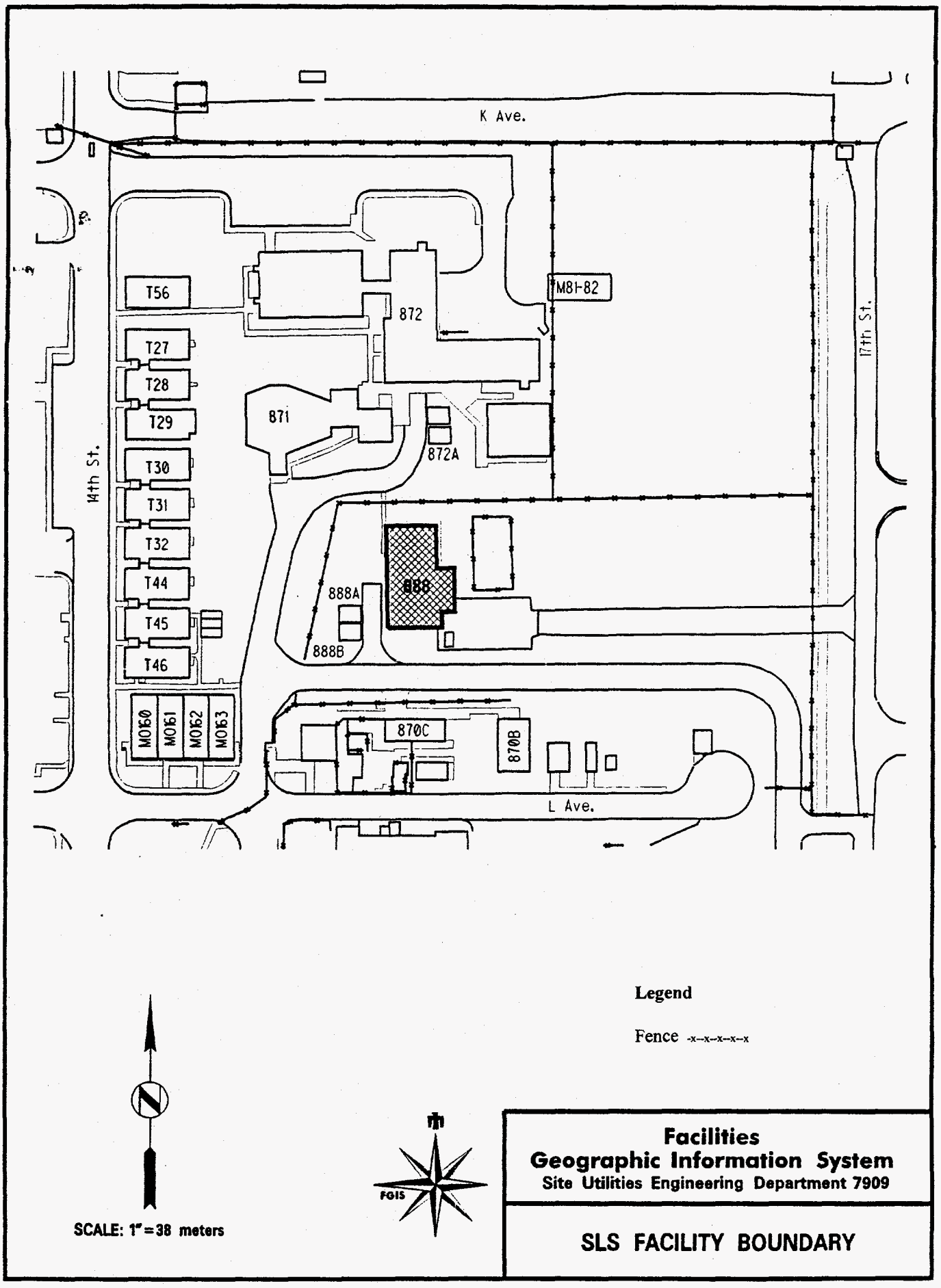
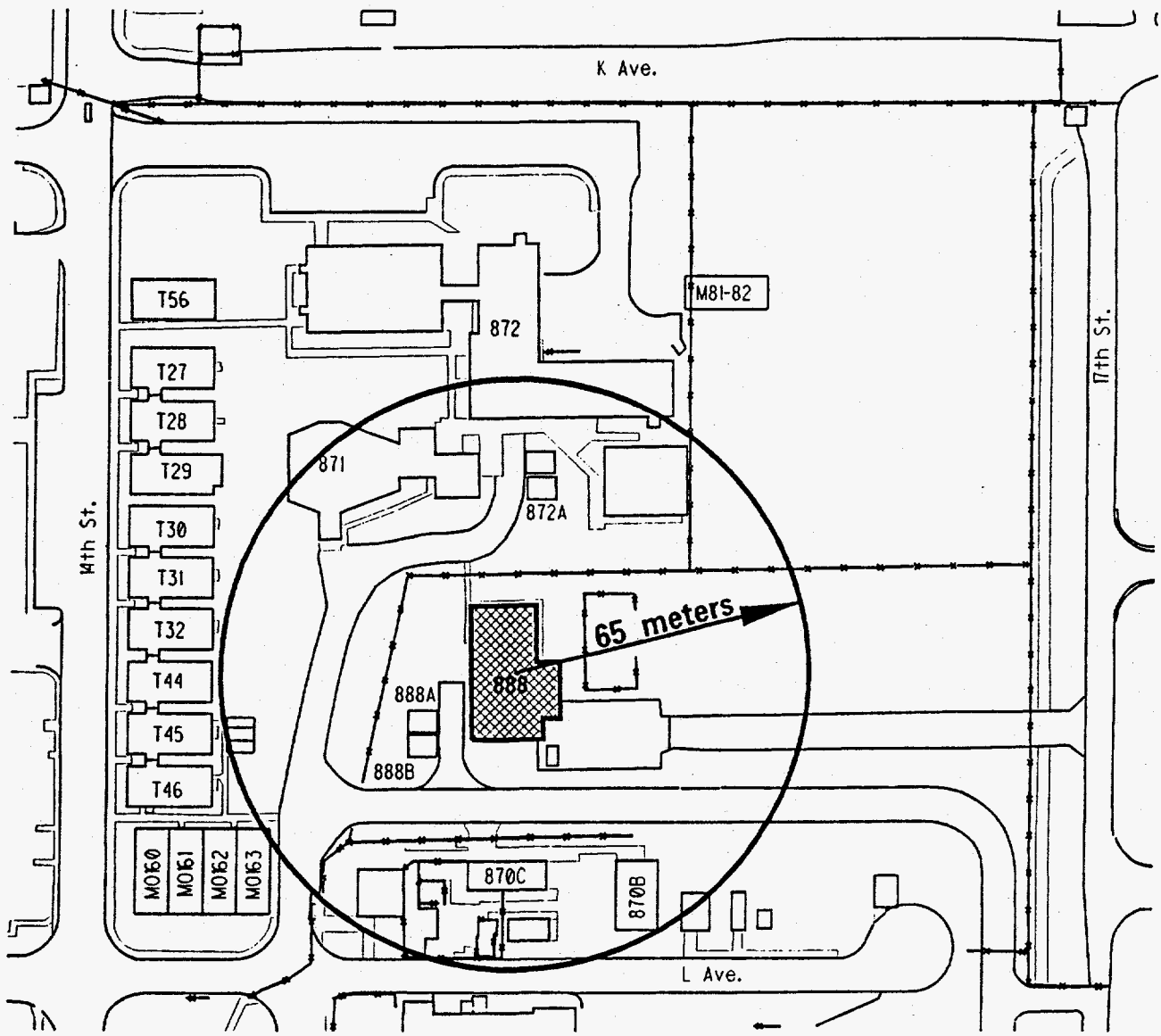


Illustration 2.8-1



Legend

Fence -x--x--x--x-

SCALE: 1"=38 meters

Facilities
Geographic Information System
Site Utilities Engineering Department 7909

SLS SITE BOUNDARY

Illustration 2.8-1

2.9 Facility Mission

The mission of the SLS is to test nuclear weapon designs and safety-critical components for conformance to nuclear safety requirements. Other duties include supporting studies of lightning's interaction with materials and structures and testing electronic components, military missiles, aircraft, and communications equipment.

2.10 Description of SLS Laboratories

The SLS is divided into 2 areas (Illustration 2.10-1). The following section provides a description of each area. The first area is a general office area. The general office area is approximately 16.5 meters by 26.4 meters and is located in the northern half of the building. The office area contains 3 offices and a computer work station. The second area is the laboratory. It consists of the high-bay area, in which the Marx generator is located; laser room; generator room, in which the large motor/generator set used to provide simulated lightning continuing current is housed; an RFI-tight DAS room; an insulating oil pump and filter room; and a machine shop.

The high-bay is approximately 165 meters by 165 meters and contains two individual 68,135 liter cubical tanks, in which are located the Marx generator modules that provide the simulated lightning return-stroke currents. During operation, each tank is filled with (non-PCB) transformer insulation oil. Each Marx generator contains numerous gas-filled sulfur hexafluoride (SF_6) spark gaps and switches. The SF_6 system vents to the outdoors on command.

The laser room contains a Class IV Krypton Fluorine (KrF) pulsed laser used to trigger electrical breakdown of a gas-filled switch inside the Marx generator and a Class III-B Helium Neon Colinear Continous Wave laser used for alignment of the pulsed laser. The room also contains a locked cabinet in which a bottle of compressed fluorine gas, associated with the laser, is located. The cabinet is equipped with a continuously running exhaust system. The room also contains a bottle of compressed Helium.

The pump room contains the pumping and filtering systems used in transferring the transformer oil to underground storage tanks during periods when the simulator is not being used for testing.

The machine shop room houses a lathe, grinder, band saw, drill press and a variety of handpower tools used in fabricating test fixtures and in the maintenance of the SLS. The shop also contains electric arc and torch-type welding and cutting equipment. Electronic test equipment is used on a routine basis. Both high (>600 V) and low (<28 V) voltages are common throughout the facility.

2.11 Sandia Lightning Simulation Facility Processes and Operations

2.11.1 SLS Facility

The SLS Facility allows equipment under test to be subjected to simulated lightning currents up to extremely severe levels. The facility is capable of producing both multiple-stroke and continuing-current components, either separately or combined in a single test event.

The SLS return-stroke output currents are generated by 4 Marx banks that can be independently configured to provide one or two return strokes. The maximum output voltage of each bank is 1.6 MV. The fast-rise, long-decay, unipolar return-stroke currents are achieved by means of ultraviolet, laser-

ultraviolet, laser-triggered crowbar switches across the Marx capacitor banks. These switches are triggered near the first current peak of the otherwise underdamped ringing output of the Marx banks into the test load. This clamping action results in an exponentially decaying tail on the simulated return-stroke current, the time constant of which can be controlled by adjusting the inductance and resistance in the crowbarred discharge circuit.

Continuing current is provided from a large motor-generator set that is spun up beforehand in the motor mode to a designated speed and is then switched into a generator mode at the initiation of the test shot.

Standard facility instrumentation used to determine current profiles of the injected currents and the response of the equipment under test include an array of commercial and custom built current and voltage sensors. Sensor analog outputs are converted to either amplitude or frequency-modulated optical signals, which are transmitted to computer-controlled, high-speed digitizers by means of wide-banded fiber-optic data links.

The first process evaluated at the SLS facility involves moving the object in for testing. Depending on size, the items can be hand carried in or , if larger, can be moved in by truck through the large door on the southeast side of the building.

A second process associated with the SLS facility involves preparing the object for testing. Preparing the object can include machining and fabricating test fixtures for the experiment. The transformer insulation oil tanks are also filled. The object is then secured and positioned for the testing by facility personnel.

A third process associated with SLS facility involves the testing itself. The items to be tested are placed in the proper position and the exposed to the simulated lightning. The normal operating complement of personnel is four technicians plus a test engineer. Occassionally personnel associated with the sponsoring activities participate in the tests.

A fourth process associated with SLS facility involves the cleanup and removal of the items used in the test. Proper procedures have been implemented for the cleanup of the object. The transformer insulation oil tanks are drained at this time. The object is then removed and sent back to the owner.

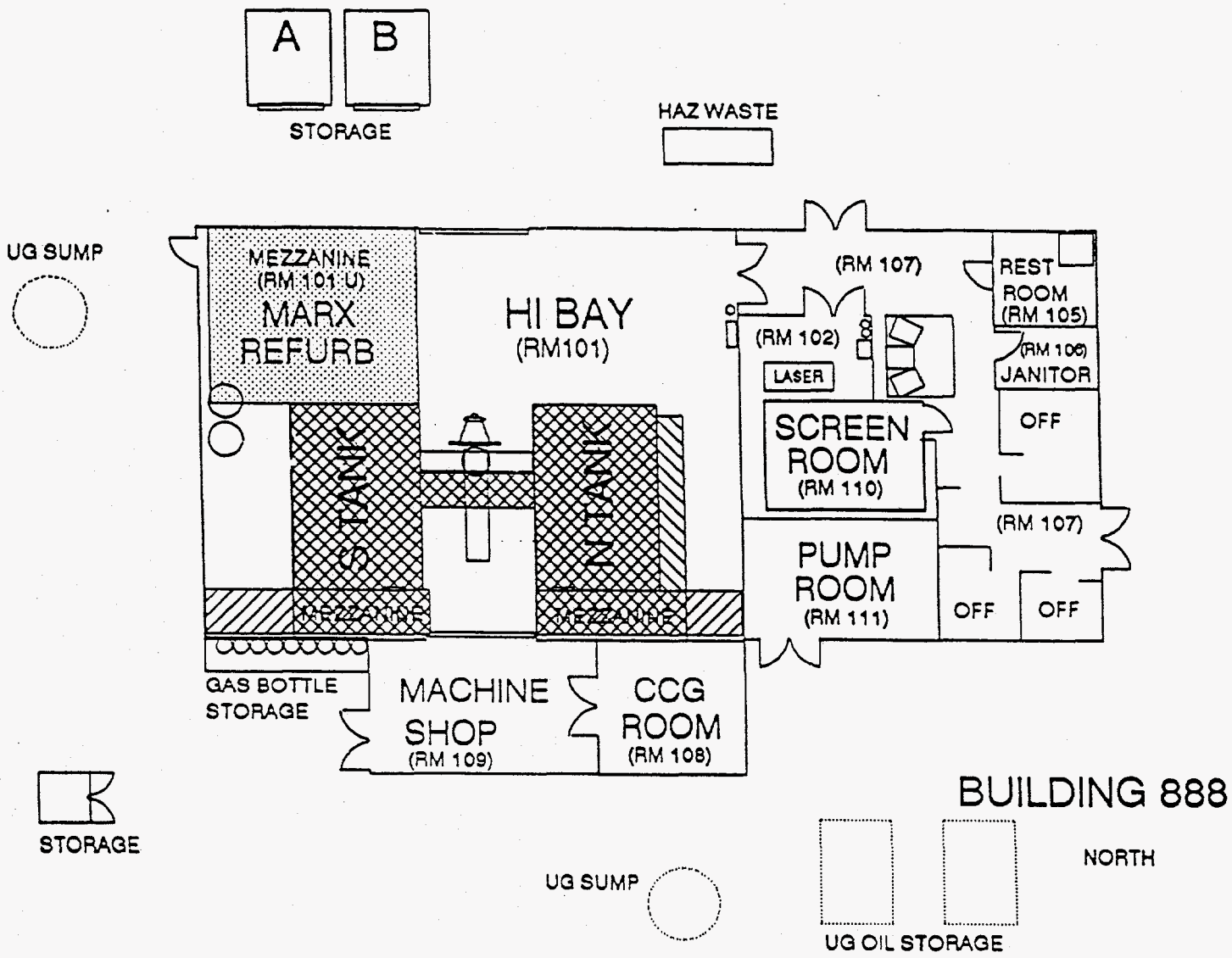


Illustration 2.10-1

3.0 IDENTIFICATION AND SCREENING OF HAZARDS

This section outlines the processes used to identify both onsite and offsite hazards significant enough to warrant consideration in the SNL/NM emergency management program for the SLS and to screen out those hazards that pose minimal risk to the health and safety of the onsite worker and the general public. Those hazards identified by the screening process that pose a significant risk are further evaluated in Section 4.0.

3.1 Identification and Screening of Onsite Hazards

For the purpose of emergency planning, onsite hazards of primary concern are those hazardous materials that if released to the environment may:

- immediately threaten those who are in close proximity to the release,
- have the potential for dispersal beyond the immediate vicinity in quantities which threaten the health and safety of onsite personnel or the public in collocated facilities and/or offsite,
- and have a rate of transport and dispersion sufficient to require time-urgent emergency response to implement protective actions.

The process of identifying the onsite hazards at SLS consisted of the following steps: (a) reviewing the most current PHAs, (b) reviewing past chemical inventories to determine the maximum historical quantities, (c) reviewing the most recent chemical inventories, and (d) conducting walkthroughs of the facility to verify that the current inventory was complete and accurate.

The following primary sources of information were used to complete the hazard identification and screening process. Based on this information, a comprehensive list of hazardous materials was compiled for SLS. The complete list was then screened to determine which hazards required further evaluation.

- Preliminary Hazard Assessments (PHAs)
- Standard Operating Procedures (SOPs)
- Chemical Inventories
- Material Safety Data Sheets (MSDSs)

3.1.1 Screening Criteria

The Emergency Management Guide (EMG) for Hazards Assessments states, in part, "... screening quantities or thresholds should be used to eliminate the need to analyze insignificant hazards."[31] Using this guidance from the EMG and other applicable documents, the following screening criteria were developed and utilized to screen chemical and radiological hazards.

3.1.1.1 Chemical Hazards

Standard Industrial Hazard (SIH)

In accordance with 40 CFR, Part 355.20, "Any substance used for personal, family, or household purposes, or is present in the same form and concentration as a product packaged for distribution and use by the general public" is not considered a hazardous chemical.[32] Therefore, for the purpose of hazards assessments, such chemicals can be eliminated from further evaluation.

Quantity of Material

The quantity at which a chemical does not require evaluation is one pound. This was established based upon 40 CFR Part 302, the Hazardous Substances and Reportable Quantities[33] and 40 CFR Part 355, Appendix A, the Extremely Hazardous Substances and Threshold Planning Quantities[34] in which no chemical had a quantity greater than one pound.

Toxicity of Material

For those chemicals exceeding one pound, the MSDS and/or the Hazardous Chemical Desk Reference[35] are reviewed to determine if a chemical is hazardous due to its toxicity. Occupational exposure limits are reviewed to determine the toxicity. Those chemicals determined to be non-toxic are screened from further evaluation.

Dispersibility

A chemical is removed from further evaluation if it is determined to be non-dispersible. In order for the chemical to be non-dispersible, it must meet at least one of the following criteria:

- have a boiling point of greater than 100° C ,
- be a powder of greater than 10 microns, or
- cannot conceivably be involved in a high energy event such as a fire or explosion.

Dispersion Modeling

Dispersion modeling allows chemicals to be analyzed to determine toxicity levels at various distances. This hazards assessment is primarily concerned with Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA)[50]. The ERPG levels in ascending order of severity are ERPG-1, ERPG-2, and ERPG-3. The level of concern used in the screening criteria is an ERPG-1. The ERPGs are discussed in detail in Section 6.2.1 of this document.

A chemical is removed from further evaluation if it does not exceed an ERPG-1 at 30 meters. The distance of 30 meters was selected because the facility boundaries existing at all SNL/NM facilities are, at a miniumum, 30 meters. An ERPG-1 at 30 meters or greater would constitute a minimum of an alert emergency classification. Emergency classifications are described in Section 8.1 of this document.

The dispersion modeling is performed through the Areal Locations of Hazardous Atmospheres (ALOHA) model. ALOHA allows two types of dispersions: heavy gas and gaussian. If unsure which dispersion type should be used, ALOHA gives the option to let the model decide. The infiltration building parameter that should be used in the screening process is 60 air changes per hour. In addition, "worst case" meteorological conditions should be employed for the purpose of modeling (i.e., wind speed of 1 m/s, 10% cloud cover, F stability, 50% humidity, and 68° F).

3.1.1.2 Radiological Hazards

For radioactive materials, the screening criteria is based on 10 CFR, Part 30.72, Schedule C[36] which lists radioactive materials that require consideration for emergency planning. Any radioactive materials that exceed the quantity in curies in 10 CFR, Part 30.72, Schedule C, are kept for further evaluation and

characterization. All other radioactive materials are considered insignificant hazards and are removed from further evaluation.

3.2 Identification and Evaluation of Offsite Hazards

The objective of the hazards assessment is to determine the type and extent of planning and preparedness that is appropriate for each facility and site. Hazards originating outside the DOE facility and site that could impact the health and safety of onsite personnel or other DOE interests are identified and examined. Offsite facilities, airways, highways, railroads, and utility transportation arteries (i.e. pipelines) are considered as possible locations of hazardous material accidents.

The Local Emergency Planning Committee (LEPC) for the City of Albuquerque, on which Sandia is represented, is headquartered in the Albuquerque Fire Department, with an assistant Fire Chief being the chairman of the committee. The Assistant Fire Chief was consulted to provide assistance in identifying nearby facilities in the city of Albuquerque that have hazardous material inventories that could potentially impact the Sandia Albuquerque site. Railroads, highways, and other transportation arteries near the facility or site were considered as possible locations of hazardous material transportation accidents. The effects on the facility of hazardous material events originating offsite were estimated and used as the basis for determining whether specific arrangements should be made with offsite authorities for notification of releases and joint response.

3.2.1 Offsite Facilities

The following offsite facility with a hazardous materials inventory large enough and within a reasonable distance of SNL/NM that could have a negative impact on the operation of SNL/NM has been identified.

- The City of Albuquerque water treatment plant is located approximately 10 km from the SNL/NM Site Boundary. This facility has the capacity to store up to 100,000 pounds of liquid chlorine in two 50,000 pound capacity tanks.[37] Chlorine is used to treat the municipal water system for biological contaminants prior to distribution. In the event of a significant airborne chlorine release to the environment, the LEPC would contact the SNL/NM EOC. The EOC would then implement protective actions, as needed.

- Additional facilities are currently being researched as part of the City of Albuquerque's Emergency Preparedness program. Several individuals from SNL/NM Emergency Planning and Risk Management and NEPA Department are members of the LEPC. The identification of offsite facilities that could potentially impact SNL/NM is a continuous process.

3.2.2 Airways

Due to the close proximity of the Albuquerque International Airport to SNL/NM, an airplane crash scenario is postulated and considered an offsite hazard. Extensive research concerning an airplane crash at SNL/NM was performed and the results of this analysis are summarized below.[38]

A significant fraction of the more than 225,000 annual operations at the airport could pass over SNL/NM facilities. SNL/NM is also located about 25 kilometers from Coronado Airport. However, since the general aviation aircraft using this facility would, in general, avoid the Albuquerque International Airport traffic area and based on the relatively long distance to Coronado Airport and the altitude that such aircraft will have if they happen to pass over Sandia, such aircraft are not a significant factor in determining the crash probability. Therefore, they are not considered to pose a significant risk to SNL/NM facilities.

3.2.2.1 Event Frequency Estimation

Several low-and high-altitude airways pass over or in the vicinity of SNL/NM. Because of nearby high terrain, the minimum en route altitudes of these airways are relatively high, about 1,400 meters or more above ground level. Although the frequency of flights using these airways is unknown, the crash frequency resulting from on-airways (or in-flight) through traffic would not be significant relative to the crash probability resulting from landings and takeoffs at the Albuquerque International Airport. The contribution of in-flight or airways traffic to the crash probability is therefore ignored.

The Albuquerque International Airport is utilized by commercial air carriers, the military, and general aviation aircraft. The carrier aircraft are jet transports, of which the largest currently in use at the airport is the Lockheed 1011. The military aircraft are primarily jet fighters but also include other aircraft ranging from small helicopters to the Lockheed C-5. General aviation aircraft include light single and twin engine airplanes. In this analysis, three types of aircraft are considered: air carrier jets typified by jet transports of the Boeing 737 through the DC-8 and 9; military aircraft typified by the A7; and air taxi (commuter) airlines and general aviation aircraft typified by light twin-engine aircraft.

Since only data on the total aircraft movement at the Albuquerque International Airport is available and because of the lack of specific data on the number of take-offs and landings, it will be assumed that the number of landings and takeoffs are the same.

Due to safety and noise abatement considerations, the preferred directions for takeoffs and landings is to the south, east, and west of the airport. If it is assumed that these directions are equally likely to be used for both landings and takeoffs, the east end of the East-West runway will have approximately 34% of the total aircraft movement. The movement of aircraft west of the East-West runway or south of the South-North runway are assumed not to contribute to the probability or number of crashes. In other words, the fraction of movements (landings and takeoffs) at the east end of the runway will be 0.34 for all types of aircraft. Table 3.2.2.1-1 presents aircraft movement data at Albuquerque International Airport for the calendar year 1990. These data were provided by the Albuquerque Airport Manager's Office.

Table 3.2.2.1-1 Total Aircraft Movement at Albuquerque International Airport (1990)	
Aircraft Type	Operations
Air Carriers	70,108
Military	35,792
General Aviation/Air Taxi	119,991
Total	225,891

This movement has been steadily increasing each year. Therefore, to ensure conservatism in aircraft movement in the future, an average increase of 100% is assumed over the life of the facility (assuming on the average, a growth rate of 2.5% per year for an assumed facility life of 40 years). Thus, the total number of movements (landings or takeoffs) at the east end of the runway per year for each of the categories of aircraft is assumed to be

$$N_{carrier} = N_1 = 140{,}216$$
$$N_{military} = N_2 = 71{,}584$$
$$N_{general} = N_3 = 239{,}982,$$

for a total of 451,782 movements. The probability of a crash per aircraft movement (landing or takeoff), P_i, for all types of aircraft is given in Table 3.2.2.1-2.

Table 3.2.2.1-2 Crash Probability (P_i) per Aircraft Movement and Type of Aircraft			
Movement	Air Carrier	Military	General Aviation
Landing	$2.3E^{-6}$	$3.1E^{-6}$	$2.3E^{-6}$
Takeoff	$6.0E^{-6}$	$1.6E^{-6}$	$6.0E^{-7}$

3.2.2.2 Airway Summary

In the unlikely event of an airplane crash at SNL/NM, the SNL/NM, KAFB, and the City of Albuquerque emergency response teams would jointly respond. For the purpose of hazards assessments, the airplane crash scenario could serve as a possible initiating event which fails all mitigative barriers.

3.2.3 Highways

Two major transportation routes are proximal to the Sandia Albuquerque site. These are U.S. Interstate 40, approximately 4.0 km to the North, and U.S. Interstate 25, approximately 4.0 km to the West of the KAFB site boundary.

Truck accident statistics (1989-1990) from the Motor Carrier Division of the National Highway Safety Council indicate the average accident rate for medium to heavy vehicles (>10,000 pounds Gross Vehicle Weight) to be one accident per 13.2 million kilometers.[39]

The accident rate may appear to be statistically quite low. However, because of the size of the transportation routes surrounding SNL/NM and the high volume of truck traffic on the roads, the potential for a vehicle accident involving hazardous materials is considered to be a credible scenario.

The New Mexico State Police maintains responsibility for response to a hazardous materials accident on local transportation routes. In compliance with the Federal Emergency Management Agency (FEMA) and the State FEMA and Local Exercise Requirements, the Albuquerque/Bernallillo LEPC conducts exercises relating to emergency response. The LEPC has conducted exercises relating to a hazardous materials accident to test the Emergency Response Plan. The Emergency Response Plan includes a provision for notifying SNL/NM in the event of an offsite transport transportation accident. SNL/NM can then take the necessary protective actions to ensure the safety and integrity of onsite personnel and their respective operations.

3.2.4 Railways

The Atchison Topeka and Santa Fe, which is a class 1 railroad, has a line that runs parallel to Interstate 25 through the city of Albuquerque, approximately 4.0 km from the western boundary of the site. The inventory of materials transported along this stretch of track for calendar year 1993 was provided by the Director of Environmental Quality and Hazardous Materials.[40] This data indicates that the majority of hazardous material is either flammable liquid or gas, or corrosive material.

Hazardous materials shipments comprise only 14% of the total car loads on the Sante Fe Railway.[41] The shipments are most likely mixed loads containing sizeable amounts of nonhazardous material within the same trailer or container. Even though the percentage of hazardous materials is low, the potential for a railway accident remains a credible scenario.

In the event of a hazardous materials accident involving a rail car, a joint response between local responders, the State Police, and the railroad would be initiated. The railroad employs a team of security personnel to secure the hazmat spill site until arrangements can be made for cleanup and disposal. Federal law requires the notification of the LEPC in the event of a hazardous materials accident. Under the Emergency Response Plan, SNL/NM would then be notified. SNL/NM can then take the necessary protective actions to ensure the safety and integrity of onsite personnel and their respective operations.

3.2.5 Pipelines

Natural gas is distributed in the SLS. The hazards of natural gas are well known and well documented. An explosion due to natural gas could result in a release of fluorine. Therefore, natural gas will be considered as an initiating event for an accident in the SLS.

3.3 SLS Chemical Hazards Summary

As a result of screening the hazards at SLS, 1 chemical was kept for further evaluation. This evaluation is performed in Section 4.0, Hazard Characterization. The chemical kept for further evaluation is listed below.

Table 3.3-1
SLS Hazardous Material Summary

Chemical	Maximum Quantity	Location
1. Fluorine/Helium gas, 5% fluorine and 95% helium	500 liters	Laser room

3.4 SLS Radiological Hazards Summary

The SLS contains no radiological hazards.

3.5 Offsite Hazards Summary

SNL/NM provides representatives to the LEPC, and a strong working relationship with the offsite Emergency Response community has been established. Development of local plans is in progress, and the contemplation of both SNL/NM hazards to the city, and city hazards to SNL/NM are being incorporated in this planning development process. Therefore, no offsite hazards were considered for characterization or further evaluation.

4.0 HAZARD CHARACTERIZATION

The screening process described in the preceding section identified 1 chemical hazard that exceeded the screening criteria. These hazards are fully characterized (i.e. physical properties, storage, and use) in this section to support the development of accident scenarios and analysis of possible airborne releases. Engineered controls and/or safety systems designed to prevent or mitigate a hazardous material release will be discussed. The administrative controls for the following facilities include approved SOPs for all handling and use of hazardous chemicals in the SLS. These procedures include the use of protective equipment and protective clothing as well as the training requirements for all workers.

The SLS orders chemicals on an as-needed basis, so there are no regular deliveries to the building. A representative of the SLS is present to accept delivery. All chemicals that enter the SLS are initially delivered to the southeast corner of the building. The chemicals are then moved to the proper storage area.

ERPGs are listed in the characterization below[42] and are utilized in Section 6.0 to determine the consequences of the following hazards. For those chemicals in which no ERPG values were published, a conservative methodology was developed that expeditiously allows ERPG equivalents to be established for every chemical that has a Time Weighted Average (TWA) value, Emergency Exposure Guidance Level (EEGL), or Short-term Public Exposure Guidance Level (SPEGL). These limits for the determining equivalent ERPG values are discussed in the EMG. This methodology is described in detail in the Concentration Limit hierarchy for Toxicological Accident Analysis,[43] and the ERPG equivalent calculations are depicted in Table 4.0-1. The ERPGs are discussed in detail in Section 6.0.

Table 4.0-1

ERPG Equivalent Calculations	
ERPG-1	TWA x 1.25
ERPG-2	TWA x 3.75
ERPG-3	TWA x 8.63

4.1 Fluorine

Fluorine is a poison gas. It is also a skin, eye, and mucous membrane irritant. Fluorine is a powerful caustic irritant to tissue. Mutation data is also reported. It is a very dangerous fire and explosion hazard. Fluorine is a very powerful oxidizer. It reacts violently with many materials.

Inventory

- 500 liters of Fluorine/Helium, 5% fluorine and 95% helium stored in the laser room.

Properties

- Density — 1.14 @ - 200° Celsius
- Melting Point — -218° C
- ERPG-1 for Fluorine — 2.5 ppm (calculated using EEGL)
- ERPG-2 for Fluorine — 7.5 ppm (calculated using EEGL)
- ERPG-3 for Fluorine — 17.25 ppm (calculated using EEGL)

Conditions of Storage and Use

Fluorine is stored in the laser room in a cylinder. The cylinder is stored in a locked cabinet equipped with a continuously running exhaust system. As stated previously, chemicals at the SLS are ordered on an as-needed basis. Fluorine is not reordered until the cylinder is almost out. It is not unusual for the SLS to use one cylinder for as long as one year. Upon replacement, a Health Physics representative is present to properly install the new cylinder of fluorine according to the SOP for the process. A second person observes the Health Physics representative change the cylinder. All other Building 888 personnel are required to leave during cylinder replacement.

5.0 EVENT SCENARIOS

The barriers that maintain control over the hazardous material described in Section 4.0 have been analyzed, and the possible failure modes have been considered. The initiating events, barrier analyses, and release scenarios are described in the following section. Each scenario is identified by a release designation.

5.1 Chemical Event Scenarios

The chemical event scenarios described below are chemical spills and are classified as laboratory-type accidents. All scenarios consider the possibility of random bullets, as mandated in DOE Order 5480.16, Fire Arms Safety.[44]

Because a chemical in a solution or mixture will not display the same vapor pressure that it does when it's in pure form, two source term parameters are used for the chemical event scenarios to estimate how a chemical will behave if released. These parameters include puddle and direct source. If a chemical is in a solution, the direct source term parameter (i.e. evaporation rate) is determined. If a chemical is in pure form, the puddle source term parameter (i.e. quantity of the material available for release and the size of the puddle) is determined.

5.1.1 Fluorine

Failure of the Primary Barrier

The fluorine is stored in a DOT approved cylinder. Therefore, the cylinder is the primary barrier. This could fail as a result of a sharp object, a bullet hole, a fire, or from impact to the ground. All methods of failure result in the release of fluorine present in the cylinder at the time of the incident.

Effects of Other Barriers

The cylinder is stored in a cabinet equipped with a continuously running exhaust system. However, in the unlikely event of an explosion, the cabinet could be damaged facilitating the release of fluorine. The continuously running exhaust system is the only other barrier that could have an impact on the release. The exhaust system in the cabinet exhausts to the outdoors any gas that might escape. The exhaust system is provided with a monitor to detect any interruption in operation, in which case, a local alarm is sounded. The fluorine gas source flow rate is also alarmed to indicate above normal flow rates. This also sounds a local alarm. However, for the purpose of emergency planning, worst case scenario is assumed. In a worse case scenario, an instaneous release is assumed. The most credible worst case scenario would be an accident occuring during delivery or installation so the exhaust system would not be useful in containing the spill. Therefore, no credit is taken for the exhaust system. A second credible scenario would involve the fracture of a depleted bottle of fluorine. As stated before, the same fluorine bottle can be used for periods of more than one year. If a depleted bottle is damaged by puncture or fracture, a worst case scenario would involve a release of approximately half the bottle.

Table 5.1
Fluorine Scenarios

Scenario	Source Term Parameter	Meteorological Conditions	Release Designation
Fluorine Gas Release 25 Liters Installation/Delivery Accident	Direct	Worst Case	F-1
	Direct	Average	F-2
Fluorine Gas Release 12 Liters Puncture/Fracture of Depleted Cylinder	Direct	Worst Case	F-3
	Direct	Average	F-4

5.2 Radiological Event Scenarios

No radiological scenarios are postulated because there are no radiological hazards associated with the SLS.

6.0 EVENT CONSEQUENCES

The consequences from the airborne release scenarios described in Section 5.0 are estimated to determine the area potentially affected, the need for personnel protective actions, and the time available to take those actions. This section describes computer codes, calculational techniques, input data used for dispersion modeling, and consequence criteria. The results of the dispersion modeling are summarized at the end of this section for each previously identified release designation. The dispersion model data sheets for each release designation are included in Appendix B.

6.1 Calculational Models and Methods

Event consequences are estimated using calculational models and methods that are most appropriate to the physical and atmospheric conditions of the site and the material released.

6.1.1 Calculational Models

The chemical model CAMEO and it's air model, ALOHA, were utilized for estimating the movement and dispersion of gases.[45] CAMEO was designed by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA) to help emergency planners, facility operators, and first responders plan for and safely handle, chemical accidents. The air model estimates pollutant concentrations downwind from the source of a release, taking into consideration the toxicological and physical characteristics of the release site, the atmospheric conditions, and the circumstances of the release.

6.1.2 Calculational Methods

The transport of hazardous materials in the atmosphere from the SLS to offsite locations during an accident is a significant concern. Several factors affect the downwind calculations. These factors include the source term (quantity of the material available for release and the size of the puddle, if applicable), release and evaporation rates, duration, mixture, and transport, diffusion, deposition, and stability. The calculations used to determine the evaporation rates for input into ALOHA are located in Appendix C.

Six classes of atmospheric stablility are used to indicate mixing in the atmosphere. These classes are referred to as the Pasquill-Gifford Stability Classes.

Pasquill-Gifford Stability Classes

A - Extremely unstable (bright, sunny days)
B - Moderately unstable
C - Slightly unstable (cloudy, low wind speed)
D - Neutral (heavy overcast, day or night)
E - Slightly stable (night, low winds)
F - Moderately stable (very low wind, night or just before dawn)

As shown in Table 5.1, two meteorological conditions were utilized: worst case and average. The meteorological conditions provided a range of accident scenarios for input into ALOHA. The worst case meteorological conditions are Pasquill-Gifford Stability Class F, a 1 m/s wind speed, and a 500 meter inversion.

The average Albuquerque meteorological conditions were obtained from the *Technical Guidance for Siting Criteria*,[46] by selecting data from four months (one from each season). This data provided a range of daily meteorological conditions. The calculations used to determine the average Albuquerque meteorological conditions can be found in the *1994 TA-V Hazards Assessment Document*.[47] The average meteorological conditions analysis resulted in the following conclusions: the average Albuquerque wind speed is 4 m/s and the average stability class is slightly unstable.

6.2 Consequence Thresholds

The consequence thresholds are based upon the Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA).[48]

6.2.1 ERPGs

The ERPG values are intended to provide estimates of concentration ranges above which one could reasonably anticipate adverse effects as a consequence of exposure to a specific substance. ERPG-1, ERPG-2, and ERPG-3 are defined below.

- The ERPG-1 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

- The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

- The ERPG-3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

  Note: For those chemicals in which no ERPG values were published, a methodology was developed that allows ERPG equivalents to be established for every chemical that has a TWA value (Table 4.0-1).

6.2.2 Application of ERPGs

The ERPGs are used to classify the operational emergency events. The three classes of operational emergencies in ascending order are: alert, site area emergency, and general emergency. The ERPGs that result in the various levels of operational emergencies are described below.

- The ERPG-1 value is used as a screening criterion, as explained in Section 3.1.1.1, Dispersion Modeling. The ERPG-1 is also used to determine the low end of the emergency classification spectrum (i.e., alert). For example, if an ERPG-1 is exceeded at 30 meters, the event would constitute a minimum of an alert emergency classification.

- The ERPG-2 value is compared with the maximum toxicity concentration at the facility and site boundaries to determine the appropriate emergency class. If the ERPG-2 is exceeded within the

site boundary, the event is considered a site area emergency. If the ERPG-2 is exceeded beyond the site boundary, the event is considered a general emergency.

- The ERPG-3 value is a consideration in defining the Emergency Planning Zone. The ERPG-3 value represents the Early Severe Health Effects (ESHE) value. The distance at which ESHE is reached is determined for each scenario.

6.3 Receptor Locations

Consequences of the hazardous material releases were quantitively evaluated for various onsite and offsite receptor locations. The demarcation between the onsite and offsite receptors is the radial 65 m site boundary. These receptor locations include emergency response facilities and those areas that could potentially be impacted by an accident at the SLS.

6.3.1 Onsite Receptors

The following onsite receptors include facilities within the 65 meter SLS site boundary.

- Building 871, ~ 50 m
- Building 872, ~ 57 m
- Building 870C, ~ 45 m

6.3.2 Offsite Receptors

The following offsite receptors include those facilities and areas outside the 65 meter SLS site boundary.

- Trailer 32, ~ 68 m
- Building 801, (SNL/NM EOC), ~847 m
- Building 831, (Medical), ~ 784 m
- KAFB Fire Station, ~ 1.1 km
- National Atomic Museum, ~ 920 m
- KAFB Housing, ~ 625 m
- Veterans Hospital, ~ 3.4 km
- Albuq. Intn'l Airport Terminal, ~ 6.5 km

Table 6.1
Summary of Consequences

Event Consequences for the SLS						
Release Designation	Maximum Concentration at		Maximum Distance to		Possible/Probable EAL(s) *	Emergency Event Classification
	Facility Boundary at 30 m (ppm)	Site Boundary at 65 m (ppm)	ERPG-2 (meters)	ESHE (meters)		
F-1	12.1	1.72	38	23	1 cylinder of Fluorine fractured	Site Area
F-2	.467	.0896	< 10	< 10	1 cylinder of Fluorine fractured	Alert
F-3	7.28	1.89	29	20	1 cylinder of Fluorine fractured	Alert
F-4	.209	.0448	< 10	< 10	1 cylinder of Fluorine fractured	Alert

* There are not any quantifiable detection methods to confirm that actual releases occured in the scenarios described in Section 5.0, therefore, symptom-based EALs are not utilized in this hazards assessment. The above mentioned event-based EALs are stated in terms of the overall event descriptors as indicated by direct observation. The resulting event classifications are based on the consequences resulting from the releases of the total quantity of the material.[49]

7.0 THE EMERGENCY PLANNING ZONE

The results of the consequence analysis performed in section 6.0 were used to propose an Emergency Planning Zone (EPZ). An EPZ is an area within which special planning and preparedness efforts are warranted, as a means of apportioning preparedness resources to the areas where they are most needed.

7.1 The Minimum EPZ Radius

As can be seen from the data in Table 6.1, the highest facility emergency class is a Site Area Emergency, and the greatest distance at which a postulated facility event will produce consequences exceeding the Early Severe Health Effects (D_{ESHE}) threshold is 23 meters (Release Designation F-1). In accordance with Figure 4.1 of the EMG, if the D_{ESHE} and the site boundary are not greater than 2 km, then the "minimum EPZ radius" (EPZ_{min}) is equal to the minimum distance to the site boundary. Therefore, the EPZ_{min} for SLS is 65 meters. The nominal 65 meter EPZ follows fence and street boundaries and is depicted in Illustration 7-1.

7.1.1 Tests of Reasonableness

The EPZ meets the following five tests of reasonableness:

1. Are the maximum distances to PAG/ERPG-level impacts for most of the analyzed accident scenarios equal to or less than the EPZ radius selected?

   Yes. All of the ERPG impacts are less than the 65 meter EPZ. As shown in table 6.1, the maximum distance for the ERPG-2 is 38 meters.

2. Is the selected EPZ radius large enough to provide a credible basis for extending response activities outside the EPZ if conditions warrant?

   Yes. Lines of communication and decision processes involving KAFB, as well as city and county response agencies, have been established and practiced. In exercises, as well as actual events, the offsite agencies have demonstrated the flexibility to adapt and extend pre-planned response actions to different areas, depending upon the conditions of the particular event. This process is facilitated through the use of the Incident Command Structure.

3. Is the EPZ radius large enough to support an effective response at and near the scene of the emergency?

   Yes. The nominal 65 meter EPZ encompasses SLS and all routes leading to it. Communication between emergency planning and safeguards and security has been established. This will allow the emergency personnel to respond to the event without interference from uninvolved people and activity, facilitate onsite protective actions, and optimize on-scene command, control, and mitigation efforts.

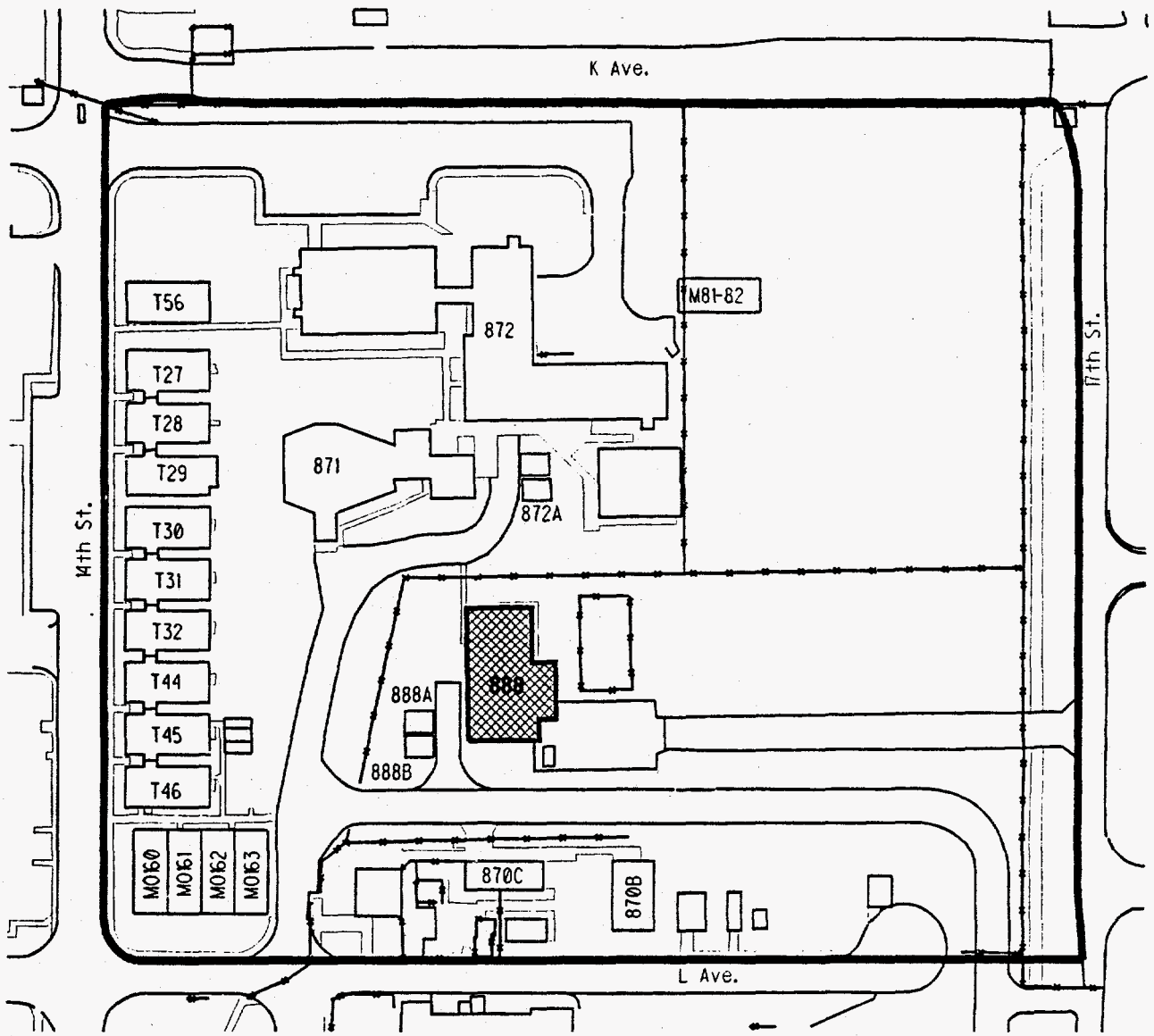
4. Does the proposed EPZ conform to natural and jurisdictional boundaries where reasonable, and are other expectations and needs of the offsite agencies likely to be met by the selected EPZ?

Yes. The EPZ conforms to jurisdictional boundaries and physical street boundaries. By utilizing streets as physical boundaries for portions of the EPZ, access within the EPZ can be adequately controlled as needed by offsite agencies.

Although SLS is entirely within the confines of KAFB, the need for offsite agencies does exist if there is a significant event which requires offsite assistance. In this situation, the established EPZ would appropriately meet the needs of offsite agencies.

5. What enhancements of the facility and site preparedness stature would be achieved by increasing the selected radius?

The proposed EPZ radius ensures the involvement and integration of any required response organizations in the planning process. It is not obvious that any increase in the proposed EPZ boundary will provide significant improvement in the level of facility or site preparedness.



Legend

Fence -x--x--x--x--x

SCALE: 1"=38 meters

Facilities
Geographic Information System
Site Utilities Engineering Department 7909

SLS EPZ BOUNDARY

Illustration 7-1

8.0 EMERGENCY CLASSES, PROTECTIVE ACTIONS, AND EALS

The correlation of event scenarios and estimated consequences developed in Sections 5.0 and 6.0 are used to determine the emergency classes and protective actions that are appropriate to the scenarios, as well as the observable indications (i.e. EALs) to trigger emergency declarations and protective actions.

8.1 Emergency Classes

As mentioned in section 6.0, the three classes of operational emergencies in ascending order of severity are alert, site area emergency, and general emergency. These classes are differentiated by severity for the purpose of specifying appropriate emergency actions, including required response activities and notifications, commensurate with the degree of hazard presented by the event. The three classes of emergencies are defined below.

8.1.1 Alert

An alert represents events in progress or have occurred which involve an actual or potential substantial reduction for the level of facility safety and protection. An environmental release of hazardous materials is expected to be limited to small fractions of the appropriate Protective Action Guide (PAG) or ERPG-2 onsite. An alert represents an event that is noteworthy; the potential impacts are not expected to be serious; and a negligible long-term supply is anticipated. Declaration of an Alert requires the availability of personnel and resources to:

- Provide continous assessment of pertinent information for DOE decision makers, offsite authorities, the public, and other appropriate entities;
- Conduct appropriate assessments, investigations, or preliminary or confirmatory sampling and monitoring;
- Mitigate the severity of the occurrence or its consequences; and
- Prepare for other response actions should the situation become more serious.

8.1.2 Site Area Emergency

A Site Area Emergency represents events which are in progress or have occurred involving actual or likely major failure(s) of facility safety or safeguards systems needed for the protection of onsite personnel, the public health and safety, the environment, or national security. An environmental release of hazardous materials is not expected to exceed the appropriate PAG or ERPG-2 levels offsite. A Site Area Emergency represents an event in which a substantial supply impact is anticipated. Declaration of a Site Area Emergency requires initiation of predetermined protective actions for onsite personnel and the notification and assembly of emergency response personnel and equipment to activate response centers to provide:

- Continuous assessment of pertinent information for DOE decision makers, offsite authorities, the public, and other appropriate entities;
- Establish communications, consultation, and liaison with offsite authorities;

- Provide information to the public through offsite authorities and the media;
- Conduct or assist in any evacuations and sheltering;
- Conduct appropriate assessments, investigations, or sampling and monitoring;
- Mitigate the severity of the actual or potential consequences; and
- Mobilize appropriate emergency response groups or security forces for immediate dispatch should the situation become more serious.

8.1.3 General Emergency

A General Emergency represents events which are in progress or have occurred that involve actual or imminent catastrophic failure of facility safety systems with potential for loss of confinement integrity, catastrophic degradation of facility protection systems, or catastrophic failure in safety or protection systems threatening the integrity of a weapon or test device which could lead to substantial offsite impacts. Any environmental release of hazardous materials can reasonably be expected to exceed the appropriate PAG or ERPG-2 levels offsite. Declaration of a General Emergency requires the notification, mobilization, and dispatch of all appropriate emergency response personnel and equipment including appropriate DOE national response assets to:

- Activate the response centers and other emergency assets to provide continuous assessment of information;
- Establish communications, consultation, and liasion with offsite authorities and recommend predetermined protective actions for the public;
- Provide information to the public through offsite authorities and the media;
- Conduct or assist evacuations and sheltering;
- Conduct appropriate assessments, investigations, or sampling and monitoring;
- Mitigate the severity of the actual or potential consequences; and
- Mobilize and dispatch appropriate emergency response groups or security forces.

8.2 Laboratory Release Events and EALs

The consequence analysis performed in Section 6.0 identified the following conditions which could precipitate an alert or a site area emergency involving chemicals inside the SLS. The EAL involves:

- Any condition which could breach the primary and secondary barriers of those chemicals stored in the SLS.

  Basis: The chemical analyzed in the SLS is appropriately stored in a hazardous materials cabinet. If the primary and secondary barriers are breached, the EAL is the fractured/punctured container and/or cabinet as indicated by direct observation.

- Any condition which could breach the primary and secondary barriers of the chemical being delivered or installed in the SLS.

  Basis: The chemical analyzed in the SLS is delivered according to the standard operating procedure for the laser room. The SOP for the laser room indicates fluorine gas cylinders are transported with plugs installed on suitable bottle handling carts with retaining chains secured. If the primary and secondary barriers are breached, the EAL is the fractured/punctured container, or the overturned/damaged bottle handling cart as indicated by direct observation.

8.3 Protective Actions

The recommended protective action involving all scenarios inside the SLS (i.e. chemical spill, fire, etc.) is evacuation using standard fire drill procedures. Building personnel should be evacuated to a point beyond the site boundary and a system devised to account for all personnel. The recommended protective actions for other buildings in response to a fluorine leak in the SLS is sheltering in place.

Response

The emergency response personnel in the SNL Emergency Operations Center (EOC) will ensure prompt notification of the DOE Kirtland Area Office (DOE-KAO) emergency response staff and ensure that the coordinated actions of the Sandia and DOE Emergency plans are initiated. Sandia EOC cadre will recommend to DOE-KAO the protective action guidance for the personnel in the affected offsite area to DOE.

DOE-KAO staff will establish and maintain contact with the offsite agencies. DOE-KAO is responsible for the notification to USAF, other DOE contractors, and other offsite authorities of the recommended Sandia protective actions, revising or supplementing the Sandia protective actions, or issuing any changes to the protective actions. After Sandia personnel have successfully mitigated the event, the Emergency Response Director will establish a recovery team and when conditions warrant, recommend termination of the emergency and prepare to initiate recovery actions.

9.0 MAINTENANCE AND REVIEW

The Risk Management and NEPA Department is responsible for ensuring that Hazards Assessment Documents are regularly reviewed and maintained.

It is the responsiblity of the chemical owners and a facility authority to periodically review Hazards Assessment Documents applicable to their facilities and insure that they accurately reflect any changes in facility design, operations, safety features, inventories of hazardous materials, and features of the surrounding area.

The line organizations should provide information relative to changes in facility design, operation, safety features, inventories of hazardous materials, and features of the surrounding area to the facility authority.

REFERENCES

1. DOE Order 5500.3A, *Planning and Preparedness for Operational Emergencies*. February 27, 1992.

2. NOAA (National Oceanic and Atmospheric Administration). 1988. *Climatological and Meteorological Data.* National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC.

3. MHE (Mason & Hanger Engineering Inc.). 1991. *Safety Assessment of the Explosive Components Facility*, Sandia National Laboratories, Albuquerque, New Mexico. Final Draft.

4. Ibid.

5. Reference 2.

6. ERDA (Energy Research and Development Administration). 1977. *Environmental Impact Assessment.* EIA/MA; 77-1. Sandia National Laboratories, Albuquerque, New Mexico.

7. Thom, H.C.S. 1963. "Tornado Probabilities," Monthly Weather Review, October-December 1963.

8. NMAQB (New Mexico Air Quality Bureau). 1984. *State of New Mexico Air Quality Bureau Annual Report 1983 & 1984.* Health & Environment Department, Environmental Division.

9. NMAQB (New Mexico Air Quality Bureau). 1988. *State of New Mexico Air Quality Bureau Annual Report 1985 & 1988.* Health & Environment Department, Environmental Division.

10. Kelley, V.C. 1979. *Tectonics, Middle Rio Grande Rift, New Mexico*, American Geophysical Union, Washington, DC.

11. Kelley, V.C. 1977. *Geology of Albuquerque Basin, New Mexico,* New Mexico Bureau of Mines and Mineral Resources Memoir 33: New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

12. Millard, G., G. Yeager, J. Phelan, T. Wolff, P. Pei, D. Dionne, C. Gray, D. Thompson, and R. Hamilton. 1989. *1988 Environmental Monitoring Report*, SAND89-1368. UC-630, May, 1989, Sandia National Laboratories, Albuquerque, NM.

13. SDP (Site Development Plan). 1989. Sandia National Laboratories, Albuquerque, NM.

14. SCS (Soil Conservation Service). 1977. *Soil Survey of Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico.* U.S.D.A. Soil Conservation Service and U.S.D.I. Bureau of Indian Affairs and Bureau of Land Management.

15. Ibid.

16. Reference 13.

17. Northrop, S.A. 1982. *Earthquakes of Albuquerque Country.* New Mexico Geological Society Guidebook 33rd Field Conference, Albuquerque Country II. Albuquerque, NM.

18. Sanford, A.R., A.J. Budding, J.P. Hoffman, O.S. Alptekin, C.A. Rush, and T.R. Toppozoda. 1972. *Seismicity of the Rio Grande Rift in New Mexico,* New Mexico Bureau of Mines and Mineral Resources Circular 120, New Mexico Bureau of Mines and Mineral Resources. Socorro, NM.

19. DOE Order 5480.28, *Natural Phenomena Hazards Mitigation.* 1-15-93.

20. Reference 6.

21. USGS (U.S. Geological Survey). 1977. *Water Resources Data for New Mexico, Water Year 1976.* U.S. Geological Survey Water-Data Report NM-76-1.

22. Reference 6.

23. Ibid.

24. Kelly, T.E. 1982. *History of Water Use in the Greater Albuquerque Area,* New Mexico Geological Society Guidebook, 33rd Field Conference, Albuquerque Country II, Albuquerque, NM.

25. NMEMRD (New Mexico Energy Mineral and Resources Department). 1990. Written communication from James D. Norwick, State Forester, Santa Fe, NM, to Steven Cox, Environmental Systems, Jacobs Engineering Group, Inc., Albuquerque, NM. March 6, 1990.

26. DOC, 1990. "1990 Census of Population and Housing," U.S. Dept. of Commerce, Economics, and Statistics, Bureau of the Census, Washington, DC.

27. Ibid.

28. Ibid.

29. Ibid.

30. *DOE Emergency Management Guide, Hazards Assessment,* Appendix I, Facility and Site Boundary Guidelines, Section 3.1.a. June 26, 1992.

31. *DOE Emergency Management Guide, Hazards Assessment,* Section D.3.b. June 26, 1992.

32. 40 CFR 355, Emergency Planning and Notification, Part 355.20 (b) Hazardous Chemicals.

33. 40 CFR 302, Designation, Reportable Quantities, and Notification. Part 302.4, List of Hazardous Substances and Reportable Quantities.

34. Reference 32.

35. Richard J. Lewis Sr. *Hazardous Chemical Desk Reference, Second Edition.* Copyright 1990 by Van Nostrand Reinhold.

36. 10 CFR, Part 30.72, Schedule C. *Quantities of Radioactive Materials Requiring Consideration of the need for and Emergency Plan for Responding to a Release.*

37. Statement by Jack Beaversted, Albuquerque City Water Department, phone interview, September, 1993.

38. SAND Report, SAND 94-0920, General Safety Documentation Material, Jeffrey A. Mahn. April 1994.

39. Record of conversation: Floyd Galegar, Project Engineer with National Highway Safety Council. April 13, 1992.

40. Correspondence from D. Clark, Director Environmental Quality and Hazardous Materials, Atchison, Topeka, Santa Fe Railway Company. August 22, 1994.

41. Ibid.

42. *Emergency Response Planning Guidelines*. Emergency Response Planning Committee of the American Industrial Hygiene Association. February 1992.

43. *Concentration Limit Hierarchy for Toxicological Accident Analysis,* Project # SNL-MDL-01. 8-9-93.

44. DOE Order 5480.16, Fire Arms Safety, Chapter 2HI. 10/10/90.

45. *Areal Locations of Hazardous Atmospheres (ALOHA)*. U.S. EPA and NOAA October, 1992.

46. NUREG/CR2239, *Technical Guidance for Siting Criteria,* Typical Meteorological Year Data for Albuquerque from the National Weather Service.

47. Sandia Report, Appendix C, *1994 Technical Area V Hazards Assessment Document.*

48. Reference 42.

49. Emergency Management Guide, Guidance for Event Classification and Emergency Action Levels. June 26, 1992. Sections D.1.d and D.2.b.

50. Reference 42.

Appendix A

888 ChemMaster Inventory

KEY to ABBREVIATIONS FOR CHEMMASTER

BD. FT	Board Feet
BP	Boiling Point
CHEM	Chemical
cyl	Cylinder
ERPG	Emergency Response Planning Guideline
ft3	Cubic Feet
G	Gas
g	Gram
gcf	Gaseous Cubic Feet
gal	Gallon
HA	Hazard Assessment
kg	kilogram
L	Liquid
l	Liter
LOC_CODE	Location Code
MQTY	Maximum Quantity
ml	Milliliter
oz	Ounce (avoirdupois)
ozd	Ounces Dry (avoirdupois)
ozf	Fluid Ounce (U.S. liquid measure)
PHYS_STATE	Physical State
pt	Pint
qt	Quart
QTY_UNIT	Quantity Unit
S	Solid
SCR_CRIT	Screening Criteria
SIH	Standard Industrial Hazard
SQ. FT	Square Feet

SNL/NM Hazards Project

HA Required : YES Number of Chemicals: 1423

Chemical Inventory

CHEM	LOC_CODE	PHYS_STATE	QTY_UNIT	MQTY	SCR_CRIT
DE-SOLV-IT MULTIPURPOSE SOLVENT,INDUSTRIAL FORMULA	888	L	(gal)	1	SIH
5% FLUORINE/ 95% HELIUM	888/102	G	(cyl)	2	KEEP
HELIUM	888/102	G	(cyl)	2	SIH
KRYPTON	888/102	G	(cyl)	3	NON-TOXIC
DIESEL FUEL	888/GEN.	L	(gal)	50	SIH
TAPMATIC # 1 CUTTING FLUID	888/HI BAY	L	(qt)	2	SIH
3-IN-ONE-OIL	888/HIBAY	L	(ozd)	16	SIH
ACETONE	888/HIBAY	L	(gal)	1	< ERPG-1 AT 30 M.
ACETONE	888/HIBAY	L	(ml)	625	< ERPG-1 AT 30 M.
AIR,COMPRESSED	888/HIBAY	G	(cyl)	6	SIH
BLOW HARD - DICHLORODIFLUORMETHAM E	888/HIBAY	G	(ozd)	128	<1 LB.
BUTANE	888/HIBAY	G	(ozd)	128	SIH
CAPACITOR AEROVOX 1.36 MICROFARAD,100 KVDC P/N	888/HIBAY	L	EACH	40	NON-TOXIC

Chemical Inventory

CHEM	LOC_CODE	PHYS_STATE	QTY_UNIT	MQTY	SCR_CRIT
PX480D0084					
CAPACITORS AEROVOX 0.7 MICROFARAD,100 KVDC P/N PX480D62	888/HIBAY	L	EACH	36	NON-TOXIC
CONTACT SHIELD	888/HIBAY	L	(ozd)	16	SIH
CUPRIC SULFATE,PENTAHYDRATE	888/HIBAY	L	(gal)	10	NON-DISPERSIBLE
DOW CORNING HIGH VACUUM GREASE	888/HIBAY	L	(ozd)	32	SIH
ETHYL ALCOHOL	888/HIBAY	L	(l)	2	SIH
FREON	888/HIBAY	L	(gal)	25	< ERPG-1 AT 30 M.
GLASS BEAD BLAST MEDIA # 2W580	888/HIBAY	S	(lb)	100	SIH
ISOPROPANOL	888/HIBAY	L	(ml)	500	< ERPG-1 AT 30 M.
KETONE	888/HIBAY	L	(ozd)	8	SIH
NYLATRON GS NYLON	888/HIBAY	S	SQ.FT	25	SIH
PLYWOOD	888/HIBAY	S	BD FT	100	SIH
RECTORSEAL	888/HIBAY	L	(pt)	1	SIH
ROCK SALT	888/HIBAY	S	(lb)	2	SIH
TAPMATIC # 2 CUTTING FLUID	888/HIBAY	L	(pt)	2	SIH

Chemical Inventory

CHEM	LOC_CODE	PHYS_STATE	QTY_UNIT	MQTY	SCR_CRIT
UNIVOLT N 61	888/HIBAY	L	(gal)	40000	SIH
UNIVOLT N 61 OIL	888/HIBAY	L	(gal)	40000	SIH
WD-40	888/HIBAY	L	(ozd)	48	SIH
WOOD DUST,HARDWOODS	888/HIBAY	S	BD.FT	100	SIH
WOOD DUST,SOFTWOODS	888/HIBAY	S	BD.FT	100	SIH
ARGON	888/RACK	G	(cyl)	1	SIH
SULFUR HEXAFLUORIDE	888/RACK	G	(cyl)	10	NON-TOXIC
ACETYLENE	888/SHOP	G	(cyl)	2	SIH
ALPHA 60/40 CEN-TRI-CORE SLODER	888/SHOP	S	(lb)	3	SIH
ALPHA LEAD FREE SOLDER #13955	888/SHOP	S	(lb)	2	SIH
ALPHA PASTE SOLDERING FLUX	888/SHOP	L	(ozd)	16	SIH
CIMSTAR 3700	888/SHOP	L	(gal)	1	SIH
HARRIS SOLDER	888/SHOP	S	(lb)	2	SIH
HARRIS STAY CLEAN PASTE FLUX	888/SHOP	L	(ozd)	8	SIH
HARRIS STAY SILVER SOLDER FLUX	888/SHOP	L	(ozd)	8	SIH

Chemical Inventory

CHEM	LOC_CODE	PHYS_STATE	QTY_UNIT	MQTY	SCR_CRIT
KESTER 50/50 SOLDER	888/SHOP	S	(lb)	2	SIH
KESTER 60/40 SOLDER	888/SHOP	S	(lb)	2	SIH
PRE-SCRIBE LAYOUT FLUID,#50162 BLUE	888/SHOP	L	(ozd)	32	SIH
PUMP OIL	888/SHOP	L	(qt)	1	SIH
SILVER SOLDER	888/SHOP	S	(lb)	5	SIH
TRU-TEST 50/50 WIRE SOLDER	888/SHOP	S	(lb)	2	SIH

Appendix B

ALOHA Dispersion Model Printouts

Procedure for Dispersing Gas Mixtures

Background

The following procedure provides a description for the dispersion of gas mixtures through the ALOHA dispersion model. ALOHA is designed to model the release rate and dispersion of pure chemicals only. It is difficult for a model like ALOHA to correctly predict the behavior of a mixture of chemicals. However, for the purpose of emergency planning, ALOHA serves a vital role in estimating the distance at which protective actions should be initiated.

The current process used to model the release of gas mixtures first requires a determination of the percent of hazardous material in the total gas mixture and releasing that percentage (quantity) as a pure chemical through ALOHA. The process used to model the release of the gas mixture first requires a determination of the percent of the hazardous material in the total gas mixture. To calculate the percentage of the hazardous material, mulitply the total quantity of the gas mixture by the percentage of hazardous material in the gas mixture. The resulting quantity is then run on ALOHA as a direct source or an instaneous release depending on the scenario. The calculated results depict the most conservative estimate of the behavior of the chemical for emergency planning purposes.

The specific calculation for each Hazard Assessment Document can be found in Appendix C.

Release Designation
F-1

Fluorine

a one hour release of fluorine due to an accident during delivery or installation

25 Liters, 1 Hour Release
Worst Case Meteorological Conditions

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 0.18 (Sheltered single storied)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 2.5 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: F Air Temperature: 68° F
Relative Humidity: 5% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 150 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 3.29 grams/min
Total Amount Released: 197 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 2.5 ppm
Max Threat Zone for LOC: 71 meters
Max Threat Zone for IDLH: 20 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 0.18 (Sheltered single storied)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 7.5 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: F Air Temperature: 68° F
Relative Humidity: 5% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 150 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 3.29 grams/min
Total Amount Released: 197 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 7.5 ppm
Max Threat Zone for LOC: 38 meters
Max Threat Zone for IDLH: 20 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 0.18 (Sheltered single storied)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 17.25 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: F Air Temperature: 68° F
Relative Humidity: 5% Ground Roughness: Open country
Cloud Cover: 1 tenths

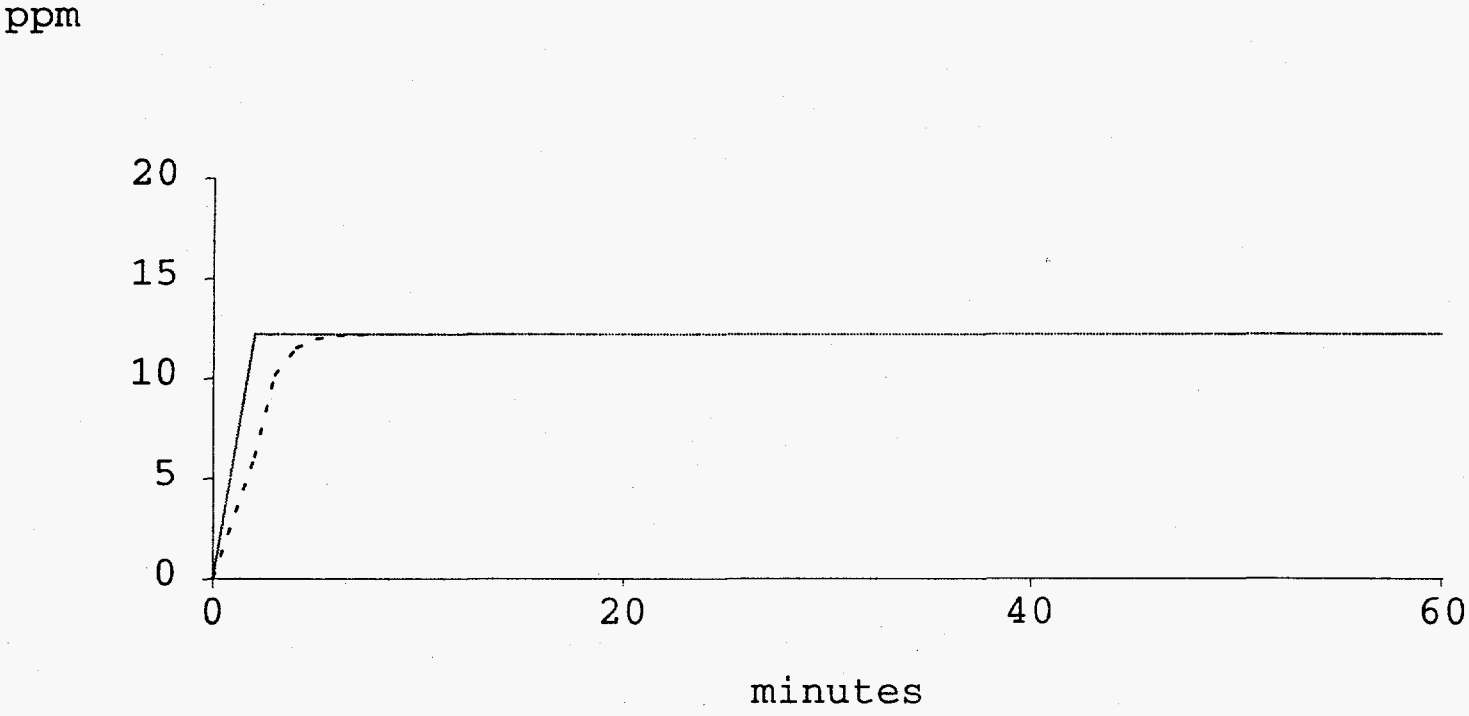
SOURCE STRENGTH INFORMATION:
Direct Source: 150 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 3.29 grams/min
Total Amount Released: 197 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 17.25 ppm
Max Threat Zone for LOC: 23 meters
Max Threat Zone for IDLH: 20 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

```
 SITE DATA INFORMATION:
  Location: ALBUQUERQUE, NEW MEXICO
  Building Air Exchanges Per Hour: 60 (User specified)
  Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
  Chemical Name: FLUORINE       Molecular Weight: 38.00 kg/kmol
  TLV-TWA: 1.00 ppm             IDLH: 25.00 ppm
  Footprint Level of Concern: 25 ppm
  Boiling Point: -188.20° C
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
  Wind: 1 meters/sec from 0° true
  Inversion Height: 500 meters
  Stability Class: F            Air Temperature: 68° F
  Relative Humidity: 5%         Ground Roughness: Open country
  Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
  Direct Source: 150 liters/hr
  Source Height: 0
  Source State: Gas
  Source Temperature: equal to ambient
  Source Pressure: equal to ambient
  Release Duration: ALOHA limited the duration to 1 hour
  Release Rate: 3.29 grams/min
  Total Amount Released: 197 grams
  Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: equals IDLH (25 ppm)
  Max Threat Zone for LOC: 20 meters
  Note: Footprint wasn't drawn because effects of
    near-field patchiness make plume presentation
    unreliable for short distances.


TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind:        30 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 12.1 ppm
     Indoor:  12.1 ppm
  Note: Indoor graph is shown with a dotted line.
```

Chemical Name: FLUORINE
Model Run: Heavy Gas
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 12.1 ppm
Indoor: 12.1 ppm
Note: Indoor graph is shown with a dotted line.

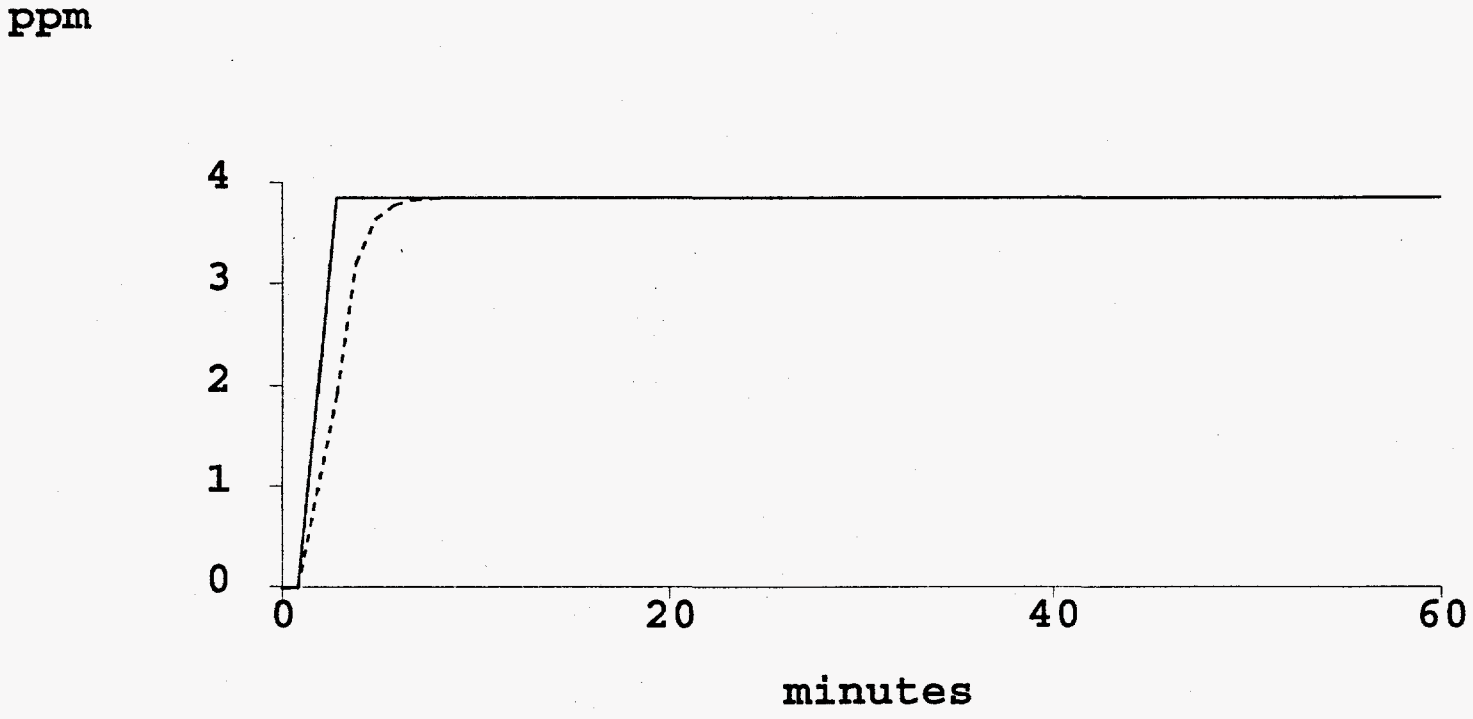


```
 SITE DATA INFORMATION:
  Location: ANAHEIM, CALIFORNIA
  Building Air Exchanges Per Hour: 60 (User specified)
  Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
  Chemical Name: FLUORINE       Molecular Weight: 38.00 kg/kmol
  TLV-TWA: 1.00 ppm             IDLH: 25.00 ppm
  Footprint Level of Concern: 25 ppm
  Boiling Point: -188.20° C
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
  Wind: 1 meters/sec from 0° true
  Inversion Height: 500 meters
  Stability Class: F            Air Temperature: 68° F
  Relative Humidity: 5%         Ground Roughness: Open country
  Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
  Direct Source: 150 liters/hr
  Source Height: 0
  Source State: Gas
  Source Temperature: equal to ambient
  Source Pressure: equal to ambient
  Release Duration: ALOHA limited the duration to 1 hour
  Release Rate: 3.93 grams/min
  Total Amount Released: 236 grams
  Note: This chemical may flash boil and/or result in two phase
flow.

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 25 ppm
  Max Threat Zone for LOC: 22 meters
  Max Threat Zone for IDLH: 22 meters
  Note: Footprint wasn't drawn because effects of
    near-field patchiness make plume presentation
    unreliable for short distances.


TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind:       65 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 3.86 ppm
     Indoor:  3.86 ppm
  Note: Indoor graph is shown with a dotted line.
```

Concentration Window 2864712611

Chemical Name: FLUORINE
Model Run: Heavy Gas
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 65 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.86 ppm
Indoor: 3.86 ppm
Note: Indoor graph is shown with a dotted line.



Release Designation
F-2

Fluorine

a one hour release of fluorine due to an accident during delivery or installation

25 Liters, 1 Hour Release
Average Case Meteorological Conditions

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 0.67 (Sheltered single storied)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 2.5 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: C Air Temperature: 68° F
Relative Humidity: 25% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 150 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 3.29 grams/min
Total Amount Released: 197 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 2.5 ppm
Max Threat Zone for LOC: 11 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 0.67 (Sheltered single storied)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 7.5 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: C Air Temperature: 68° F
Relative Humidity: 25% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 150 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 3.29 grams/min
Total Amount Released: 197 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 7.5 ppm
Max Threat Zone for LOC: less than 10 meters(10.9 yards)
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 0.67 (Sheltered single storied)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 17.25 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: C Air Temperature: 68° F
Relative Humidity: 25% Ground Roughness: Open country
Cloud Cover: 3 tenths

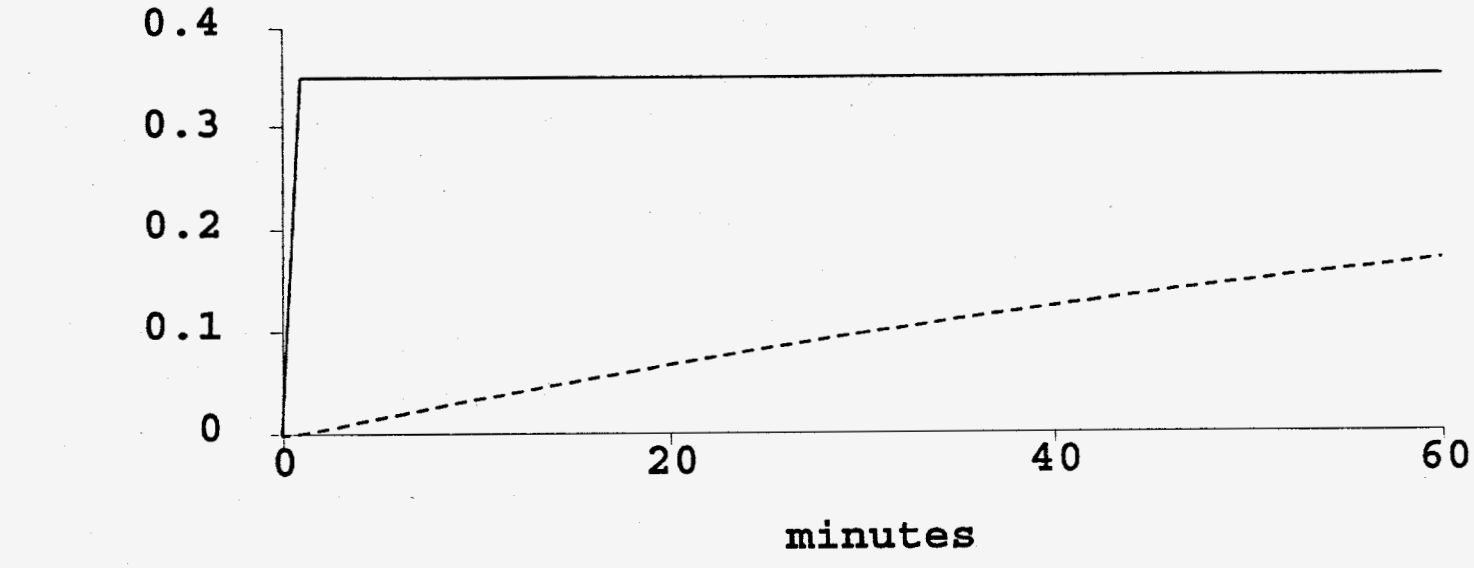
SOURCE STRENGTH INFORMATION:
Direct Source: 150 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 3.29 grams/min
Total Amount Released: 197 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 17.25 ppm
Max Threat Zone for LOC: less than 10 meters(10.9 yards)
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

```
 SITE DATA INFORMATION:
   Location: ALBUQUERQUE, NEW MEXICO
   Building Air Exchanges Per Hour: 0.67 (Sheltered single storied)
   Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
   Chemical Name: FLUORINE          Molecular Weight: 38.00 kg/kmol
   TLV-TWA: 1.00 ppm                IDLH: 25.00 ppm
   Footprint Level of Concern: 25 ppm
   Boiling Point: -188.20° C
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
   Wind: 4 meters/sec from 0° true
   Inversion Height: 500 meters
   Stability Class: C               Air Temperature: 68° F
   Relative Humidity: 25%           Ground Roughness: Open country
   Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
   Direct Source: 150 liters/hr
   Source Height: 0
   Source State: Gas
   Source Temperature: equal to ambient
   Source Pressure: equal to ambient
   Release Duration: ALOHA limited the duration to 1 hour
   Release Rate: 3.29 grams/min
   Total Amount Released: 197 grams
   Note: This chemical may flash boil and/or result in two phase
flow.

FOOTPRINT INFORMATION:
   Dispersion Module: Gaussian
   User specified LOC: 25 ppm
   Max Threat Zone for LOC:  less than 10 meters(10.9 yards)
   Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
   Note: Footprint was not drawn because
      effects of near-field patchiness make plume
      presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
   Concentration Estimates at the point:
   Downwind:        30 meters
   Off Centerline: 0 meters
   Max Concentration:
      Outdoor: 0.35 ppm
      Indoor:  0.17 ppm
   Note: Indoor graph is shown with a dotted line.
```

Chemical Name: FLUORINE
Model Run: Gaussian
Building Air Exchanges Per Hour: 0.67 (Sheltered single storied)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.35 ppm
Indoor: 0.17 ppm
Note: Indoor graph is shown with a dotted line.

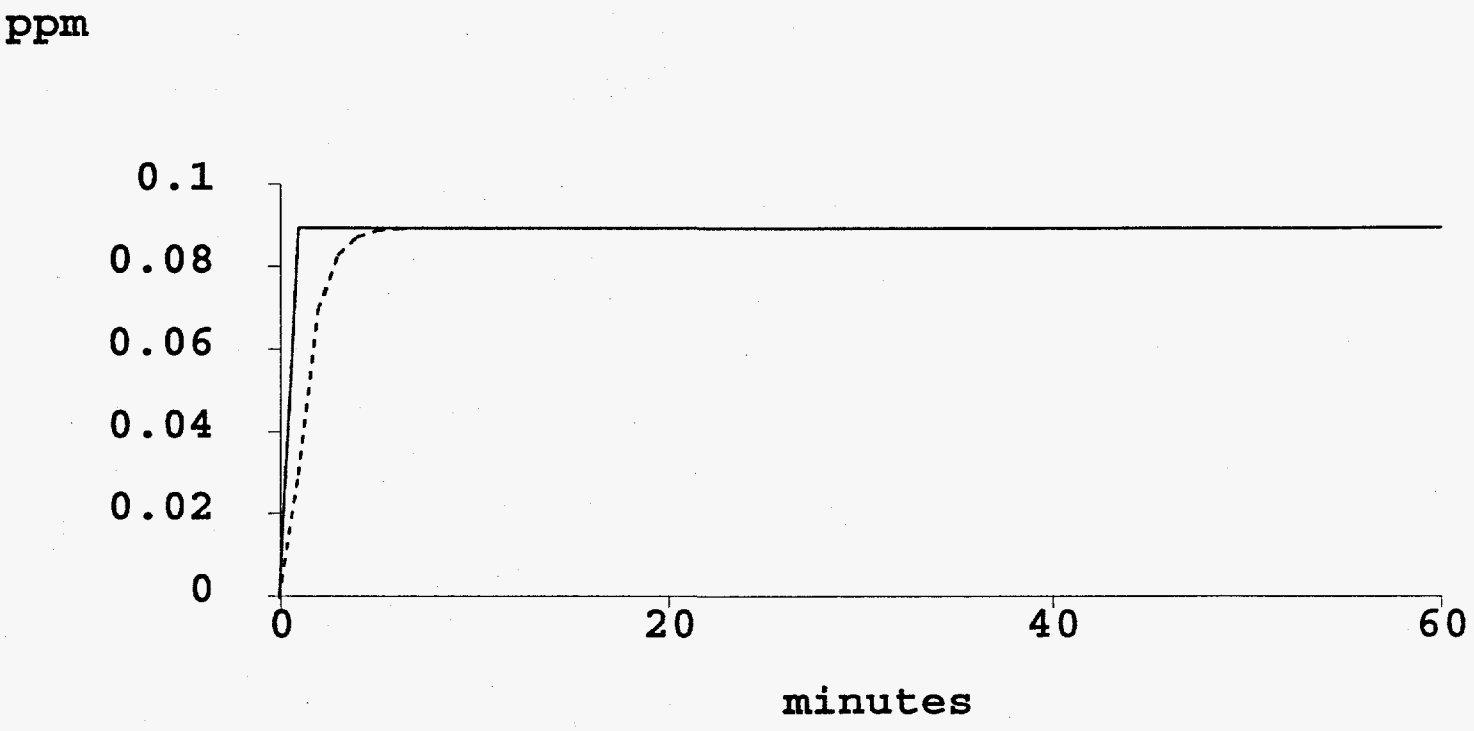


```
 SITE DATA INFORMATION:
  Location: ANAHEIM, CALIFORNIA
  Building Air Exchanges Per Hour: 60 (User specified)
  Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
  Chemical Name: FLUORINE       Molecular Weight: 38.00 kg/kmol
  TLV-TWA: 1.00 ppm             IDLH: 25.00 ppm
  Footprint Level of Concern: 25 ppm
  Boiling Point: -188.20° C
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
  Wind: 4 meters/sec from 0° true
  Inversion Height: 500 meters
  Stability Class: C            Air Temperature: 68° F
  Relative Humidity: 25%        Ground Roughness: Open country
  Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
  Direct Source: 150 liters/hr
  Source Height: 0
  Source State: Gas
  Source Temperature: equal to ambient
  Source Pressure: equal to ambient
  Release Duration: ALOHA limited the duration to 1 hour
  Release Rate: 3.93 grams/min
  Total Amount Released: 236 grams
  Note: This chemical may flash boil and/or result in two phase
flow.

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind:        65 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 0.0896 ppm
     Indoor:  0.0896 ppm
  Note: Indoor graph is shown with a dotted line.
```

Concentration Window 2864712734

Chemical Name: FLUORINE
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 65 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.0896 ppm
Indoor: 0.0896 ppm
Note: Indoor graph is shown with a dotted line.



Release Designation
F-3

Fluorine

a one hour release of fluorine due to puncture or fracture of a depleted cylinder

12.5 Liters, 1 Hour Release
Worst Case Meteorological Conditions

```
 SITE DATA INFORMATION:
   Location: ANAHEIM, CALIFORNIA
   Building Air Exchanges Per Hour: 60 (User specified)
   Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
   Chemical Name: FLUORINE          Molecular Weight: 38.00 kg/kmol
   TLV-TWA: 1.00 ppm                IDLH: 25.00 ppm
   Footprint Level of Concern: 2.5 ppm
   Boiling Point: -188.20° C
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
   Wind: 1 meters/sec from 0° true
   Inversion Height: 500 meters
   Stability Class: F               Air Temperature: 68° F
   Relative Humidity: 5%            Ground Roughness: Open country
   Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
   Direct Source: 75 liters/hr
   Source Height: 0
   Source State: Gas
   Source Temperature: equal to ambient
   Source Pressure: equal to ambient
   Release Duration: ALOHA limited the duration to 1 hour
   Release Rate: 1.96 grams/min
   Total Amount Released: 118 grams
   Note: This chemical may flash boil and/or result in two phase
flow.

FOOTPRINT INFORMATION:
   Model Run: Heavy Gas
   User specified LOC: 2.5 ppm
   Max Threat Zone for LOC: 54 meters
   Max Threat Zone for IDLH: 17 meters
   Note: Footprint wasn't drawn because effects of
     near-field patchiness make plume presentation
     unreliable for short distances.
```

SITE DATA INFORMATION:
Location: ANAHEIM, CALIFORNIA
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 7.5 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: F Air Temperature: 68° F
Relative Humidity: 5% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 75 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 1.96 grams/min
Total Amount Released: 118 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 7.5 ppm
Max Threat Zone for LOC: 29 meters
Max Threat Zone for IDLH: 17 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

SITE DATA INFORMATION:
Location: ANAHEIM, CALIFORNIA
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 17.25 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: F Air Temperature: 68° F
Relative Humidity: 5% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 75 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 1.96 grams/min
Total Amount Released: 118 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 17.25 ppm
Max Threat Zone for LOC: 20 meters
Max Threat Zone for IDLH: 17 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

SITE DATA INFORMATION:
Location: ANAHEIM, CALIFORNIA
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 25 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: F Air Temperature: 68° F
Relative Humidity: 5% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 75 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 1.96 grams/min
Total Amount Released: 118 grams
Note: This chemical may flash boil and/or result in two phase flow.

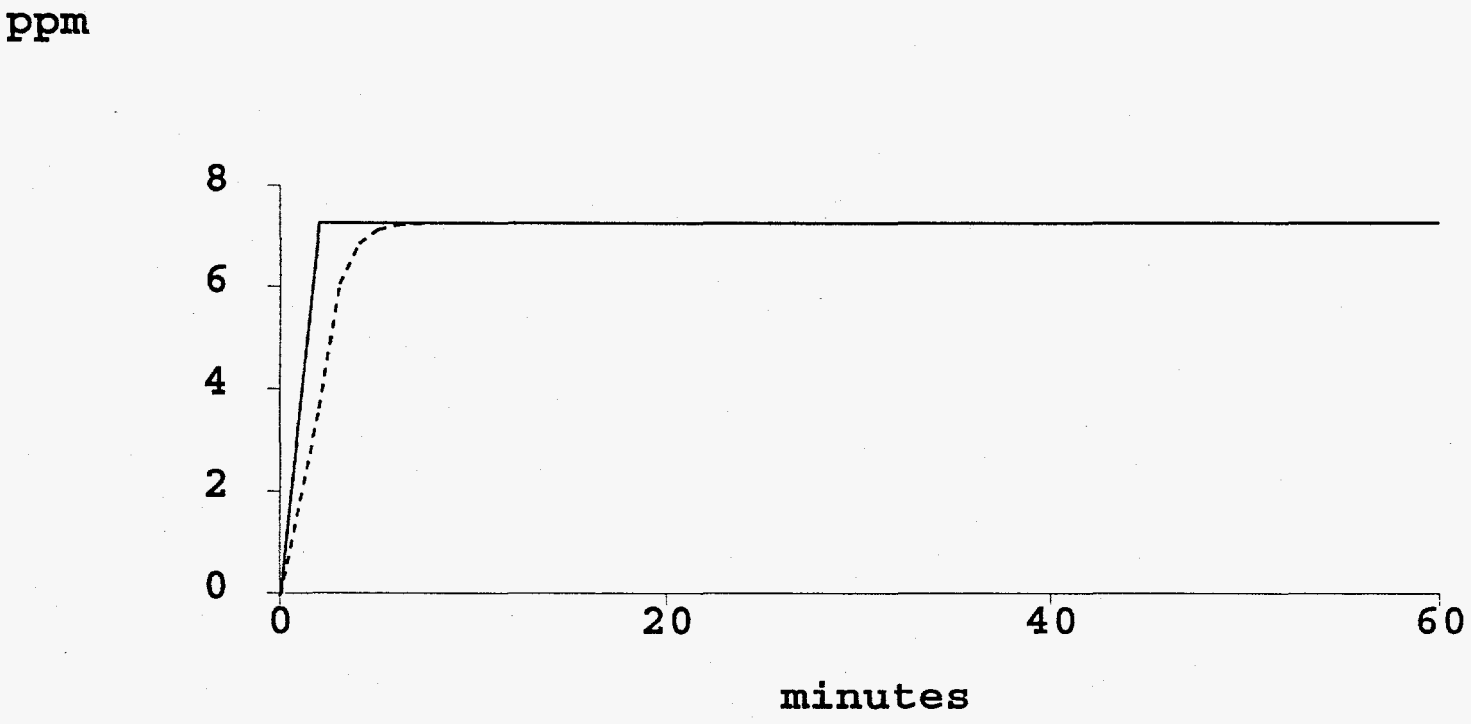
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 25 ppm
Max Threat Zone for LOC: 17 meters
Max Threat Zone for IDLH: 17 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 7.28 ppm
Indoor: 7.28 ppm
Note: Indoor graph is shown with a dotted line.

Concentration Window 2864712413

Chemical Name: FLUORINE
Model Run: Heavy Gas
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 7.28 ppm
Indoor: 7.28 ppm
Note: Indoor graph is shown with a dotted line.



SITE DATA INFORMATION:
Location: ANAHEIM, CALIFORNIA
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 25 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: F Air Temperature: 68° F
Relative Humidity: 5% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 75 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 1.96 grams/min
Total Amount Released: 118 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 25 ppm
Max Threat Zone for LOC: 17 meters
Max Threat Zone for IDLH: 17 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

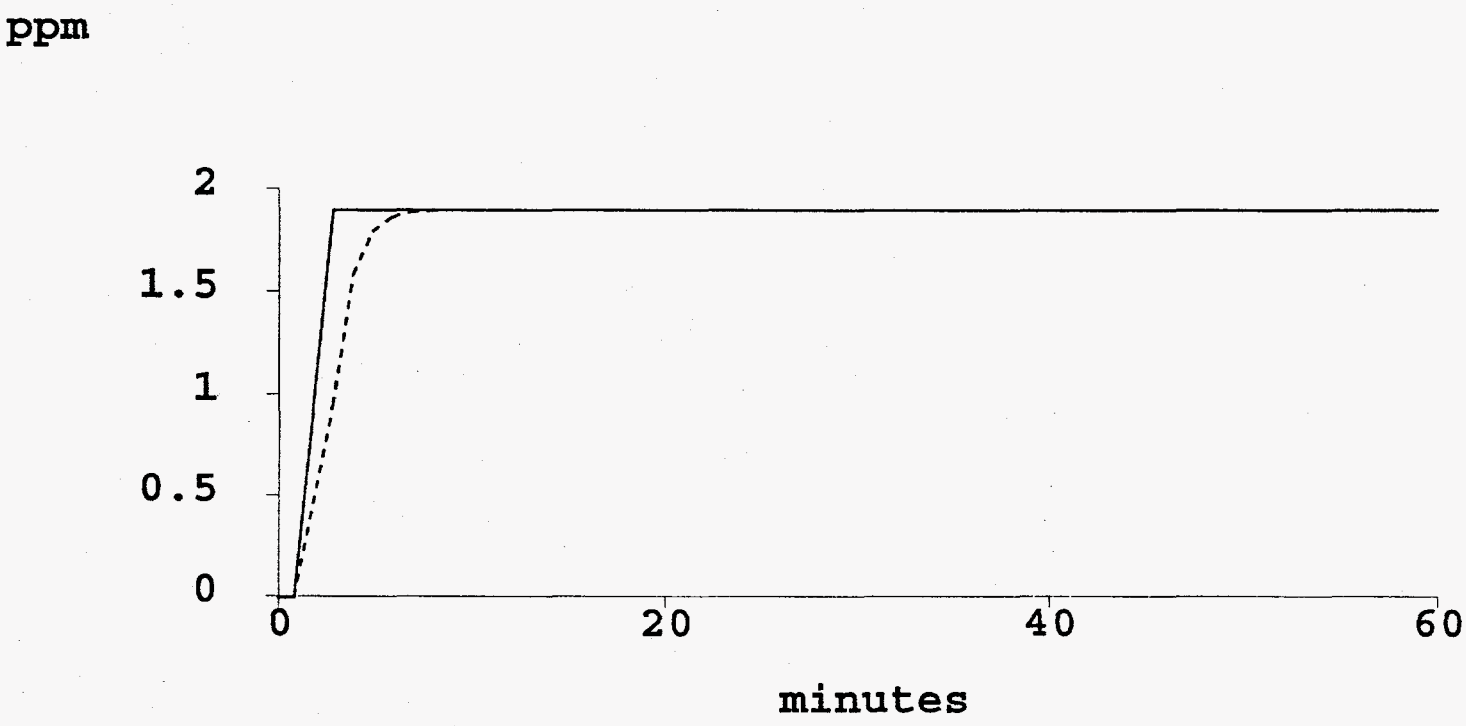
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 65 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1.89 ppm
Indoor: 1.89 ppm
Note: Indoor graph is shown with a dotted line.

Concentration Window

2864712434

Chemical Name: FLUORINE
Model Run: Heavy Gas
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 65 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1.89 ppm
Indoor: 1.89 ppm
Note: Indoor graph is shown with a dotted line.



Release Designation
F-4

Fluorine

a one hour release of fluorine due to puncture or fracture of a depleted cylinder

12.5 Liters, 1 Hour Release
Average Case Meteorological Conditions

SITE DATA INFORMATION:
Location: ANAHEIM, CALIFORNIA
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 2.5 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: C Air Temperature: 68° F
Relative Humidity: 25% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 75 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 1.96 grams/min
Total Amount Released: 118 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 2.5 ppm
Max Threat Zone for LOC: less than 10 meters(10.9 yards)
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

SITE DATA INFORMATION:
Location: ANAHEIM, CALIFORNIA
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 7.5 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: C Air Temperature: 68° F
Relative Humidity: 25% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 75 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 1.96 grams/min
Total Amount Released: 118 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 7.5 ppm
Max Threat Zone for LOC: less than 10 meters(10.9 yards)
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

```
 SITE DATA INFORMATION:
   Location: ANAHEIM, CALIFORNIA
   Building Air Exchanges Per Hour: 60 (User specified)
   Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
   Chemical Name: FLUORINE          Molecular Weight: 38.00 kg/kmol
   TLV-TWA: 1.00 ppm                IDLH: 25.00 ppm
   Footprint Level of Concern: 17.25 ppm
   Boiling Point: -188.20° C
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
   Wind: 4 meters/sec from 0° true
   Inversion Height: 500 meters
   Stability Class: C               Air Temperature: 68° F
   Relative Humidity: 25%           Ground Roughness: Open country
   Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
   Direct Source: 75 liters/hr
   Source Height: 0
   Source State: Gas
   Source Temperature: equal to ambient
   Source Pressure: equal to ambient
   Release Duration: ALOHA limited the duration to 1 hour
   Release Rate: 1.96 grams/min
   Total Amount Released: 118 grams
   Note: This chemical may flash boil and/or result in two phase
flow.

FOOTPRINT INFORMATION:
   Dispersion Module: Gaussian
   User specified LOC: 17.25 ppm
   Max Threat Zone for LOC:  less than 10 meters(10.9 yards)
   Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
   Note: Footprint was not drawn because
      effects of near-field patchiness make plume
      presentation unreliable for short distances.
```

SITE DATA INFORMATION:
Location: ANAHEIM, CALIFORNIA
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
Chemical Name: FLUORINE Molecular Weight: 38.00 kg/kmol
TLV-TWA: 1.00 ppm IDLH: 25.00 ppm
Footprint Level of Concern: 25 ppm
Boiling Point: -188.20° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true
Inversion Height: 500 meters
Stability Class: C Air Temperature: 68° F
Relative Humidity: 25% Ground Roughness: Open country
Cloud Cover: 3 tenths

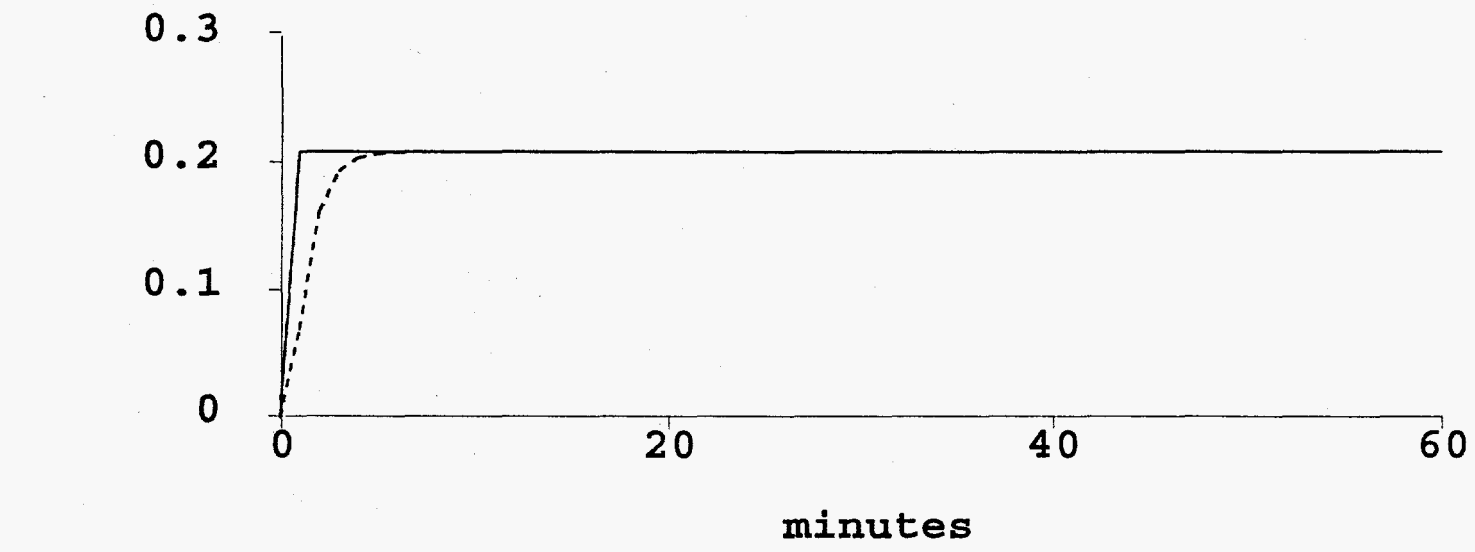
SOURCE STRENGTH INFORMATION:
Direct Source: 75 liters/hr
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 1.96 grams/min
Total Amount Released: 118 grams
Note: This chemical may flash boil and/or result in two phase flow.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.209 ppm
Indoor: 0.209 ppm
Note: Indoor graph is shown with a dotted line.

Concentration Window 2864712933

Chemical Name: FLUORINE
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.209 ppm
Indoor: 0.209 ppm
Note: Indoor graph is shown with a dotted line.

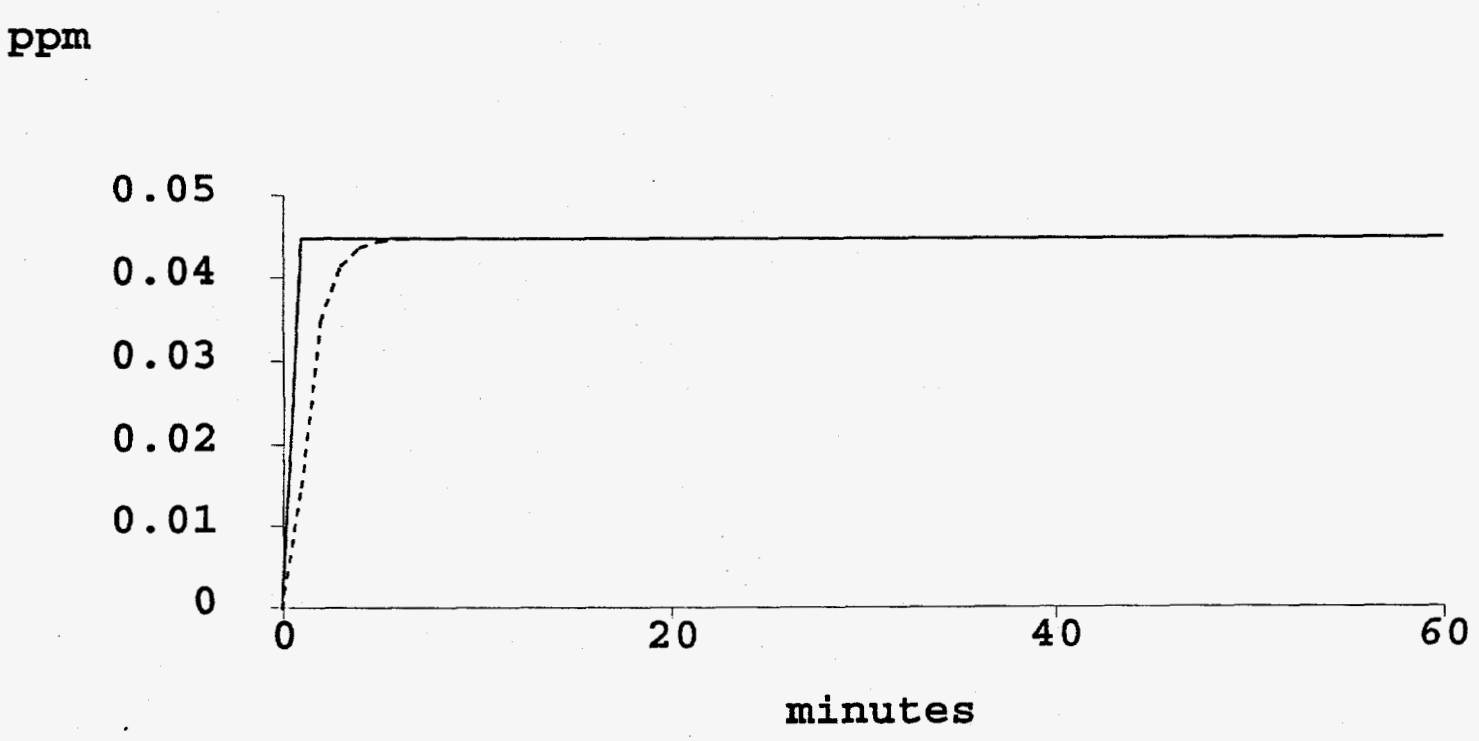


```
 SITE DATA INFORMATION:
  Location: ANAHEIM, CALIFORNIA
  Building Air Exchanges Per Hour: 60 (User specified)
  Date and Time: Using computer's internal clock

CHEMICAL INFORMATION:
  Chemical Name: FLUORINE       Molecular Weight: 38.00 kg/kmol
  TLV-TWA: 1.00 ppm             IDLH: 25.00 ppm
  Footprint Level of Concern: 25 ppm
  Boiling Point: -188.20° C
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
  Wind: 4 meters/sec from 0° true
  Inversion Height: 500 meters
  Stability Class: C            Air Temperature: 68° F
  Relative Humidity: 25%        Ground Roughness: Open country
  Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
  Direct Source: 75 liters/hr
  Source Height: 0
  Source State: Gas
  Source Temperature: equal to ambient
  Source Pressure: equal to ambient
  Release Duration: ALOHA limited the duration to 1 hour
  Release Rate: 1.96 grams/min
  Total Amount Released: 118 grams
  Note: This chemical may flash boil and/or result in two phase
flow.

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind:        65 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 0.0448 ppm
     Indoor:  0.0448 ppm
  Note: Indoor graph is shown with a dotted line.
```

Concentration Window 2864712945

Chemical Name: FLUORINE
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 65 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.0448 ppm
Indoor: 0.0448 ppm
Note: Indoor graph is shown with a dotted line.



Appendix C

Calculation Sheets

CALCULATION SHEET

CALCULATION TITLE: Estimation of the quantity of fluorine in a 500 liter fluorine/helium mixture, 5% fluorine

CALCULATION ID: F-1-2, (release designations for 25 liters of fluorine)

REVISION: 0

Prepared by:	R. Brent Barnett	R. Brent Barnett	12/14/94
	Signature	Printed Name	Date
Checked by:	Alan D. Swihart	Alan D. Swihart	12/14/94
	Signature	Printed Name	Date
Approved by:	L L Dukes	L L Dukes	12/14/94
	Signature	Printed Name	Date

The following equation is used to calculate the quantity of fluorine in a 500 liter fluorine/helium mixture, 5% fluorine.

EQUATION 1: QF= TM x 5%

where: QF= Total quantity of fluorine in the mixture

TM= Total quantity of the mixture

QF= 500 x 5%= 25 liters of fluorine

CALCULATION SHEET

CALCULATION TITLE: Estimation of the quantity of fluorine in a 250 liter fluorine/helium mixture, 5% fluorine

CALCULATION ID: F-3-4, (release designations for 12.5 liters of fluorine)

REVISION: 0

Prepared by:	R. Brent Barnett Signature	R Brent Barnett Printed Name	12/14/94 Date
Checked by:	[signature] Signature	Arlan D. Swihart Printed Name	12/14/94 Date
Approved by:	[signature] Signature	L L Dukes Printed Name	12/14/94 Date

The following equation is used to calculate the quantity of fluorine in a 250 liter fluorine/helium mixture, 5% fluorine.

EQUATION 1: QF= TM x 5%

where: QF= Total quantity of fluorine in the mixture

TM= Total quantity of the mixture

QF= 250 x 5%= 12.5 liters of fluorine