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Glass Formulation and Fabrication Laboratory Building 864 Hazards Assessment Document

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Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
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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 Glass Formulation and Fabrication Laboratory, Building 864. 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 distances at which a postulated facility event will produce consequences exceeding the ERPG-2 threshold is 96 meters. The highest emergency classification is a Site Area Emergency. The Emergency Planning Zone is 100 meters.

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EXECUTIVE SUMMARY

This hazards assessment provides an evaluation of the chemical and radiological hazards at the Glass Formulation and Fabrication Laboratory (GFFL, Building 864) as mandated by the Department of Energy (DOE) Order 5500.3A, Planning and Preparedness for Operational Emergencies.

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

- The greatest distance at which a postulated facility event will produce consequences exceeding an Emergency Response Planning Guideline two (ERPG-2) threshold is 96 meters. This event involves the release of 10 gallons (37.85 liters) of hydrofluoric acid in worst case meteorological conditions.
- The greatest distance at which a postulated facility event will produce consequences exceeding the Early Severe Health Effects threshold is 60 meters. This event involves the release of 10 gallons (37.85 liters) of hydrofluoric acid in worst case meteorological conditions.
- The highest emergency classification is a Site Area Emergency.
- The Emergency Planning Zone is 100 meters.

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KEY to ABBREVIATIONS

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
CHEM	Chemical
D _{ESHE}	Distance at which Early Severe Health Effects are reached
DOE	Department of Energy
DOE-KAO	Department of Energy-Kirtland Area Office
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
G	Gas
g	Gram
GFFL	Glass Formulation and Fabrication Laboratory
gal	Gallon
gcf	Gaseous cubic feet
KAFB	Kirtland Air Force Base
kg	Kilogram
L	Liquid
l	Liter
lb	Pound
LEPC	Local Emergency Planning Committee
LOC CODE	Location Code
ml	Milliliter
MQTY	Maximum Quantity
MSDS	Material Safety Data Sheets
oz	Ounce (avoirdupois)
ozd	Dry ounce (avoirdupois)
ozf	Fluid ounce (U.S. liquid measure)
PAG	Protective Action Guide
PHA	Preliminary Hazard Assessments
PHYS STATE	Physical State
ppm	Parts Per Million
pt	Pint
QTY UNIT	Quantity Unit
S	Solid
SCR CRIT	Screening Criteria
SIH	Standard Industrial Hazard
SOP	Standard Operating Procedures
SNL/NM	Sandia National Laboratories/New Mexico

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 Glass Formulation and Fabrication Laboratory (GFFL), building 864, 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 5500.3A¹ 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 GFFL. 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 GFFL, Sandia National Laboratories, Albuquerque, NM (SNL/NM), collocated facilities, and surrounding jurisdiction to protect workers, the public, and the environment.

A key objective of 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.

Building 864 is a two story building constructed/occupied in 1957. The GFFL first occupied the building in 1976. Personnel at the GFFL prepare glass and glass-ceramic products for customers in the defense, energy, environmental, and industrial sectors.

All chemicals within the GFFL have been identified. There are no radioactive materials within the GFFL. The entire chemical inventory was screened according to the potential to affect onsite and offsite individuals. Those chemicals that were determined hazardous in accordance with the screening criteria described in Section 3.0 were fully characterized, accident scenarios were developed, and consequences were 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

SNL/NM is located approximately 10 kilometers (6 miles) 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 (4,922 feet) at the Rio Grande to a high of 3,255 meters (10,680 feet) at Sandia Crest. KAFB is at a mean elevation of 1,630 meters (5,348 feet).

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 74-square-mile 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 (8.3 inches); 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 (8-to-12 inches) of snow. The maximum observed precipitation in 24 hours occurred in September, 1983, when 5.7 centimeters (2.3 inches) of rain was recorded. The total annual precipitation of 33 centimeters (13 inches) for 1988 was 12 centimeters (4.8 inches) above the 30-year average of 21 centimeters (8.3 inches). 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 (32 miles per hour) on an average of 46 days per year. Every two years, a one-minute duration gust of 52 knots (60 miles per hour) is expected.⁴ The average hourly wind velocity at the Albuquerque International Airport recorded from 1951 to 1980 ranged from 6.7 knots (12.4 km/hr) in December to 9.6 knots (11 miles per hour) 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 (3.7 to 4.4 miles) 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 mechanisms¹² 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 (0.75 to 0.9 miles) thick (Illustration 2.4-2).

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, coarse-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, 105 kilometers (65 miles) 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 (75 miles) 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 180 feet 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 (250 feet per mile) near the mountains to 3.8 meters per kilometer (20 feet per mile) near the river. The distance from the foot of the mountains to the river varies from 4.8 kilometers (three miles) in the northern part of the mesa to 14.5 kilometers (nine miles) in the southern part of the mesa.*

From UBC, 1988.

Illustration 2.4-3 Seismic Risk Zone, 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 (10 miles) 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 Grande²¹ 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 1,597 meters (5,240.5 feet). The 24 meter (80 ft) 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 (5,000 feet) 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 two meters per kilometer (10 feet per mile). The transmissivity of the alluvial aquifer is estimated to be 2,480 square meters per day (200,000 gallons per day per foot), 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 six meters per year (20 feet per year).²³ The water table beneath SNL/NM on the East Mesa is approximately 150 meters (500 feet) 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 Department²⁵ 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 1992 was 499,262.²⁶ 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 an estimated population of 398,492 in 1992.²⁷ 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 48,305.²⁹ 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 50 mile radius of SNL/NM is 66,800.

2.8 GFFL Facility

The Glass Formulation and Fabrication Laboratory is located within Technical Area (TA-I), on the southeast corner of 9th and H streets. The building consists of 13,750 ft². The building is constructed with a concrete slab foundation, CMU interior and exterior walls, wallboard interior office walls, vinyl floor tile, suspended acoustical ceiling, and a bar joist/metal decking built up roof on the original building with hypalon fabric and rolled fiber fabric on the recent additions to the building. The GFFL has approximately 8 personnel.

The electrical systems consist of emergency exit lighting, emergency lighting with battery backup, access alarm, fire alarm, and a public address/intercom system. The mechanical systems include refrigerated central air, with steam heated hot water heat, compressed air, several process gas systems, and a wet pipe fire protection.

2.8.1 Facility and Site Boundaries

The GFFL facility boundary is defined as the outside walls of the GFFL. However, this hazards assessment conservatively utilizes a 30 meter boundary from the perimeter of the GFFL for emergency classification purposes (Illustration 2.8.1-1). The GFFL facility boundary is established in consonance with emergency planning practices³⁰ and is utilized in Section 6.0 for determining GFFL's emergency classifications.

The GFFL site boundary is defined as the TA-I fence line. As stated in the Emergency Management Guide, the perimeter of the DOE-owned and controlled land is the site boundary.³¹ The minimum distance from the GFFL to the TA-I fence and an uncontrolled area is approximately 100 meters. Therefore, the GFFL site boundary is conservatively established at 100 meters and is also used in Section 6.0 for determining GFFL's emergency classifications (Illustration 2.8.2-2). It should be noted that locations exceeding 100 meters but within the TA-I fence are considered onsite.

↑
N
1" = 150 meters

Illustration 2.8-1 Building 864 Facility Boundary (30 Meters)

Illustration 2.8-2 GFFL Site Boundary

1" = 200 meters

2.9 GFFL Facility Mission

The mission of the GFFL is to provide glass and glass-ceramic products for the defense, energy, environmental, and industrial sectors.

2.10 GFFL Facility Process Description

GFFL's Glass capabilities include: preparing high expansion glass-ceramic seals; sealing glasses for hermetic headers; preparing corrosion-proof, silicate-free glasses; melting and sealing of specially formulated glasses; fabricating scientific glassware; and preparing solution derived glasses.

2.10.1 Glass Melt Facility

The glass melt facility is located in room two on the GFFL's first floor (Illustration 2.10.1-1). This lab is used to batch, melt, form, and anneal glass compositions.

The hydrofluoric acid cleaning station which holds 10 gallons (37.85 liters) of hydrofluoric acid is located in the glass melt facility. The hydrofluoric acid cleaning station is primarily used in the cleaning of platinum crucibles. The hydrofluoric acid cleaning station is also used in the cleaning or etching of glass and glass ceramics.³²

The melt room personnel routinely use a variety of chemicals, including arsenic and inorganic lead powders. Access to these chemicals is restricted to melt room personnel. All shelves have secondary containment. In addition, the downflow fume hood has a built-in spill containment to handle any spill while operating in the hood. There is a vacuum cleaner with a HEPA approved filter to be used on any dry chemical spill.³³

2.10.2 Cleaning Facility

The cleaning facility is located in room 22 on GFFL's second floor (Illustration 2.10.2-1). The cleaning facility is primarily used by the section personnel for cleaning components related to the glass-to-metal sealing operations. Acid etching and degreasing are also performed here. Acids, oxidizers, and corrosives are stored in separate compartments below the cleaning hoods. Flammables are stored in a separate OSHA approved cabinet. All chemical cabinets are fitted with secondary containment.³⁴

2.10.3 Sol-Gel Development Laboratory

The sol-gel development laboratory is located in room 25 and 26 on GFFL's second floor as shown in Illustration 2.10.2-1. The sol-gel lab processes metal alkoxide to derive thin glass coatings and porous metal alkoxide to derive bulk glasses.³⁵

Illustration 2.10.1-1 GFFL's First Floor

Illustration 2.10.2-1 GFPL's Second Floor

Normal operations of the sol-gel lab include: the preparation of metal alkoxide based sols in flammable solvents; aging and characterization of the sol; deposition of the sol on a wide variety of substrates via spin, dip or spray techniques; thermal, chemical, or plasma processing of the sol-gel coatings to achieve the desired film properties; characterization of the glassy films by accelerated aging, optical or electrical techniques.³⁶

Bulk glasses are also prepared by sol-gel techniques and these operations include: solvent removal from the gel by evaporation or super-critical solvent extraction; characterization of the bulk glass by mass spectrometry and dilatometry; machining of the bulk glasses using air cooled high speed diamond tooling; thermally processing the bulk glasses in air, vacuum or controlled atmospheres.³⁷

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 GFFL 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, 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 GFFL consisted of the following steps: (a) reviewing the PHAs associated with the Glass Formulation and Fabrication Laboratory for facility- specific information (b) reviewing the ChemMaster chemical inventory to determine the maximum quantities, and (c) conducting walkthroughs of the facility to verify that the ChemMaster inventory was complete and accurate.

Based on the following primary sources of information, a comprehensive list of hazardous materials was compiled to complete the hazard identification and screening process:

- Standard Operating Procedures
- ChemMaster Chemical Inventory
- Preliminary Hazards Assessments (PHA)

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."³⁸ 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.³⁹ Therefore, for the purpose of hazards assessments, such chemicals are 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 Quantities⁴⁰ and 40 CFR Part 355, Appendix A, the Extremely Hazardous Substances and Threshold Planning Quantities⁴¹ in which no chemical had a quantity less than one pound.

Toxicity of Material

For those chemicals exceeding one pound, the MSDS and/or the Hazardous Chemical Desk Reference⁴² 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.⁴³ 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 it represents the minimum facility boundary at SNL/NM. The minimum facility boundary of 30 meters was determined in accordance with the Emergency Management Guide which states that a 200 meter radius may be utilized as the facility boundary if this area does not encompass a significant number of other site workers and does not include areas routinely accessible to the general public. In such a case, a smaller facility boundary is appropriate.⁴⁴ Because SNL/NM has densely populated areas accessible to the general public, a conservative 30 meter facility boundary was determined and is utilized in dispersion modeling to determine toxicity levels at a definitive distance. An ERPG-1 at 30 meters or greater would constitute a minimum of an alert emergency classification. Emergency classifications are described in Section 6.2.2 of this document.

The dispersion modeling is performed through the Areal Locations of Hazardous Atmospheres (ALOHA) model.⁴⁵ 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

Quantity of Material

For radioactive materials, the screening criteria is based on 10 CFR, Part 30.72, Schedule C which lists quantities (in curies) of radioactive materials⁴⁶ that require consideration for emergency planning. Radioactive materials that have quantities less than those on 10 CFR, Part 30.72, Schedule C can be eliminated from further evaluation.

Dispersibility

A radioactive material is removed from further evaluation if it is determined to be non-dispersible. In order for the material to be non-dispersible it must meet both of the following criteria:

- it is a *sealed source* (a radioactive material encapsulated in a container designed to prevent leakage or escape of the material), and
- it cannot conceivably be involved in a high energy event such as a fire or explosion.

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 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 45,360 kg (100,000 pounds) of liquid chlorine in two 22,680 kg (50,000 pound) capacity tanks.⁴⁷ 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.⁴⁸

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 (approximately 4,600 feet) 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

$$N_{\text{carrier}} = N_1 = 140,216$$

$$N_{\text{military}} = N_2 = 71,584$$

$$N_{\text{general}} = N_3 = 239,982,$$

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, KAFB, SNL/NM, 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 (>4536 kg/10,000 pounds Gross Vehicle Weight) to be one accident per 2.2 million miles.⁴⁹

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. The Albuquerque/Bernalillo LEPC conducts exercises relating to emergency response and 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.⁵⁰ 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.⁵¹ The shipments are most likely mixed loads containing sizable 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

A natural gas line is distributed to the north side of the GFFL. The major hazard associated with the natural gas line is an explosion hazard. An explosion from the gas line would not present an airborne hazard in which protective actions would need to be initiated other than response.

3.3 GFFL Chemical Hazards Summary

As a result of the hazards screening at the GFFL, 3 chemicals were kept for further evaluation. This evaluation is performed in section 4.0, hazard characterization. The GFFL chemical inventory and the criteria used to screen out those chemicals considered non-hazardous are provided in Appendix A. The chemicals kept for further evaluation are listed below.

Table 3.3-1
GFFL Hazardous Material Summary

<i>Chemical</i>	<i>Maximum Quantity*</i>	<i>Location</i>
1. Ammonium Hydroxide	2 gallons (7.57 liters) 1 gallon (3.79 liters)	Room 10 <i>temporary storage</i> Room 25
2. Hydrofluoric Acid (49%) (49%) (49%) (2 gallons (7.57 liters) @ 49% and 8 gallons (30.28 liters) @ 5%)	2 liters 1 liter 1 liter 10 gallons (37.85 liters)	Room 10 <i>temporary storage</i> Room 22 Room 25 Room 2
3. Nitric Acid (70%)	2 gallons (7.57 liters) 1 gallon (3.79 liters) 1 gallon (3.79 liters)	Room 10 <i>temporary storage</i> Room 22 Room 25

* *Maximum quantity* represents the maximum quantity in one location.

3.4 Radiological Hazards

There are no radiological hazards located in the GFFL that exceed the screening criteria.

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 3 chemical hazards 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 GFFL.

ERPGs are listed in the characterization below⁵² and are utilized in Section 6.0 to determine the toxicological 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. This methodology is described in detail in the Concentration Limit Hierarchy for Toxicological Accident Analysis,⁵³ and the ERPG equivalent calculations are depicted in Table 4.0-1. ERPGs are further discussed 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 Ammonium Hydroxide

- 2 gallons (7.57 liters) in room 10, temporary storage area
- 1 gallon (3.79 liters) in room 25

Ammonium hydroxide is a clear, colorless liquid solution of less than 44% ammonia. It is soluble in water. It is a human poison by ingestion and an experimental poison by inhalation and ingestion. It is a severe eye irritant. Mutation data has been reported. It is considered dangerous as the liquid can inflict burns.

Table 4.1-1

Ammonium Hydroxide Properties	
Molecular Weight	35.06
Specific Gravity	0.8974 @ 15.5° C
Boiling Point	27° C
Melting Point	-75° C
Density	0.90
Vapor Pressure	475 mmHg @ 15.5° C
OSHA PEL: TWA (for ammonia)	25 ppm
Published ERPG-1 (for ammonia)	25 ppm
Published ERPG-2 (for ammonia)	200 ppm
Published ERPG-3 (for ammonia)	1000 ppm

4.1.1 Conditions of Storage and Use

Ammonium hydroxide is stored in one gallon plastic containers. The containers are delivered to room ten of the GFFL until needed in room 25. There can be as much as two gallons (7.57 liters) temporarily stored in room ten. The ammonium hydroxide is hand carried in the DOT approved cardboard box from room ten to a metal cabinet with a ventilated hood in room 25. There can be as much as 1 gallon in room 25.

4.2 Hydrofluoric Acid

- 10 gallons (37.85 liters) in room 2
- 2 liters in room 10
- 1 liter in room 22
- 1 liter in room 25

Hydrofluoric acid is a human poison by inhalation. It is a poison experimentally by inhalation, subcutaneous and intraperitoneal routes. It is a corrosive irritant to skin, eyes, and mucous membranes. Mutation data has been reported. Inhalation of the vapor may cause ulcers of the upper respiratory tract. Concentrations of 50-250 ppm are dangerous, even for brief exposures. Hydrofluoric acid produces severe skin burns which are slow in healing. The subcutaneous tissues may be affected, becoming blanched and bloodless. Gangrene of the affected areas may follow. It is a common air contaminant.

Table 4.2-1

Hydrofluoric Acid Properties	
Molecular Weight	20.01
Melting Point	-83.1° C
Boiling Point	-19.54° C
Density	0.699 @ 22° C
Vapor Pressure	400 mm @ 2.5° C
OSHA PEL: TWA	3 ppm
Published ERPG-1	2 ppm
Published ERPG-2	20 ppm
Published ERPG-3	50 ppm

4.2.1 Conditions of Storage and Use

The hydrofluoric acid used in the GFFL are 49% and 5% solutions. The one liter containers of hydrofluoric acid (49%) are delivered to room ten of the GFFL. There can be as much as two liters of hydrofluoric acid (49%) temporarily stored in room ten. Once delivered to rooms 22 and/or 25, the hydrofluoric acid is stored in a DOT approved plastic cabinet. There can be as much as one liter in rooms 22 and 25. The ten gallons (37.85 liters) of hydrofluoric acid (2 gallons (7.57 liters) @ 49% and 8 gallons (30.28 liters) @ 5%) in room two are used in the hydrofluoric acid cleaning station.

4.3 Nitric Acid

- 2 gallons (7.57 liters) in room 10, temporary storage area
- 1 gallon (3.79 liters) in room 22
- 1 gallon (3.79 liters) in room 25

The nitric acid used in the GFFL is a 70% solution. Nitric acid is a transparent, colorless or yellowish, fuming, suffocating, caustic and corrosive liquid. Nitric acid is a human poison. It has experimental teratogenic and reproductive effects. It is corrosive to eyes, skin, mucous membranes, and teeth. Nitric acid causes upper respiratory irritation which may seem to clear up only to return in a few hours and more severely. Depending on environmental factors the vapor consists of a mixture of the various oxides of nitrogen and nitric acid. It is flammable by chemical reaction with reducing agents. Nitric acid is a powerful oxidizing agent. It will react with water or steam to produce heat and toxic and corrosive fumes. When heated to decomposition it emits highly toxic fumes of NO_x and hydrogen nitrate.

Table 4.3-1

Nitric Acid Properties	
Molecular Weight	63.02
Melting Point	-42° C
Boiling Point	86° C
Density	1.50269 @ 25° C
OSHA PEL: TWA	2 ppm
Draft ERPG-1	2 ppm
Draft ERPG-2	15 ppm
Draft ERPG-3	30 ppm

4.3.1 Conditions of Storage and Use

Nitric acid is stored in one gallon glass bottles. The bottles are delivered to room ten of the GFFL. There can be as much as two gallons (7.57 liters) temporarily stored in room ten, until needed in the appropriate laboratory. The nitric acid is hand carried in the DOT approved cardboard box from room ten to chemical storage cabinets in rooms 22 and 25. There can be as much as 1 gallon in rooms 22 and 25.

5.0 EVENT SCENARIOS

The barriers that maintain control over the chemicals described in Section 4.0 are analyzed in the following section. The following scenarios are based upon initiating events and failure modes which could impact the primary barriers of the previously described hazardous chemicals.

5.1 Chemical Event Scenarios

The chemical event scenarios listed below involve the breach of the following chemicals' primary barriers resulting in an unmitigated release to the environment. Two meteorological conditions are utilized in the following event scenarios.

- Delivery to GFFL
- Transfer to Lab
- Explosion

5.1.1 Ammonium Hydroxide

The ammonium hydroxide used in the GFFL is stored in one gallon plastic bottles. The plastic container is the primary barrier to be considered. Upon delivery to the GFFL, the ammonium hydroxide is first stored in room ten, prior to its transfer to a hooded cabinet in room 25.

5.1.1.1 Delivery (NH₄-1, NH₄-2)

During the delivery of two gallons (7.57 liters) of ammonium hydroxide to room ten of the GFFL, the containers could be inadvertently dropped. It is assumed that both containers are ruptured prior to reaching the GFFL creating an unmitigated release of two gallons (7.57 liters) of ammonium hydroxide to the environment.

5.1.1.2 Transfer (NH₄-3)

During the transfer of one gallon of ammonium hydroxide from room ten to room 25, it is assumed that the bottle is inadvertently dropped. It is assumed that the building integrity is maintained which would prevent an airborne release that would exceed an ERPG-1 beyond 30 meters. Hence, the meteorological conditions are not considered.

Table 5.1.1-1
Ammonium Hydroxide Release Designations

Scenario	Location of Chemical	Quantity Released	Meteorological Conditions	Release Designations
Ruptured bottles during delivery	South Dock	2 gallons (7.57 liters)	Worst case	NH ₄ -1
			Average	NH ₄ -2
Ruptured bottle during transfer	Inside GFFL	1 gallon (3.79 liters)	n/a	NH ₄ -3

5.1.2 Hydrofluoric Acid

The hydrofluoric acid used in the GFFL is stored in one liter and one gallon plastic containers. Therefore, the plastic container is the primary barrier to be considered. Upon delivery to the GFFL, the hydrofluoric acid that is utilized in rooms 22 and 25 are first stored in room ten, prior to its transfer to the appropriate laboratory. However, the hydrofluoric acid utilized in the hydrofluoric acid cleaning station is delivered directly to room two, on the west side of the GFFL.

5.1.2.1 Delivery (HF-1, HF-2)

During the delivery of two liters of hydrofluoric acid (49%) to room ten of the GFFL, the containers could be inadvertently dropped. It is assumed that both containers are ruptured prior to reaching the GFFL creating an unmitigated release of two liters of hydrofluoric acid to the environment.

5.1.2.2 Transfer (HF-3)

During the transfer of one liter of hydrofluoric acid (49%) from room ten to the appropriate laboratory, it is assumed that the bottle is inadvertently dropped. It is assumed that the building integrity is maintained which would prevent an airborne release that would exceed an ERPG-1 beyond 30 meters. Hence, the meteorological conditions are not considered.

5.1.2.3 Explosion (HF-4, HF-5)

The hydrofluoric acid cleaning station in room two utilizes ten gallons (37.85 liters) of hydrofluoric acid (two gallons (7.57 liters) @ 49% and eight gallons (30.28 liters) @ 5%). It is assumed that the hydrogen line in room five which is adjacent to room two is ruptured creating a leak and an explosion. It is assumed that the hydrofluoric acid cleaning station is negatively impacted, and the building integrity is compromised resulting in an unmitigated release of ten gallons (37.85 liters) of hydrofluoric acid to the environment.

Table 5.1.2-1
Hydrofluoric Acid Release Designations

Scenario	Location of Chemical	Quantity Released	Meteorological Conditions	Release Designations
Ruptured bottles during delivery	South Dock	2 liters	Worst case	HF-1
			Average	HF-2
Ruptured bottle during transfer	Inside GFFL	1 liter	n/a	HF-3
Explosion	Room Two	10 gallons (37.85 liters)	Worst case	HF-4
			Average	HF-5

5.1.3 Nitric Acid

The nitric acid (70%) used in the GFFL is stored in one gallon glass bottles. The glass bottle is the primary barrier to be considered. Upon delivery to the GFFL, the nitric acid is first stored in room ten, prior to its transfer to the appropriate laboratory.

5.1.3.1 Delivery (HNO₃-1, HNO₃-2)

During the delivery of two gallons (7.57 liters) of nitric acid to room ten of the GFFL, the containers could be inadvertently dropped. It is assumed that both containers are ruptured prior to reaching the GFFL creating an unmitigated release of two gallons (7.57 liters) of nitric acid to the environment.

5.1.3.2 Transfer (HNO₃-3)

During the transfer of one gallon of nitric acid from room ten to the appropriate laboratory, it is assumed that the bottle is inadvertently dropped. It is assumed that the building integrity is maintained which would prevent an airborne release that would exceed an ERPG-1 beyond 30 meters. Hence, the meteorological conditions are not considered.

Table 5.1.3-1
Nitric Acid Release Designations

Scenario	Location of Chemical	Quantity Released	Meteorological Conditions	Release Designations
Ruptured bottles during delivery	South Dock	2 gallons (7.57 liters)	Worst case	HNO ₃ -1
			Average	HNO ₃ -2
Ruptured bottle during transfer	Inside GFFL	1 gallon (3.79 liters)	n/a	HNO ₃ -3

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 its air model, ALOHA, were utilized for estimating the movement and dispersion of gases. 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.⁵⁴ 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 GFFL 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.

Six classes of atmospheric stability 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 Tables 5.1.1-1 through 5.1.3-1, 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*,⁵⁵ 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*.⁵⁶ 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).⁵⁷

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. 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 quantitatively evaluated for various onsite and offsite receptor locations. The demarcation between the onsite and offsite receptors is the TA-I fence line surrounding the GFFL. The closest distance from the GFFL to the TA-I fence is 100 meters, and this conservative distance is utilized in Table 6.4-1 in determining the emergency classification for each scenario. The distances depicted in Tables 6.3-1 and 6.3-2 are measured from the west side of the GFFL, and the concentrations are based upon the worst case scenario, release designation HF-4 (Hydrofluoric acid, 10 gallons, 37.85 liters).

Note: The concentrations associated with the receptor locations listed below should be compared to the following published ERPG exposure levels for hydrogen fluoride:

ERPG-1 = 2 ppm
ERPG-2 = 20 ppm
ERPG-3 = 50 ppm

**Table 6.3-1
Onsite Receptors**

Onsite Receptor (Within TA-I Fence)	Distance from W. Side of GFFL (m)	Population	Concentration * (ppm)
Building 841	31	25	118
Building 865	42	20	65.3
M 55	80	5	18.4
SNL/NM EOC	320	20	1.25

* Based upon worst case scenario, release designation HF-4 (Hydrofluoric acid, 10 gallons, 37.85 liters)

**Table 6.3-2
Offsite Receptors**

Offsite Receptor (Outside TA-I Fence)	Distance from W. Side of GFFL (m)	Population	Concentration * (ppm)
Gate 6 (east of 864)	126	2	7.57
Gate 4 (northwest of 864)	263	2	1.82
Building 831, Medical	274	30	1.68
Gate 1 (west of 864)	305	2	1.37

* Based upon worst case scenario, release designation HF-4 (Hydrofluoric acid, 10 gallons, 37.85 liters).

6.4 Summary of Consequences

As shown in Table 6.4-1, the greatest distances at which an ERPG-2 is reached is 96 meters. This distance is derived from the worst case scenario, release designation HF-4 (10 gallons of hydrofluoric acid, 37.85 liters). The greatest GFFL emergency classification is a site area emergency.

Table 6.4-1

Summary of Consequences						
Release Designation	Maximum Concentration at		Maximum Distance to		Possible/Probable EAL(s) *	Emergency Event Classification
	Facility Boundary at 30 m (ppm)	Site Boundary at 100 m (ppm)	ERPG-2 (meters)	ESHE (meters)		
NH ₄ -1	1,070	99	70	31	Breach of 2 bottles (2 gallons - w.c. met)	site
NH ₄ -2	58.2	5.29	16	<10	Breach of 2 bottles (2 gallons - avg. met)	alert
NH ₄ -3	<25	<25	<10	<10	Breach of 1 bottle (1 gallon)	n/a
HF-1	35.7	3.31	40	25	Breach of 2 bottles (2 liters - w.c. met)	site
HF-2	0.7	0.06	< 10	< 10	Breach of 2 bottles (2 liters - avg. met)	n/a
HF-3	<2	<2	< 10	< 10	Breach of 1 bottle (1 liter)	n/a
HF-4	193	18.3	96	60	Breach of HF cleaning station (10 gallons)	site
HF-5	3.41	0.3	13	<10	Breach of HF cleaning station (10 gallons)	alert
HNO ₃ -1	59.9	5.67	61	43	Breach of 2 bottles (2 gallons - w.c. met)	site
HNO ₃ -2	2.06	0.185	11	<10	Breach of 2 bottles (2 gallons - avg. met)	alert
HNO ₃ -3	<2	<2	<10	<10	Breach of 1 bottle (1 gallon)	n/a

* There aren't any quantifiable detection methods to confirm that actual releases occurred 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.⁵⁸

Note: w.c. met. = worst case meteorological conditions
avg. met. = average meteorological conditions

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 a geographic area surrounding a specific DOE facility for which special planning and preparedness efforts are carried out to ensure that prompt and effective actions can be taken to reduce or minimize the impact to onsite personnel, public health and safety, and the environment in the event of an Operational Emergency.

7.1 The Minimum EPZ Radius

As can be seen from the data in Table 6.4-1, 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 60 meters (Release Designation HF-4). 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 the GFFL is 100 meters. The nominal 100 meter EPZ follows physical boundaries and is depicted in Illustration 7.1.1-1.

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 100 meter EPZ. As shown in table 6.4-1, the maximum distance for the ERPG-2 is 96 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 100 meter EPZ encompasses building 864 and all routes leading to it. Communication between emergency planning and safeguards and security organizations has been established. Emergency personnel are able to respond to events without interference from uninvolved people and activity, facilitate onsite protective actions, and optimize on-scene command, control, and mitigation efforts.

Illustration 7.1.1-1 GFL EPZ

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 100 meter EPZ conforms to jurisdictional boundaries as it follows the TA-I fence where plausible. The 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.

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 impact is anticipated. Declaration of an alert requires the availability of personnel and resources to:

- Provide continuous 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 liaison 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 South Dock Events and EALs

The consequence analysis performed in Section 6.0 identified the following conditions which could precipitate a site or alert emergency classification involving the delivery of chemicals to the south dock of the GFFL.

8.2.1 Site Area Emergency EAL

From the analyses in Section 6.0, the following EAL is identified for the site area emergency class as a result of a GFFL south dock event:

- Any condition which could breach, puncture or rupture the container of one of the following three chemicals on the south dock with a direct release to the atmosphere in worst case meteorological conditions:

Ammonium Hydroxide
Hydrofluoric Acid
Nitric Acid

Basis: In the event that the container of one of the above mentioned chemicals is breached on the south dock of the GFFL, a direct release to the environment is assumed. Since no mitigating barriers exist, and there are no means of quantifying the release in the time within which action is needed to protect personnel, the entire contents is assumed to be spilled.

8.2.2 Alert Emergency EAL

From the analyses in Section 6.0, the following EAL is identified for the alert emergency class as a result of a GFFL south dock event:

- Any condition which could breach, puncture or rupture the container of one of the following two chemicals on the south dock with a direct release to the atmosphere in average meteorological conditions:

Ammonium Hydroxide
Nitric Acid

Basis: As mentioned in Section 8.2.1, no mitigating barriers exist on the south dock and a direct release to the environment is assumed for ammonium hydroxide and nitric acid. However, in average meteorological conditions, the consequences would not be as severe, and conditions would not constitute an emergency classification greater than an alert for the release of the two above mentioned chemicals.

8.2.3 Protective Actions

In the event of a chemical release on the south dock, as described above, the immediate area should be evacuated. Sheltering in place for the remaining of the GFFL is the immediate protective action of choice.

8.3 Room Two Events and EALs

8.3.1 Site Area Emergency EAL

From the analyses in Section 6.0, the following EAL is identified for the Site Area Emergency class as a result of a room two event:

- Any condition which could breach, puncture or rupture the primary and secondary barriers of the following chemical in room two with a direct release to the atmosphere in worst case meteorological conditions:

Hydrofluoric Acid

Basis: In the event that the primary and secondary barriers associated with the above mentioned chemical are impacted in room two, and the integrity of the building is compromised (such as through an explosion), a direct release to the environment is assumed. With the loss of the building integrity, there are no means of quantifying the release in the time within which action is needed to protect personnel. Therefore, the entire contents of hydrofluoric acid within room two is assumed to be released.

8.3.2 Alert Emergency EAL

From the analyses in Section 6.0, the following EAL is identified for the alert emergency class as a result of a GFFL south dock event:

- Any condition which could breach, puncture or rupture the container of one of the following chemical in room two with a direct release to the atmosphere in average meteorological conditions:

Hydrofluoric Acid

Basis: As mentioned in Section 8.3.1, the building integrity is compromised (such as through an explosion), and a direct release to the environment is assumed. However, in average meteorological conditions, the consequences would not be as severe, and conditions would not constitute an emergency classification greater than an alert for the release of hydrofluoric acid.

8.3.3 Protective Actions

In the event of a chemical release in room two and the building integrity is compromised, as described above, the entire building should be evacuated. Sheltering in place for the surrounding buildings is the protective action of choice.

8.4 GFFL Spills

If there were a spill within the GFFL of one liter of hydrofluoric acid, one gallon of ammonium hydroxide, one gallon of nitric acid, or greater, the personnel within the GFFL would evacuate the building to a gathering point on the northwest corner of the building. Spills of this nature do not constitute an emergency classification.

8.5 Response

The emergency response personnel in the SNL Emergency Operations Center (EOC) will ensure prompt notification of the DOE Kirtland Area Office (DOE-KAO) Duty Officer and ensure that the coordinated actions of the Sandia and DOE Emergency plans are initiated. Sandia EOC cadre will initiate consequence assessment and recommend to DOE-KAO protective action guidance.

The DOE-KAO Duty Officer will establish and maintain contact with offsite agencies such as KAFB, City of Albuquerque, State of New Mexico and the Isleta Pueblo. DOE-KAO is responsible for the notification to 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 declare the emergency to be in the recovery mode, establish a recovery team, and when conditions warrant, recommend termination of the emergency.

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 responsibility 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.

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Appendix A

GFFL ChemMaster Inventory

NOTE: The following list of chemicals is derived from the SNL/NM ChemMaster Inventory.
The quantities herein are listed in various units, as listed in ChemMaster.

SNL/NM Hazards Project

HA Required : YES Number of Chemicals: 359

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MGTY	SCR CRIT
1-BROMONAPHTHALENE, 1- IODONAPHTHALENE	864/5B	L	(ml)	30	<1 LB.
75 REPOSITIONABLE ADHESIVE (1PD)	864/5A	L	(ozf)	16.5	SIH
76 HIGH TACK ADHESIVE (1PA)	864/5A	L	(ozf)	16.5	SIH
90 HIGH STRENGTH ADHESIVE (1PA)	864/5A	L	(ozf)	16.5	SIH
ACRYLIC ADHESIVE	864/5A	L	(ozf)	8	SIH
ACTIVATED ALUMINA	864/25	S	(ozd)	14	<1 LB.
ALCONOX	864/22	S	(lb)	8	NON-DISPERSIBLE
ALCONOX	864/5A	S	(lb)	24	NON-DISPERSIBLE
ALIPHATIC HYDROCARBONS, HYDROGENATED TERPHENYL	864/5B	L	(ml)	30	SIH
ALUMINA, ACTIVATED	864/02	S	(lb)	1	<1 LB.
ALUMINUM CHLORIDE	864/25	S	(g)	500	<1 LB.
ALUMINUM FLUORIDE	864/02	S	(g)	3000	BP > 100 C

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
ALUMINUM FLUORIDE ANHYDROUS	864/02	S	(g)	500	BP > 100 C
ALUMINUM HYDROXIDE	864/02	S	(g)	2000	NON-DISPERSIBLE
ALUMINUM HYDROXIDE	864/25	S	(g)	500	<1 LB.
ALUMINUM HYDROXIDE	864/5A	S	(g)	500	<1 LB.
ALUMINUM METAPHOSPHATE	864/02	S	(kg)	5	NON-DISPERSIBLE
ALUMINUM OXIDE	864/02	S	(kg)	4	NON-DISPERSIBLE
ALUMINUM OXIDE	864/02	S	(kg)	6	NON-DISPERSIBLE
ALUMINUM OXIDE	864/2	S	(kg)	216	NON-DISPERSIBLE
ALUMINUM OXIDE	864/Q Y/RD	S	(kg)	3	NON-DISPERSIBLE
ALUMINUM OXIDE	864/Q/YAR	S	(kg)	3	NON-DISPERSIBLE
ALUMINUM PHOSPHATE	864/02	S	(lb)	5	NON-DISPERSIBLE
ALUMINUM PHOSPHATE	864/02	S	(kg)	4	NON-DISPERSIBLE
ALUMINUM PHOSPHATE PURATRONIC	864/Q Y/RD	S	(g)	250	<1 LB.
ALUMINUM S-BUTOXIDE	864/25	L	(g)	500	<1 LB.
ALUMINUM TRIHYDROXIDE	864/02	S	(lb)	7.5	NON-DISPERSIBLE
ALUNDUM	864/25	S	(lb)	25	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MGTY	SCR CRIT
AMMONIUM BIFLUORIDE	864/02	S	(g)	1500	NON-DISPERSIBLE
AMMONIUM DIHYDROGEN PHOSPHATE	864/02	S	(kg)	4	NON-DISPERSIBLE
AMMONIUM FLUORIDE	864/02	S	(g)	1000	BP > 100 C
AMMONIUM HYDROXIDE	864/22	L	(gal)	0	<1 LB.
AMMONIUM HYDROXIDE	864/25	L	(gal)	1	KEEP
AMMONIUM HYDROXIDE	864/10	L	(gal)	2	KEEP
AMMONIUM PHOSPHATE	864/02	S	(g)	7000	NON-DISPERSIBLE
AMMONIUM SULFATE	864/02	S	(g)	500	<1 LB.
AMYL ACETATE	864/22	L	(ml)	1000	BP > 100 C
AMYL ACETATE	864/5A	L	(ml)	4500	BP > 100 C
ANTIMONY OXIDE	864/02	S	(lb)	1	<1 LB.
APIEZON GREASE TYPE H	864/22	S	(g)	75	SIH
APIEZON GREASE TYPE N	864/22	S	(g)	275	SIH
APIEZON GREASE TYPE T	864/22	S	(g)	25	SIH
APIEZON H	864/25	L	(g)	25	SIH
APIEZON N	864/25	L	(g)	75	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
AQUADAG	864/5A	L	(qt)	1	BP > 100 C
ARSENIC TRIOXIDE	864/02	S	(g)	300	<1 LB.
BARIUM ACETATE	864/25	S	(kg)	2	NON-DISPERSIBLE
BARIUM BROMIDE	864/02	S	(g)	2000	NON-DISPERSIBLE
BARIUM BROMIDE ANHYDROUS	864/02	S	(g)	250	<1 LB.
BARIUM CARBONATE	864/02	S	(kg)	5	NON-DISPERSIBLE
BARIUM CARBONATE	864/02	S	(kg)	18	NON-DISPERSIBLE
BARIUM FLUORIDE	864/02	S	(g)	3000	NON-DISPERSIBLE
BARIUM HYDROXIDE	864/25	S	(lb)	1	<1 LB.
BARIUM NITRATE	864/02	S	(lb)	40	NON-DISPERSIBLE
BARIUM SULFATE	864/02	S	(lb)	2	NON-DISPERSIBLE
BASIC ALUMINA AG-10	864/02	S	(lb)	2	NON-DISPERSIBLE
BENTONITE (PURIFIED)	864/5A	S	(g)	500	<1 LB.
BEST TEST PAPER CEMENT	864/5A	S	(ozf)	16	SIH
BIPHENYL	864/02	S	(kg)	1	NON-DISPERSIBLE
BIS(2-ETHYLHEXANOATE)TIN	864/25	L	(g)	100	<1 LB.

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
BLOW HARD	864/11	L	(ozd)	12	<1 LB.
BN SLIP MOLD RELEASE COMPOUND	864/02	L	(qt)	1	SIH
BOELUBE	864/02	S	(ozd)	5	SIH
BORIC ACID	864/01	S	(lb)	200	NON-DISPERSIBLE
BORIC ACID	864/25	S	(g)	1000	NON-DISPERSIBLE
BORIC ACID	864/Q/YAR	S	(kg)	114	NON-DISPERSIBLE
BORIC ANHYDRIDE	864/02	S	(g)	2500	NON-DISPERSIBLE
BORIC ANHYDRIDE	864/Q Y/RD	S	(g)	12000	NON-DISPERSIBLE
BORON NITRIDE SPRAY	864/22	L	(ozf)	16	<1 LB.
BORON OXIDE	864/02	S	(g)	1000	NON-DISPERSIBLE
BORON OXIDE, ANHYDROUS	864/02	S	(g)	500	<1 LB.
BRIGHT GOLD	864/5A	L	(g)	200	SIH
CALCIUM BROMIDE	864/02	S	(g)	500	<1 LB.
CALCIUM CARBONATE	864/02	S	(g)	6500	NON-DISPERSIBLE
CALCIUM CARBONATE	864/2	S	(g)	2000	NON-DISPERSIBLE
CALCIUM FLUORIDE	864/02	S	(g)	3500	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MGTY	SCR CRIT
CALCIUM FLUOROSILICATE	864/02	S	(g)	1000	NON-DISPERSIBLE
CALCIUM PHOSPHATE MONOBASIC	864/02	S	(kg)	1.5	NON-DISPERSIBLE
CALCIUM SULFATE, INDICATING	864/25	S	(lb)	15	NON-DISPERSIBLE
CARBON DIOXIDE	864/GH	G	(gcf)	243	SIH
CARGILLE IMMERSION FLUID	864/22	L	(gal)	1	SIH
CARGILLE IMMERSION FLUID	864/22	L	(gal)	3	SIH
CHLOROPLATINIC ACID	864/23A	L	(g)	14	<1 LB.
CHROMIC ACID	864/22	L	(l)	1	SIH
CHROMIUM OXIDE	864/02	S	(g)	1500	NON-DISPERSIBLE
CHROMIUM SESQUIOXIDE	864/02	S	(lb)	5	NON-DISPERSIBLE
CLEANING GLASS	864/02	S	(lb)	10	SIH
COBALT OXIDE	864/02	S	(lb)	5	NON-DISPERSIBLE
COLLOIDAL CERIA ACETATE	864/25	L	(oth)	1	BP > 100 C
COLLOIDAL YTTRIA	864/25	L	(oth)	1	BP > 100 C
CUPRIC OXIDE	864/02	S	(g)	2000	NON-DISPERSIBLE
CUPROUS OXIDE	864/02	S	(g)	750	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
D-GLUCOSE ANHYDROUS	864/02	S	(lb)	9	NON-DISPERSIBLE
DAG 154	864/5A	L	(pt)	6	SIH
DEXTROSE	864/02	S	(lb)	5	SIH
DIBUTYL TIN DIACETATE	864/25	L	(kg)	2	BP > 100 C
DIODOIMETHANE/SULFUR	864/5B	L	(ml)	30	<1 LB.
DIODOMETHANE METHYLENE INDIDE	864/5B	L	(ml)	30	<1 LB.
DIPHENYLDIETHOXYSILANE	864/25	L	(g)	250	<1 LB.
DRIERITE	864/02	S	(lb)	10	SIH
DYCLEAN II	864/25	L	(gal)	1	SIH
ENAMEL SPRAY PAINT	864/5A	L	(ozf)	12	SIH
EPOWELD 8173B	864/02	L	(g)	492	SIH
EPOXI-PATCH EPOXY RESIN	864/22	L	(ozd)	4	SIH
EPOXY RESIN	864/5A	L	(gal)	1	SIH
EPOXY, EXTRA FAST SETTING, COLE PARMER	864/25	L	(g)	42	SIH
ERBIUM ISOPROPOXIDE	864/25	L	(ml)	100	<1 LB.
ETHYL ALCOHOL	864/25	L	(l)	6	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
ETHYL ALCOHOL	864/26	L	(gal)	5	SIH
ETHYL ALCOHOL, DENATURED	864/25	L	(l)	1	SIH
ETHYLENE GLYCOL	864/25	L	(l)	1	BP > 100 C
ETHYLENE GLYCOL	864/5A	L	(qt)	1	BP > 100 C
ETHYLENE GLYCOL	864/Q Y/RD	L	(gal)	20	BP > 100 C
EU-2	864/25	S	(lb)	2	SIH
FERRIC CHLORIDE	864/02	S	(g)	500	<1 LB.
FERRIC OXIDE	864/02	S	(kg)	3	NON-DISPERSIBLE
FIBRMET	864/22	L	(pt)	0.5	<1 LB.
FLUORINERT (FC-43)	864/22	L	(lb)	30	NON-TOXIC
FOMBLIN PERFLUORO POLYETHER	864/25	L	(kg)	6	SIH
FORMIC ACID	864/25	L	(ml)	500	<1 LB.
FORMIC ACID	864/25	L	(pt)	1	BP > 100 C
FORMING GAS	864/GH	G	(gcf)	224	<1 LB.
GALLIUM FLUORIDE	864/02	S	(g)	200	<1 LB.
GALLIUM OXIDE	864/02	S	(kg)	3	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
GAUNIDINE HYDROCHLORIDE	864/25	S	(g)	500	<1 LB.
GERMANIUM OXIDE	864/02	S	(kg)	10	NON-DISPERSIBLE
GLYCERIN	864/22	L	(qt)	3	BP > 100 C
GLYCERIN	864/22	L	(ml)	500	BP > 100 C
GLYCERIN	864/25	L	(qt)	1	BP > 100 C
GLYCERIN	864/5A	L	(qt)	1	BP > 100 C
GUANIDINE CARBONATE	864/25	S	(kg)	1	NON-DISPERSIBLE
GUM TRAGACANTH	864/25	S	(g)	500	SIH
GUM TRAGACANTH	864/5A	S	(kg)	3	SIH
GUM TRAGACANTH	864/5A	S	(ozd)	16	SIH
HAFNIUM ETHOXIDE	864/25	S	(g)	25	<1 LB.
HAFNIUM ETHYLHEXANE-T- BUTOXIDE	864/25	L	(ml)	100	<1 LB.
HAFNIUM PENTANEDIONATE	864/25	S	(g)	10	<1 LB.
HAFNIUM TERT-BUTOXIDE	864/25	L	(ml)	200	<1 LB.
HANOVIA LIQUID BRIGHT PLATINUM	864/5A	L	(g)	300	SIH
HELIUM	864/22	G	(gcf)	219	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
HELIUM	864/GH	G	(gcf)	243	SIH
HELIUM	864/GH	G	(gcf)	438	SIH
HELIUM GAS	864/GAS	G	(gcf)	486	SIH
HEXANES	864/25	L	(l)	1	< ERPG-1 AT 30 M.
HIGH VACUUM GREASE, DOW CORNING	864/25	L	(g)	150	SIH
HYDROCHLORIC ACID	864/22	L	(gal)	1	SIH
HYDROCHLORIC ACID	864/22	L	(ml)	500	SIH
HYDROCHLORIC ACID	864/25	L	(ml)	500	SIH
HYDROFLUORIC ACID (49%)	864/22	L	(l)	1	KEEP
HYDROFLUORIC ACID (49%)	864/25	L	(l)	1	KEEP
HYDROFLUORIC ACID (49%)	864/S	L	(l)	2	KEEP
HYDROFLUORIC ACID (49%)	864/W	L	(gal)	2	KEEP
HYDROFLUORIC ACID (5%)	864/W	L	(gal)	8	KEEP
HYDROFLUOROSILICIC ACID 23-25%	864/SW	L	(gal)	2	SIH
HYDROFLUOROSILICIC ACID 30-32%	864/22	L	(lb)	10	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
HYDROGEN SULFIDE, PERMEATION DEVICE	864/25	G	(g)	5	<1 LB.
HYDROGENATED TERPHENYL, 1- BROMONAPHTHALENE	864/5B	L	(ml)	30	<1 LB.
HYDROGENATED TERPHENYL, 1- BROMONAPHTHALENE	864/5B	L	(ml)	30	<1 LB.
HYDROGENATED TERPHENYL, 1- BROMONAPHTHALENE	864/5B	L	(ml)	30	<1 LB.
HYDROGENATED TERPHENYL, 1- BROMONAPHTHALENE	864/5B	L	(ml)	30	<1 LB.
HYDROGENATED TERPHENYL, DIIODOMETHANE	864/5B	L	(ml)	30	<1 LB.
IMMERSION LIQUID CODE 40BN	864/22	L	(ozf)	16	<1 LB.
IMMERSION LIQUID CODE BNDN	864/22	L	(ozf)	16	<1 LB.
INDIUM III 2,4- PENTANEDIONATE	864/25	S	(g)	10	<1 LB.
KRYLON PAINT	864/5A	L	(ozf)	12	SIH
LACQUER THINNER	864/22	L	(gal)	1	SIH
LANTHANUM OXIDE	864/02	S	(g)	750	NON-DISPERSIBLE
LANTHANUM OXIDE	864/2	S	(g)	1500	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
LANTHANUM OXIDE	864/2	S	(g)	2000	NON-DISPERSIBLE
LATEX MICROSPHERES	864/25	L	(ml)	100	<1 LB.
LATEX MICROSPHERES	864/25	L	(ml)	100	<1 LB.
LATEX MICROSPHERES, CARBOYLATED	864/25	L	(ml)	100	<1 LB.
LEAD BROMIDE	864/02	S	(g)	400	<1 LB.
LEAD BROMIDE	864/02	S	(g)	500	<1 LB.
LEAD CHLORIDE	864/02	S	(g)	200	<1 LB.
LEAD CHLORIDE	864/02	S	(g)	500	<1 LB.
LEAD FLUORIDE	864/02	S	(g)	500	<1 LB.
LEAD OXIDE	864/02	S	(g)	1000	NON-DISPERSIBLE
LEAD OXIDE	864/02	S	(kg)	2	NON-DISPERSIBLE
LEPAGE RUBBER CEMENT	864/5A	L	(ozf)	8	SIH
LIQUI-NOX	864/22	L	(qt)	3	SIH
LIQUID BRIGHT GOLD	864/5A	L	(g)	100	SIH
LITHIUM CARBONATE	864/02	S	(lb)	5	NON-DISPERSIBLE
LITHIUM CARBONATE	864/Q Y/RD	S	(lb)	10	NON-TOXIC

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
LITHIUM FLUORIDE	864/02	S	(g)	2000	NON-DISPERSIBLE
LITHIUM PHOSPHATE	864/02	S	(kg)	11	NON-DISPERSIBLE
LITHIUM PHOSPHATE	864/02	S	(kg)	10	NON-DISPERSIBLE
LITHIUM SULFATE	864/02	S	(kg)	1	NON-DISPERSIBLE
LITHIUM SULFATE	864/Q Y/RD	S	(kg)	8	NON-DISPERSIBLE
LITHIUM SULFATE MONOHYDRATE	864/02	S	(g)	2000	NON-DISPERSIBLE
LITHIUM SULFATE MONOHYDRATE	864/2	S	(g)	5000	NON-DISPERSIBLE
MACCO CONTACT CEMENT	864/5A	S	(ozf)	16	SIH
MAGNESIUM CARBONATE	864/02	S	(lb)	45	NON-DISPERSIBLE
MAGNESIUM CARBONATE	864/Q Y/RD	S	(lb)	90	NON-DISPERSIBLE
MAGNESIUM OXIDE	864/02	S	(g)	500	<1 LB.
MAGNESIUM SULFATE	864/02	S	(lb)	1	<1 LB.
MANGANESE DIOXIDE	864/02	S	(lb)	20	NON-DISPERSIBLE
MANGANESE MONOXIDE	864/2	S	(kg)	2	NON-DISPERSIBLE
MASTER BOND EPOXY SYSTEM HARDENER	864/5A	S	(qt)	1	SIH
MASTER BOND EPOXY SYSTEM RESIN	864/5A	S	(qt)	1	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
MERCURIC CHLORIDE	864/02	S	(lb)	1	NON-DISPERSIBLE
METADI DIAMOND PASTE	864/22	S	(g)	160	SIH
METADI FLUID	864/22	L	(qt)	2	SIH
METALLO ORGANIC BRIGHT PLATINUM INK	864/5A	L	(g)	75	SIH
METALLO ORGANIC GOLD INK	864/5A	L	(g)	30	SIH
METHANOL	864/22	L	(l)	4	< ERPG-1 AT 30 M.
METHYL ETHYL KETONE	864/5A	L	(qt)	1	< ERPG-1 AT 30 M.
METHYLTRIMETHOXYSILANE	864/25	L	(g)	250	<1 LB.
MIROMET	864/22	L	(ozf)	12	<1 LB.
N-BUTYL ACETATE	864/5A	L	(qt)	1	BP > 100 C
N-BUTYL TIN HYDROXIDE OXIDE	864/25	S	(g)	100	<1 LB.
NICKEL OXIDE	864/02	S	(lb)	5	NON-DISPERSIBLE
NICKEL OXIDE	864/02	S	(kg)	1	NON-DISPERSIBLE
NIOBIUM OXIDE	864/02	S	(kg)	10	NON-DISPERSIBLE
NIOBIUM PENTOXIDE	864/02	S	(g)	500	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
NITRIC ACID (70%)	864/22	L	(gal)	1	KEEP
NITRIC ACID (70%)	864/25	L	(gal)	1	KEEP
NITRIC ACID (70%)	864/S	L	(gal)	2	KEEP
NITROGEN	864/GH	G	(gcf)	460	SIH
NITROGEN DIOXIDE, PERMEATION DEVICE	864/25	L	(g)	5	<1 LB.
OAKITE ALUMINUM CLEANER NST	864/21	L	(l)	1	SIH
OAKITE DEOXIDIZER SS	864/22	L	(l)	1	SIH
OIL BASE FLOOR SWEEP	864/02	S	(lb)	25	SIH
OPTICALLY CLEAR UV ADHESIVE	864/5A	L	(ozf)	8.5	SIH
OXALIC ACID	864/25	S	(g)	500	<1 LB.
PARAFIN OIL	864/25	L	(l)	1	SIH
PELDRI II	864/25	S	(g)	500	<1 LB.
PHENYLTRIETHOXYSILANE	864/25	L	(g)	250	<1 LB.
PHENYLTRIMETHOXYSILANE	864/25	L	(g)	250	<1 LB.
PHOSPHOR, ZINC OXIDE	864/25	S	(g)	500	<1 LB.
POLY-SCRUB (HAND CLEANER)	864/5A	L	(pt)	2	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
POTASSIUM CARBONATE	864/Q Y/RD	S	(g)	1000	NON-DISPERSIBLE
POTASSIUM CHLORIDE	864/2	S	(kg)	3	NON-DISPERSIBLE
POTASSIUM DICHROMATE	864/02	S	(g)	1000	NON-DISPERSIBLE
POTASSIUM HYDROXIDE	864/2	S	(g)	1000	NON-DISPERSIBLE
POTASSIUM HYDROXIDE	864/25	S	(lb)	1	<1 LB.
POTASSIUM METAPHOSPHATE	864/02	S	(g)	2000	NON-DISPERSIBLE
POTASSIUM NITRATE	864/02	S	(kg)	6	NON-DISPERSIBLE
POTASSIUM NITRATE	864/22	S	(lb)	1	<1 LB.
POTASSIUM NITRATE	864/Q Y/RD	S	(kg)	3	NON-DISPERSIBLE
POTASSIUM NITRATE	864/Q Y/RD	S	(lb)	3	NON-DISPERSIBLE
POTASSIUM PHOSPHATE DIBASIC	864/02	S	(g)	2000	NON-DISPERSIBLE
POTASSIUM PHOSPHATE DIBASIC TRIHYDRATE	864/02	S	(g)	500	<1 LB.
POTASSIUM PHOSPHATE MONOBASIC	864/02	S	(g)	8000	NON-DISPERSIBLE
QUINIDINE SULFATE	864/02	S	(g)	100	<1 LB.
RED LACQUER STOP-OFF	864/22	L	(pt)	1	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
REFRACTOMETER LIQUID 1.80+	864/9	L	(oth)	30	SIH
REFRACTORY LIQUID 1.57 - 1.656	864/9	L	(oth)	30	SIH
REFRACTORY LIQUID 1.657 - 1.700	864/9	L	(oth)	30	SIH
SAMARIUM ISOPROPOXIDE	864/25	L	(ml)	100	<1 LB.
SCOTCH CLAD STRIP COATING 2253	864/5A	L	(gal)	1	SIH
SILICAN DIOXIDE	864/2	S	(lb)	960	NON-DISPERSIBLE
SILICAN DIOXIDE	864/Q/YAR	S	(lb)	480	NON-DISPERSIBLE
SILICON DIOXIDE	864/SHED	S	(lb)	120	NON-DISPERSIBLE
SILICON DIOXIDE (ALPHA QUARTZ)	864/5A	S	(kg)	18	NON-DISPERSIBLE
SILOXIDE ETCHANT	864/22	L	(gal)	4	SIH
SILVER ACETATE	864/02	S	(g)	100	<1 LB.
SILVER CARBONATE	864/02	S	(g)	500	<1 LB.
SILVER NITRATE	864/02	S	(lb)	0.3	<1 LB.
SILVER NITRATE	864/02	S	(g)	113	<1 LB.
SILVER OXIDE	864/02	S	(g)	700	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
SILVER PHOSPHATE	864/02	S	(g)	125	<1 LB.
SIMICHROME POLISH	864/22	S	(ozd)	1.8	SIH
SODIUM ACETATE	864/25	S	(kg)	2	NON-DISPERSIBLE
SODIUM BICARBONATE	864/02	S	(g)	5000	SIH
SODIUM BORATE DECAHYDRATE	864/2	S	(kg)	40	NON-DISPERSIBLE
SODIUM BOROHYDRIDE	864/02	S	(g)	60	<1 LB.
SODIUM CARBONATE	864/02	S	(lb)	80	NON-DISPERSIBLE
SODIUM CARBONATE ANHYDROUS	864/02	S	(kg)	2	NON-DISPERSIBLE
SODIUM CARBONATE ANHYDROUS	864/2	S	(kg)	30	NON-DISPERSIBLE
SODIUM CHLORIDE	864/02	S	(kg)	3	NON-DISPERSIBLE
SODIUM FLUORIDE	864/02	S	(lb)	1	<1 LB.
SODIUM FLUORIDE	864/02	S	(g)	1000	<1 LB.
SODIUM FLUOROSILICATE	864/02	S	(kg)	1	NON-DISPERSIBLE
SODIUM HEXAMETAPHOSPHATE	864/02	S	(kg)	30	NON-DISPERSIBLE
SODIUM HYDROXIDE	864/25	S	(lb)	2	NON-DISPERSIBLE
SODIUM HYPOPHOSPHITE	864/02	S	(lb)	8	NON-DISPERSIBLE

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
SODIUM METASILICATE	864/Q Y/RD	S	(lb)	10	NON-TOXIC
SODIUM NITRATE	864/02	S	(lb)	12	NON-DISPERSIBLE
SODIUM NITRITE	864/02	S	(lb)	6	NON-DISPERSIBLE
SODIUM NITRITE	864/5A	S	(g)	500	NON-TOXIC
SODIUM PHOSPHATE DIBASIC ANHYDROUS	864/02	S	(g)	6000	NON-DISPERSIBLE
SODIUM PHOSPHATE MONOBASIC	864/02	S	(kg)	21	NON-DISPERSIBLE
SODIUM PHOSPHATE, DI BASIC	864/25	S	(lb)	1	<1 LB.
SODIUM SILICATE SOLUTION	864/25	L	(l)	1	NON-TOXIC
SODIUM SILICATE SOLUTION	864/5A	L	(l)	1	NON-TOXIC
SODIUM SULFATE	864/2	S	(kg)	3	NON-DISPERSIBLE
SODIUM TETRABORATE DECAHYDRATE	864/02	S	(kg)	20	NON-DISPERSIBLE
SPAN 80	864/22	L	(lb)	8	SIH
SPRAY MOUNT ARTISTS ADHESIVE	864/5A	L	(ozf)	13.5	SIH
SS WHITE ABRASIVE POWDER #3	864/5A	S	(lb)	88	SIH
STANNIC CHLORIDE ANHYDR	864/5A	L	(pt)	1	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
OUS					
STANNOUS CHLORIDE	864/02	S	(lb)	1	<1 LB.
STRONTIUM CARBONATE	864/02	S	(kg)	20	NON-DISPERSIBLE
STRONTIUM CARBONATE	864/Q Y/RD	S	(lb)	25	NON-DISPERSIBLE
SULFURIC ACID	864/22	L	(l)	10	SIH
SULFURIC ACID	864/25	L	(ml)	500	SIH
TELLURIUM ISOPROPOXIDE	864/25	L	(ml)	100	<1 LB.
TELLURIUM OXIDE	864/02	S	(g)	1000	NON-DISPERSIBLE
TELLURIUM TERT-BUTOXIDE	864/25	L	(ml)	100	<1 LB.
TETRA ETHOXY SILANE	864/25	L	(g)	1125	BP > 100 C
TETRA-T-BUTOXY TIN	864/25	L	(g)	25	<1 LB.
THIN FILM CLEANER	864/25	L	(ozf)	15	SIH
THREE IN ONE OIL	864/22	L	(ozd)	4	SIH
TIN (IV) ISOPROPOXIDE	864/25	L	(ml)	100	<1 LB.
TIN (IV) TERT-AMYLOXIDES	864/25	L	(ml)	100	<1 LB.
TIN DIOXIDE	864/02	S	(g)	3000	NON-DISPERSIBLE
TIN II ETHOXIDE	864/25	S	(g)	10	<1 LB.

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
TIN II OXALATE	864/25	S	(g)	100	<1 LB.
TITANIUM DIOXIDE	864/02	S	(lb)	25	NON-DISPERSIBLE
TITANIUM DIOXIDE	864/02	S	(lb)	2	NON-DISPERSIBLE
TITANIUM DIOXIDE	864/2	S	(g)	5000	NON-DISPERSIBLE
TITANIUM ETHOXIDE	864/25	L	(g)	400	<1 LB.
TITANIUM ETHOXIDE	864/25	L	(g)	250	<1 LB.
TOLUENE	864/5A	L	(qt)	1	BP > 100 C
TORR SEAL, LOW VAPOR PRESSURE RESIN, HARDNER	864/22	L	(ozf)	5.6	SIH
TORR SEAL, LOW VAPOR PRESSURE RESIN, HARDNER	864/25	L	(ozf)	14	SIH
TORR SEAL, LOW VAPOR PRESSURE RESIN, HARDNER	864/5A	L	(ozf)	12.6	SIH
TORR SEAL, LOW VAPOR PRESSURE RESIN, HARDNER	864/5A	L	(ozf)	1.4	SIH
TORR SEAL, LOW VAPOR PRESSURE RESIN, RESIN	864/22	L	(ozf)	11.2	SIH
TORR SEAL, LOW VAPOR PRESSURE RESIN, RESIN	864/25	L	(ozf)	28	SIH
TORR SEAL, LOW VAPOR PRESSURE RESIN, RESIN	864/5A	L	(ozf)	28	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
TORR SEAL, LOW VAPOR PRESSURE RESIN, RESIN	864/5A	L	(ozf)	5.6	SIH
TRIETHYL BORATE	864/25	L	(g)	500	<1 LB.
TRIMETHYL BORATE	864/25	L	(l)	1	NON-TOXIC
TRITON N101 SURFACTANT	864/22	L	(gal)	5	SIH
TUF-ENUF (HAND SOAP CLEANER)	864/5A	L	(ozf)	14	SIH
TUNGSTEN OXIDE	864/02	S	(lb)	12.5	NON-DISPERSIBLE
ULTRAJET CO2	864/23	G	(ozd)	40.8	SIH
UREA	864/25	S	(g)	500	<1 LB.
VINYL STRIPPABLE PROTECTIVE COATING	864/5A	L	(ozf)	390	SIH
VISCOSITY STANDARD FLUID	864/25	L	(qt)	2	SIH
VISCOSITY STANDARD FLUID	864/25	L	(qt)	2	SIH
VISCOSITY STANDARD FLUID	864/25	L	(qt)	2	SIH
VISCOSITY STANDARD FLUID	864/25	L	(qt)	2	SIH
VITAL 23 HYDRAULIC OIL	864/Q Y/RD	L	(gal)	10	SIH
WD-40	864/22	L	(ozf)	9	SIH
WD-40	864/5A	L	(ozf)	9	SIH

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
WD-40	864/5A	L	(ozf)	18	SIH
WELLBORN PAINT	864/5A	S	(ozf)	124	SIH
YELLOW REFINED BEESWAX	864/05	S	(ozd)	32	SIH
YTTERBIUM FLUORIDE	864/02	S	(g)	200	NON-DISPERSIBLE
YTTRIUM ACETATE HYDRATE	864/25	S	(g)	250	<1 LB.
YTTRIUM NITRATE	864/25	S	(g)	30	<1 LB.
YTTRIUM OXIDE	864/02	S	(kg)	1	NON-DISPERSIBLE
YTTRIUM OXIDE	864/25	S	(g)	250	<1 LB.
YTTRIUM OXY SULFIDE	864/25	S	(g)	100	<1 LB.
ZINC ACETATE	864/25	S	(g)	500	<1 LB.
ZINC CARBONATE	864/02	S	(g)	500	<1 LB.
ZINC CHLORIDE	864/25	S	(g)	500	<1 LB.
ZINC FLUORIDE	864/02	S	(g)	500	<1 LB.
ZINC OXIDE	864/02	S	(lb)	50	NON-DISPERSIBLE
ZINC SULFIDE	864/25	S	(g)	100	<1 LB.
ZINC SULFIDE	864/25	S	(g)	100	<1 LB.

Chemical Inventory

CHEM	LOC CODE	PHYS STATE	QTY UNIT	MQTY	SCR CRIT
ZIRCAR SALI CASTABLE CERAMIC	864/SHED	L	(gal)	2	SIH
ZIRCONIUM ACETATE	864/25	L	(ml)	120	<1 LB.
ZIRCONIUM ACETATE SOLUTION	864/25	L	(g)	200	<1 LB.
ZIRCONIUM SILICATE	864/02	S	(lb)	10	NON-DISPERSIBLE
ZY-GLO	864/22	L	(pt)	1	SIH

Appendix B

ALOHA Dispersion Model Printouts

NOTE: ALOHA is used to determine the maximum concentration levels at the facility and site boundaries and the greatest distances at which ERPG-2 and ESHE concentration levels are reached for each postulated scenario described in Section 5.0. The scenarios consider both worst case and average meteorological conditions. The results of the ALOHA dispersion analysis are summarized in Table 6.4-1. However, this appendix includes the ALOHA printouts of the worst case meteorological conditions only. The ALOHA printouts of the average meteorological conditions can be referenced in HAD file 95-864.

ALOHA.....	B-1
Ammonium Hydroxide.....	B-2
Hydrofluoric Acid.....	B-7
Nitric Acid.....	B-17

ALOHA

Provided below is a brief description of the processes used to disperse chemicals through the chemical dispersion model, ALOHA. As with any model, there are limitations. In order to compensate for limitations in the model and to accurately reflect the postulated scenarios described in Section 5.0, compensation adjustments are used in ALOHA. The following issues are described below:

- Chemical Solutions
- Modeling Ammonium Hydroxide

For the purpose of emergency planning, ALOHA serves a vital role in estimating the distance at which protective actions should be initiated. ALOHA provides the tool needed to estimate the 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.

Chemical Solutions

For chemical solutions other than ammonium hydroxide which is described below, the total quantity of the solution is multiplied by the concentration (percent).⁵⁹ The resultant calculation is then utilized in ALOHA's Puddle Source Option. This calculation is established in consonance with emergency planning practices and is conservatively used in ALOHA to determine the distances at which protective actions should be taken.

The following cover sheets depict the total amount of the solution which is a direct correlation to the release designations illustrated in Section 5.0, Event Scenarios. The ALOHA printout sheets, however, utilize the above mentioned calculation and depict the total concentration of the solutions as this represents the maximum quantity of the hazardous material that could be released.

Modeling Ammonium Hydroxide

A procedure to model the evaporation and dispersion of chemicals is provided in the Technical Guidance for Hazards Analysis.⁶⁰ Due to the lack of chemical information needed to model ammonium hydroxide using ALOHA's Puddle Source Option, evaporation rate calculations were determined and used as the estimate source strength in ALOHA's Direct Source Option. The ammonium hydroxide evaporation rate calculations are provided in Appendix C.

Release Designation
NH₄-1

Ammonium Hydroxide
Breach of 2 containers, worst case meteorological conditions

2 gallons
1 centimeter thickness puddle

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: AMMONIUM HYDROXIDE
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: -unavail-
Footprint Level of Concern: 200 ppm
Boiling Point: -33.43° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%
Note: Not enough chemical data to use Heavy Gas option

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: .003 pounds/sec
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 81.6 grams/min
Total Amount Released: 4.90 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 200 ppm
Max Threat Zone for LOC: 70 meters
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: 1,070 ppm
Indoor: 1,070 ppm
Note: Indoor graph is shown with a dotted line.

Concentration Window

2887622881

Chemical Name: AMMONIUM HYDROXIDE
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: 1,070 ppm

Indoor: 1,070 ppm

Note: Indoor graph is shown with a dotted line.

ppm

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: AMMONIUM HYDROXIDE
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: -unavail-
Footprint Level of Concern: 1000 ppm
Boiling Point: -33.43° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%
Note: Not enough chemical data to use Heavy Gas option

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: .003 pounds/sec
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 81.6 grams/min
Total Amount Released: 4.90 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 1000 ppm
Max Threat Zone for LOC: 31 meters
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: 100 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 99 ppm
Indoor: 99 ppm
Note: Indoor graph is shown with a dotted line.

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

TIME DEPENDENT INFORMATION:

Concentration Estimates at the point:

Downwind: 100 meters

Off Centerline: 0 meters

Max Concentration:

Outdoor: 99 ppm

Indoor: 99 ppm

Note: Indoor graph is shown with a dotted line.

ppm

Release Designation
HF-1

Hydrofluoric Acid (49%)
Ruptured bottles, worst case meteorological conditions

2 liters
1 centimeter thickness puddle

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: HYDROFLUORIC ACID, ANHYDROUS
Molecular Weight: 20.01 kg/kmol
TLV-TWA: 3.00 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: 19.52° 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:

Puddle Area: .1 square meters
Puddle Volume: .98 liters
Soil Type: Default Ground Temperature: 68° F
Initial Puddle Temperature: boiling point
Release Duration: ALOHA limited the duration to 1 hour
Max Computed Release Rate: 6.35 grams/min
Max Average Sustained Release Rate: 3.21 grams/min
(averaged over a minute or more)
Total Amount Released: 172 grams

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: 40 meters
Max Threat Zone for IDLH: 33 meters
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: 35.7 ppm
Indoor: 35.7 ppm
Note: Indoor graph is shown with a dotted line.

Chemical Name: HYDROFLUORIC ACID, ANHYDROUS
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: 35.7 ppm

Indoor: 35.7 ppm

Note: Indoor graph is shown with a dotted line.

ppm

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: HYDROFLUORIC ACID, ANHYDROUS
Molecular Weight: 20.01 kg/kmol
TLV-TWA: 3.00 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 50 ppm
Boiling Point: 19.52° 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:

Puddle Area: .1 square meters
Puddle Volume: .98 liters
Soil Type: Default Ground Temperature: 68° F
Initial Puddle Temperature: boiling point
Release Duration: ALOHA limited the duration to 1 hour
Max Computed Release Rate: 6.35 grams/min
Max Average Sustained Release Rate: 3.21 grams/min
(averaged over a minute or more)
Total Amount Released: 172 grams

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 50 ppm
Max Threat Zone for LOC: 25 meters
Max Threat Zone for IDLH: 33 meters
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: 100 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.31 ppm
Indoor: 3.31 ppm
Note: Indoor graph is shown with a dotted line.

Concentration Window

2887952558

Chemical Name: HYDROFLUORIC ACID, ANHYDROUS
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:

Concentration Estimates at the point:

Downwind: 100 meters

Off Centerline: 0 meters

Max Concentration:

Outdoor: 3.31 ppm

Indoor: 3.31 ppm

Note: Indoor graph is shown with a dotted line.

ppm

Release Designation
HF-4

Hydrofluoric Acid

(2 gallons @ 49% and 8 gallons @ 5%)

Ruptured bottles, worst case meteorological conditions

10 gallons
1 centimeter thickness puddle

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: HYDROFLUORIC ACID, ANHYDROUS
Molecular Weight: 20.01 kg/kmol
TLV-TWA: 3.00 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: 19.52° 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:

Puddle Area: .522 square meters
Puddle Volume: 5.22 liters
Soil Type: Default Ground Temperature: 68° F
Initial Puddle Temperature: boiling point
Release Duration: ALOHA limited the duration to 1 hour
Max Computed Release Rate: 32.7 grams/min
Max Average Sustained Release Rate: 17.7 grams/min
(averaged over a minute or more)
Total Amount Released: 963 grams

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: 96 meters
Max Threat Zone for IDLH: 78 meters
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: 193 ppm
Indoor: 193 ppm
Note: Indoor graph is shown with a dotted line.

Chemical Name: HYDROFLUORIC ACID, ANHYDROUS
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: 193 ppm

Indoor: 193 ppm

Note: Indoor graph is shown with a dotted line.

ppm

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: HYDROFLUORIC ACID, ANHYDROUS
Molecular Weight: 20.01 kg/kmol
TLV-TWA: 3.00 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 50 ppm
Boiling Point: 19.52° 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:

Puddle Area: .522 square meters
Puddle Volume: 5.22 liters
Soil Type: Default Ground Temperature: 68° F
Initial Puddle Temperature: boiling point
Release Duration: ALOHA limited the duration to 1 hour
Max Computed Release Rate: 32.7 grams/min
Max Average Sustained Release Rate: 17.7 grams/min
(averaged over a minute or more)
Total Amount Released: 963 grams

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 50 ppm
Max Threat Zone for LOC: 60 meters
Max Threat Zone for IDLH: 78 meters
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: 100 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 18.3 ppm
Indoor: 18.3 ppm
Note: Indoor graph is shown with a dotted line.

Chemical Name: HYDROFLUORIC ACID, ANHYDROUS
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:

Concentration Estimates at the point:

Downwind: 100 meters

Off Centerline: 0 meters

Max Concentration:

Outdoor: 18.3 ppm

Indoor: 18.3 ppm

Note: Indoor graph is shown with a dotted line.

ppm

Release Designation
HNO₃-1

Nitric Acid (70%)

Ruptured bottles, worst case meteorological conditions

2 gallons
1 centimeter thickness puddle

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: NITRIC ACID
Molecular Weight: 63.01 kg/kmol
TLV-TWA: 2.00 ppm IDLH: 100.00 ppm
Footprint Level of Concern: 15 ppm
Boiling Point: 83.00° C
Vapor Pressure at Ambient Temperature: 0.063 atm
Ambient Saturation Concentration: 75,930 ppm or 7.59%

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:

Puddle Area: .53 square meters
Puddle Volume: 5.3 liters
Soil Type: Default Ground Temperature: 68° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Computed Release Rate: 17.4 grams/min
Max Average Sustained Release Rate: 17.4 grams/min
(averaged over a minute or more)
Total Amount Released: 966 grams

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 61 meters
Max Threat Zone for IDLH: 23 meters
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: 59.9 ppm
Indoor: 59.9 ppm
Note: Indoor graph is shown with a dotted line.

Chemical Name: NITRIC ACID

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: 59.9 ppm

Indoor: 59.9 ppm

Note: Indoor graph is shown with a dotted line.

ppm

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: NITRIC ACID
Molecular Weight: 63.01 kg/kmol
TLV-TWA: 2.00 ppm IDLH: 100.00 ppm
Footprint Level of Concern: 30 ppm
Boiling Point: 83.00° C
Vapor Pressure at Ambient Temperature: 0.063 atm
Ambient Saturation Concentration: 75,930 ppm or 7.59%

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:

Puddle Area: .53 square meters
Puddle Volume: 5.3 liters
Soil Type: Default Ground Temperature: 68° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Computed Release Rate: 17.4 grams/min
Max Average Sustained Release Rate: 17.4 grams/min
(averaged over a minute or more)
Total Amount Released: 966 grams

FOOTPRINT INFORMATION:

Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 43 meters
Max Threat Zone for IDLH: 23 meters
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: 100 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 5.67 ppm
Indoor: 5.67 ppm
Note: Indoor graph is shown with a dotted line.

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

TIME DEPENDENT INFORMATION:

Concentration Estimates at the point:

Downwind: 100 meters

Off Centerline: 0 meters

Max Concentration:

Outdoor: 5.67 ppm

Indoor: 5.67 ppm

Note: Indoor graph is shown with a dotted line.

ppm

Appendix C

Ammonium Hydroxide Calculations

NOTE: The following calculations follow a procedure to model the evaporation and dispersion of ammonium hydroxide located in the GFFL. This procedure, approved by the U.S. Environmental Protection Agency, the Federal Emergency Management Agency, and the U.S. Department of Transportation, determines the evaporation rate of the puddle.⁶¹ Due to the lack of chemical information needed to utilize ALOHA's Puddle Source Option, the evaporation rate calculations are used as the estimate of source strength in ALOHA's Direct Source Option.

CALCULATION SHEET

CALCULATION TITLE: Estimation of the airborne quantity released to the atmosphere

CALCULATION ID: Release Designation NH₄-1 (2 gallons of ammonium hydroxide in worst case meteorological conditions)

REVISION: 0

Prepared by:	Signature	Printed Name	Date
Checked by:	Signature	Printed Name	Date
Approved by:	Signature	Printed Name	Date

The following equation is used to calculate the evaporation rate of ammonium hydroxide for a direct source input parameter in ALOHA.

Equation 1: $QR = (.106)(U) \cdot 78(MW)^{2/3}(A)(VP)$

$$R(T1 + 273)$$

where:

QR	=	Rate of release to air (lbs/min)
U	=	Windspeed (m/s)
MW	=	Molecular weight (g/g mole)
A	=	Surface area of spilled material (ft ²)
VP	=	Vapor Pressure (mm Hg)
R	=	82.05 atm cm ³ /g mole K
T	=	Temperature at which the material is stored (°C)

$$QR = \frac{(.106)(1) \cdot 78(35.06)^{2/3}(8.15)(475)}{82.05(20 + 273)} = 0.1806 \text{ lb/min} = 0.003 \text{ lb/sec}$$

CALCULATION SHEET

CALCULATION TITLE: Estimation of the airborne quantity released to the atmosphere

CALCULATION ID: Release Designation NH₄-2 (2 gallons of ammonium hydroxide in average meteorological conditions)

REVISION: 0

Prepared by:	Signature	CARRIE L. WOOD Printed Name	7/6/95 Date
Checked by:	Signature	Joseph A. Schmier Printed Name	7/6/95 Date
Approved by:	Signature	L. L. Dukies Printed Name	7/13/95 Date

The following equation is used to calculate the evaporation rate of ammonium hydroxide for a direct source input parameter in ALOHA.

Equation 1:
$$QR = \frac{(.106)(U)^{.78}(MW)^{2/3}(A)(VP)}{R(T_1 + 273)}$$

where:

QR	=	Rate of release to air (lbs/min)
U	=	Windspeed (m/s)
MW	=	Molecular weight (g/g mole)
A	=	Surface area of spilled material (ft ²)
VP	=	Vapor Pressure (mm Hg)
R	=	82.05 atm cm ³ /g mole K
T	=	Temperature at which the material is stored (°C)

$$QR = \frac{(.106)(4)^{.78}(35.06)^{2/3}(8.15)(475)}{82.05(20 + 273)} = 0.5391 \text{ lb/min} = 0.009 \text{ lb/sec}$$

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