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Kauai Test Facility Hazard Assessment Document

Zeferino Banda, Project Leader
Arlan Swihart, Author

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185, and Livermore, California 94550
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Project Leader: Zeferino Banda
Author: Arlan Swihart
Special Thanks To: Dave Beck

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Abstract

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EXECUTIVE SUMMARY

The hazards assessment provides an evaluation of the chemical and radiological hazards at the Kauai Test Facility, on the island of Kauai, Hawaii, as mandated by the Department of Energy (DOE) Order 5500.3A, Planning and Preparedness for Occupational Emergencies.

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

- The highest emergency classification is a General Emergency.
- The greatest distance at which a postulated facility event (spill of 55 gal. or 209 l of Unsymmetrical Dimethylhydrazine under "worst case" meteorological conditions) will produce consequences exceeding the Early Severe Health Effects threshold is 4.2 km. (~2.62 mi.) at the KTF "Main Complex". A Terrier Missile is the largest motor system that has been launched at the Kokole Point launch site. Motor systems with larger fuel inventories are not projected to be launched from this site because of off site (Pacific Missile Range Facility) encroachment concerns. However, due to resource limitations and to ensure the greatest level of conservatism the consequences identified for the KTF "Main Complex" (a STARS Rocket) was utilized at Kokole Point. The STARS Rocket has a solid fuel inventory over 25 times larger than the Terrier motor system. A STARS motor system would produce Early Severe Health Effects (ESHE) concentrations of Hydrogen Chloride at <100 m (<~330ft.).
- The protective response actions and the time available to take those actions for evacuation, sheltering in place, and accounting of personnel range from less than one minute to as long as 1 hour and 40 minutes, depending on the scenario.
- The Emergency Planning Zones are determined to be 5 km. (~3.12 mi.) for the KTF's "Main Complex" and the Pacific Missile Range Faciltiy (PMRF) site boundary for the KTF's Kokole Point launch site (Pad 41).

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ACRONYMS AND ABBREVIATIONS

~	Approximately
AEB	Auxiliary Equipment Building
AFB	Air Force Base
ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ALOHA	Areal Locations of Hazardous Atmospheres
AMOS	Air Force Maui Optical Station
BMDO	Ballistic Missile Defense Organization
C	Celsius
CAMEO	Computer-Aided Management of Emergency Operations
CAS	Chemical Abstracts Service
CFR	Code of Federal Regulations
cm.	Centimeter
CTS	Cable Termination Shelter
DFG	(German Research Society Maximum Exposure Limits)
dia.	Diameter
Div.	Division
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DPM	Disintegrations Per Minute
EA	Environmental Assessment
EAL	Emergency Action Level
EIS	Environmental Impact Statement
EMG	Emergency Management Guide
EOC	Emergency Operating Center
ERPG	Emergency Response Planning Guide
EPZ	Emergency Planning Zone
ESHE	Early Severe Health Effects
F	Fahrenheit
FEMA	Federal Emergency Management Agency
ft.	Feet
FTS	Flight Termination System
FY	Fiscal Year
HAD	Hazard Assessment Document
HE	High Explosive
hr.	Hour
HVAC	Heating, Ventilation, and Air Conditioning
in.	Inch
ISA	Inter Service Agreement
k	Thousand
KECO	Kauai Electric Company
km.	Kilometer
KTF	Kauai Test Facility
kW	KiloWatt
lb.	Pound
ICBM	Inter-Continental Ballistic Missile
l	Liter
LEPC	Local Emergency Planning Committee
LOB	Launch Operations Building

m	Meter
MAB	Missile Assembly Building
MAK	(German Research Society Maximum Exposure Limits)
Mev	Million Electron Volts
mg/m^3	Milligram Per Meter Cubed
mi.	Mile
MLP	Missile Launch Pad
MO	Mobile Building
mph	Miles Per Hour
mps	Meters Per Second
MSL	Mean Sea Level
mm.	Millimeter
mr/hr	Millirem Per Hour
MSDS	Material Safety Data Sheet
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NEW	Net Explosive Weight
NIOSH	National Institute for Occupational Safety and Health
NNTRP	National Nuclear Test Readiness Program
NOAA	National Oceanographic and Atmospheric Administration
NTO	Nitrogen Tetroxide
ODES	Operations and Deployment Experiment Simulator
Ops.	Operational
OSHA	Occupational Safety and Health Administration
PAG	Protective Action Guide
PBV	Post Boost Vehicle
PEL	Permissible Exposure Level
PHA	Preliminary Hazard Assessment
PMRF	Pacific Missile Range Facility
ppm	Parts Per Million
R&D	Research and Development
REL	Recommended Exposure Limit
rf	Radio Frequency
SA	Safety Assessment
SARA	Superfund Amendment and Reauthorization Act of 1986
SCBA	Self Contained Breathing Apparatus
SCG	Storage and Compatibility Group
SIH	Standard Industrial Hazard
SNL	Sandia National Laboratories
SOP	Standard Operating Procedures
SPEGLs	Short-Term Public Emergency Guidance Levels
sq.	Square
SS	Second Stage
STARS	Strategic TARget System
Stg.	Stage
STEL	Short Term Exposure Level
TLV	Threshold Limit Value
TS	Third Stage
TWA	Time Weighted Average
UDMH	Unsymmetrical Dimethylhydrazine
ug	Microgram
ug/dl	Microgram per decaliter

UNO	United Nations Organization
US	United States
USAKA	United States Army Kwajelein Atoll
USDOD	United States Department of Defense
USEPA	United States Environmental Protection Agency
MST	Missile Service Tower
WSTF	White Sands Test Facility

1.0 INTRODUCTION

The purpose of the hazards assessment is to document the evaluation results of those hazards at the Kauai Test Facility (KTF) that are significant enough to warrant consideration in Sandia National Laboratories' (SNL) operational emergency management program. This hazards assessment is prepared in accordance with the Department of Energy Order (DOE) 5500.3A[1] requirement that facility-specific hazards assessments be prepared, maintained, and used for emergency planning purposes.

This Hazards Assessment Document (HAD) provides an analysis of the potential airborne release of radiological and chemical hazards associated with the operations and processes at the Kauai Test Facility (KTF). An airborne release of materials represents a most time-urgent situation and requires a rapid, coordinated emergency response on the part of the KTF, SNL/NM, collocated facilities, and surrounding jurisdictions to protect workers, the public, and the environment. The KTF is run by Sandia National Laboratories/New Mexico (SNL/NM) for the DOE, on the United States (U.S.) Navy's Pacific Missile Range Facility (PMRF) at Barking Sands on the island of Kauai, Hawaii. The KTF has been the site of over 355 rocket test launches since the facility first opened in 1962.[2] Operations at the KTF are conducted by a small operational staff supervised by SNL's Kauai Test Facility and Range Interfaces Department.[3]

A key objective of DOE's emergency planning 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 the 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 be identified and understood. The hazards assessment herein provides the technical basis for such planning.

All chemical and radioactive materials at the KTF have been identified. Those materials that were determined hazardous were fully characterized, accident scenarios were developed, and consequences of release were estimated. The resultant consequences were utilized to determine the appropriate emergency planning zone, emergency classes, and emergency action levels.

[1] a superscript throughout the document denotes a reference.

2.0 SITE AND FACILITY DESCRIPTION

The following information will describe the KTF, the location of this facility, and its function within SNL. Also, in order to provide a comprehensive understanding of the facilities being assessed, the site in which these facilities are located will be characterized.

The SNL/KTF site is shared with the DOD; it is located on the Navy's Pacific Missile Range Facility, and access to the site is controlled by the Navy. The general public is allowed unescorted access to many areas of the site, such as public roads and recreational facilities during non-operational periods. This relatively open access means that much of the PMRF is accessible to the general public. For emergency planning purposes, area subject to access by the general public must be considered offsite unless it is assured that those areas can be evacuated and access control can be established within (1) hour of any emergency declaration. Therefore, determination of the site boundary for each hazards assessment was based on establishing a boundary whereby the ingress and egress of personnel is under the direct control of SNL or other coordinating organizations.

2.1 KTF Site Description

The KTF is comprised of an administrative compound and two launch facilities. The administrative compound and main launch facility is located on the north end of the PMRF while the smaller Kokole Point launch facility is located on the south end of the PMRF. The KTF and the PMRF are located on the seaward side of the broad western Mana coastal plain of Kauai. By 1936 this large wetland had been filled in and planted with sugarcane [4] (Illustration 2-1).

The PMRF complex extends for about 8 miles (mi.) or approximately (~) 12.8 kilometers (km.) along the ocean with the KTF at its north end. The shoreline nearest the KTF is about 1,000 feet (ft.) or ~303 meters (m) to the west of launch pad 42 (the Strategic Target Systems Launch Pad known as the STARS Launch Pad).[5]

The public has access to the beach in front of the PMRF by means of roads through the range and by walking along the beach from points beyond the range. Access to the beach through the PMRF and along the road to Polihale State Park is controlled during testing.[6]

The population at the KTF fluctuates between 10 and 140, depending on launch schedules. PMRF military and dependent, population on the island can range from 700 to 1,100, with an additional 600 to 700 transient workers on the PMRF at any point in time while in transit, leave or during exercises (these figures do not include Air National Guard or National Guard).[7]

The nearest off-base community is the village of Kekaha, ~46,500 ft. (~14.1 km.) to the south and east of the KTF "Main Complex". An extension of State Highway 50 skirts the PMRF on the mountain side, leading to Polihale State Park, ~17,000 ft. (~5.15 km.) northeast of the KTF. This beachside park is just south of an old heiau, a stone platform used in Hawaiian religious practices before the influence of Christianity in the Hawaiian Islands. [8]

Land directly outside KTF is used primarily for agriculture. The predominant crop is sugarcane (Kauai has one of the highest yields of sugarcane per acre in the world). Land outside the coastal flat zone is forest and open land owned by the State of Hawaii. The beach along which both launch facilities lie is used by the public for recreational purposes. Lands not used by the KTF are part of the PMRF complex and are used by the Navy. [9]

The West Coast of Kauai and the Greater Pacific Missile Range Facility Area

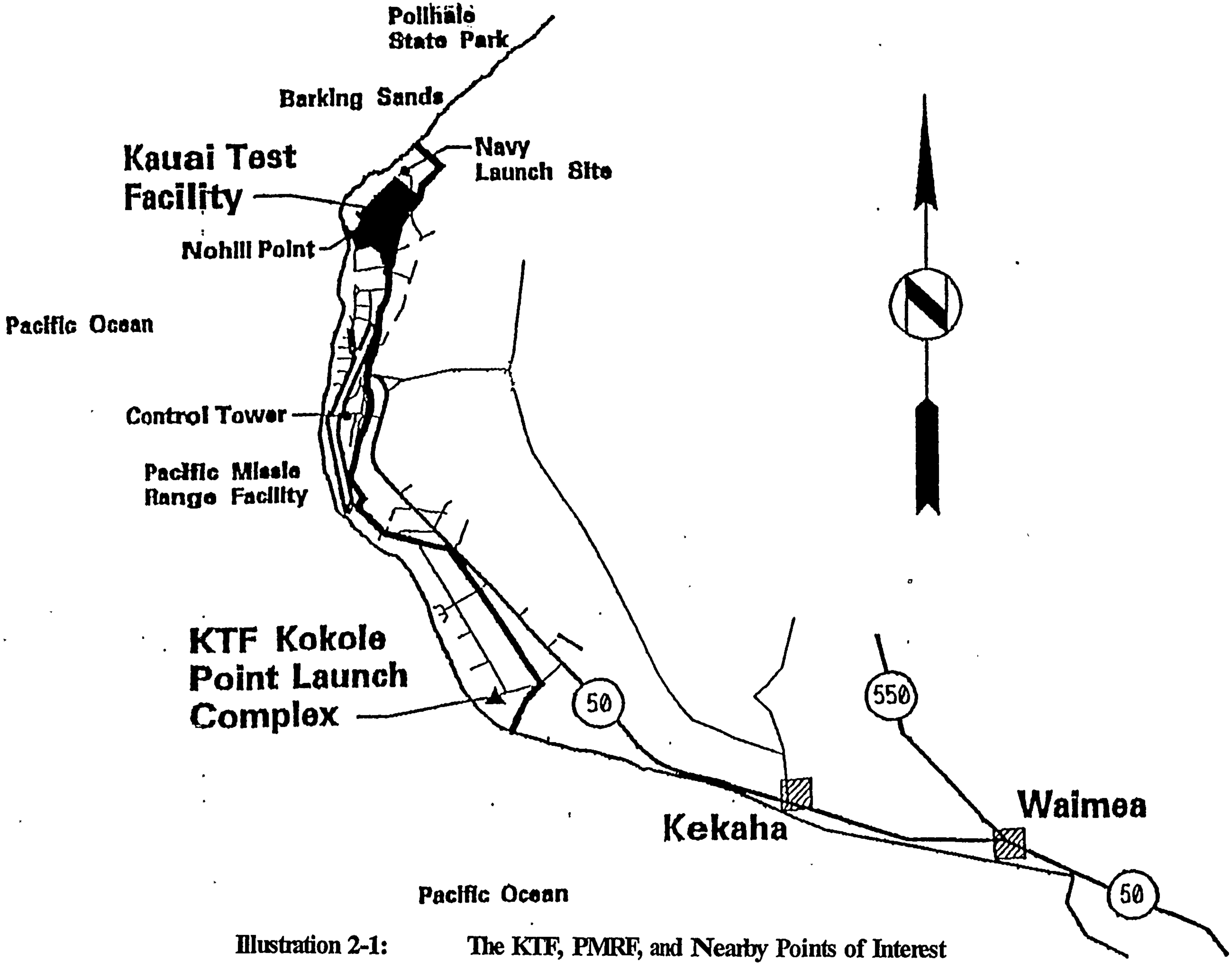


Illustration 2-1: The KTF, PMRF, and Nearby Points of Interest

The ocean along the PMRF is used for commercial fishing. Other uses for the ocean include recreational use by the public.[10]

The KTF areas not in present use are vegetated with grass and shrubs. Along the northwestern boundary, there are some medium-size trees and bushes. The areas in use are covered by native grasses outside of the paved areas and are mowed on a regular basis.[11]

Carbon dating has confirmed human presence on the north coast of Kauai as early as 359 AD. The U.S. Navy considers the entire PMRF/KTF a culturally sensitive "major ancient burial ground," because human remains have been found at various locations along the dunes and coastline.[12] None of the recorded archaeological resources in the vicinity of the KTF are above ground. Therefore, the potential for damage to historical or prehistorical cultural resources is unlikely.

2.1.1 Site Natural Conditions

External and/or natural phenomena affecting the KTF Site include climate, topography, hydrology, seismology, geology, vegetation, and wildlife.

2.1.1.1 Climate

"Regionally" storm tracks, or the paths taken by eastward migrating high and low pressure systems, generally lie between 35° and 65° North, so these are the latitudes of changeable weather.[13]

Hawaii is located to the south of these systems. In this area, atmospheric eddies are semi-stationary. These relatively well-anchored eddies include the large subtropical high-pressure systems or anticyclones, and places in their vicinity can expect to have correspondingly stable weather. One of these, the Pacific High anticyclone, generally lies northeast of Hawaii, so that the air moving outward from it is, in fact, the northeasterly trade winds, whose persistence directly reflects that of the Pacific High from which it originates.[14]

Between October and April, occasional surges of cold air invade the Hawaiian area from the north. The cold fronts, which mark the leading edges of these cold air masses, are frequently accompanied by wide spread clouds, heavy rain, and thunderstorms. Severe fronts may be preceded by strong southwest winds followed by gusty northerly winds. As many as 20 fronts may pass Kauai during the winter.[15]

Hurricanes (called typhoons west of 180° longitude) are uncommon in Hawaii. However, two hurricanes have hit Kauai in the past two decades. The hurricanes and lesser tropical cyclones that affect Hawaii usually originate off the western coast of Mexico or Central America, but almost always dissipate before reaching the islands, or pass westward to the south.[16]

"Locally" the KTF lies in the rain shadow of Mt. Kawai Kini and Mt. Waialeale. This part of the island is sheltered from the predominant northeast trade winds and, as such, is one of the driest sections of Kauai. Average rainfall is just over 20 inches (in.) per (/) year (yr.) (~51 cm./yr.). Most rain falls between October and April. The greatest single day of rain on record for the area was 5.02 in. (~12.8 cm.) on February 1, 1975.[17]

The average surface wind is 5 knots (~9.26 km.) with the high average of 11 knots (~20.4 km.) occurring in January. Under normal conditions, winds are generally light and variable; abnormal conditions can result in gusty winds in excess of 30 knots (~55.6 km.) from southerly, westerly, or northerly directions. The peak gusts have come from the north at ≥80 knots (~148.2 km.).[18]

The average temperature is 82 ° F (~27.8 ° C) with a minimum average of 64 ° F (~17.8 ° C) and high average of 86 ° F (~30 ° C). Extremes have been 91 ° F (~32.7 ° C) in June 1969 and a low of 53 ° F (~11.7 ° C) in the same year. [19]

2.1.1.2 Topography

The area consists of gentle to moderately sloping broad-based hills with large level areas. Elevations range from 15 to 30 ft. (~4.5 to ~9 m) above mean sea level. [20]

2.1.1.3 Flooding

The entire KTF lies within two flood plain zones, a 100 - year flood zone, and a 100 - year flood zone from wave velocity in a coastal area. [21] "Surface" drainage on the KTF site is not integrated. The sand is so permeable and its moisture-holding capacity so low that no drainage pattern has been established on the surface. Rains simply sink into the sand and disappear. [22]

In pre-development time, flood runoff from the volcanic highlands flowed onto the Mana Plain, causing temporary flooding. Permanent marshes, created by upward seepage of ground water, covered parts of Nohili and Kawaiele. Water which accumulated on the plain moved as ground water through sand dunes to discharge at the coast. When the plain was claimed for agriculture, the natural mode of drainage was modified by a network of small ditches and several large canals. [23]

If the drainage canals are kept free of obstructions, flooding does not take place. However, the canals may become clogged with debris and mud, causing them to overflow onto the non-sandy part of the plain (this does not occur at the KTF). The last episode of flooding occurred in the fall of 1982. [24] This flooding does occur at various areas within the PMRF, however, no flooding occurs on the KTF due to blocked drainage canals. [25]

The PMRF's coastal location and low elevation make the area susceptible to wave damage. Several tsunamis have occurred at the PMRF in the past 45 years. The most serious was in 1946 when wave run-up reached the 11 ft. (~3.3 m) elevation and inundated an area almost as far inland as the Kaumualii Highway or Route 50 (reference back to Illustration 2.1). [26]

The Mana Plain is composed of a wedge of terrestrial and marine sediments overlying a volcanic basement. The basement rock outcrops at the inland edge of the Plain; its steep slope formed a cliff during a former high-stand of the sea. The volcanic basement plunges below the plain at a dip of about 5 ° until, at the coast, it is about 400 ft. (~121 m) deep. [27]

The seaward edge of the Plain is covered by fossil sand dunes formed when the sea was lower than it is now. The PMRF is located almost entirely on these dunes, which now are no higher than 10 ft. (~3 m) or so except just to the north of the KTF, where they are up to 100 ft. (~30 m) high. [28]

The three geological formations (bedrock, alluvium, and dunes) constitute hydraulically connected aquifers. The basement volcanoes are highly permeable, containing brackish water floating on sea water. The overlying sediments act as a caprock because of their low permeability; they are saturated, but are not exploitable as an aquifer because of unfavorable hydraulic characteristics. [29]

The dune sand aquifer, on which the PMRF lies has a moderate hydraulic conductivity and a reasonable porosity. It consists of a lens of brackish ground water floating on sea water, and is recharged by storm rainfall and by seepage from the underlying sediments. The only record of an attempt to exploit the groundwater was in 1974, 4 to 5 mi. (~6.4 to 8 km.) south of the KTF "Main Complex". It yielded water too brackish for plants. [30]

2.1.1.4 Geology

The Hawaiian Islands are almost wholly volcanic. Sedimentary rocks form only a narrow fringe around the island perimeter. Most of the volcanic rocks are products of lava flows formed by outpouring of liquid magma. Only a small percentage is pyroclatic rocks, formed of fragments thrown out by volcanic explosions. [31]

The volcanoes were formed along a line, probably a series of cracks, extending in a northwest-southwest direction across the ocean floor. Starting at the northwest end, at Kure Island, about 30 million years ago, the centers of eruption gradually shifted, where today, only the volcanoes located at the southeastern end of the chain are still active. Geologically, Kauai is the oldest of the main Hawaiian Islands. [32]

The Mana coastal plain is composed of alluvium washed from uplands, calcareous and clayey lagoon deposits, and sand dunes and beach rock. The poorly consolidated deposits of the present plain were formed in a shallow lagoon behind an ancient beach ridge.[33]

Site subsurface conditions consist of fine-to-medium coralline sand. This sand is loose on top and moderately dense 2 to 4 ft. (~0.6 to ~1.2 m) below the surface. Interbedded with sand are partially-to-moderately cemented zones of silty sands. One test hole had backhoe refusal at a dept of 4 ft. (~1.2 m) In low-lying areas, the water table is 9 to 11 ft. (~2.7 to ~3.3 m) deep. [34]

2.1.1.5 Seismology

Volcanic eruptions on the island of Hawaii commonly are preceded and accompanied by thousands of earthquakes, but only a few of them are strong enough to be felt, and still fewer do any damage. The quakes result from the shifting of segments of the volcano as the mountain swells before eruptions or shrinks during the eruption as magma is drained away. In terms of origin, they are volcanic earthquakes. [35]

Between 1964 and 1981 there were two earthquakes within 60 mi. (~96 km.) of Kauai measured at 4 to 4.5 on the Richter Scale. Major earthquakes in the Hawaiian Islands before 1985 are shown in Table 3.1. [36]

Tectonic activity, in the sense of crustal deformation such as that which causes most earthquakes in continental regions, is nearly absent in Hawaii. But, off-shore fault movements have caused water waves called tsunamis, which have been reported to have come in over the tops of the coconut trees on the south shore of Hawaii. However, most tsunamis which affect the Hawaiian Islands come from sources in the zone of mountain building that border the Pacific Ocean. Since 1820, nine tsunamis have caused moderate to severe damage or deaths on Hawaiian shores, but only those occurring in 1868 and 1975 were of local origin. Five came from South America, one from Kamchitca, and one from the Aleutian Islands. Six others, one of local origin, have caused only minor damage. [37]

The entire Hawaiian region tilts slightly to the southeast, with the island of Hawaii sinking at a rate of about 0.3 m (~12 in.) per century. The islands are partly surrounded by a deep trench that appears to be the result of the sinking of the adjacent ocean floor, probably because of the load of the volcanoes resting on it. Minor basins have been formed by the sagging of some caldera floors over shallow magma chambers, and some faults pass into monoclines, but no other folding is present.[38]

Table 2.1

Major Earthquakes Before 1994 (Hawaiian Islands)[39]

Date	Magnitude	Origin
1938	6.75	40 km. (~25 mi.) north of Pauwela, north shore Maui.
1951	6.8	Kealahchua fault off the Kona coast of Hawaii.
1975	7.2	Puna coast southeast of Kilauea Caldera.
Various since 1925 (11 total)	7.53	Seven originated on the island of Hawaii and four on faults on the ocean floor.

2.1.1.6 Vegetation

Kauai's Heavy rainfall and many streams give rise to extensive areas of vegetation. In marked contrast to the wet areas are the dry coastal plains of the southwest where cacti, and sand cover much of the area.

The KTF is in the "kiawe and lowland scrub" zone of Hawaii. This classification is used to identify areas below 1,000 ft. (~303 m) elevation where the annual rainfall is less than 20 inches (~51 cm.). The vegetation of these coastal lowlands is largely composed of introduced species such as kiawe (Prosopis pallida) and Koa-haole (Leucaena leucocephala), both of which are summer deciduous. Based on a botanical survey conducted at the KTF and environs during July 1990, there are basically four vegetation zones with minor variations of each. There is the kiawe/koa-haole scrub zone, the open scrub zone, the coastal dunes zone, and the coastal strand (ocean shoreline) zone. The understory in each zone is made up of various native and introduced forbs and grasses.[40]

Two proposed endangered or threatened plant species have been reported on or near the KTF. The first is a small ephemeral fern, 3 to 4 in. (~7.6 to 10.2 cm.) in height, which is usually found one to two weeks after heavy rains called Adder's tongue or pololei fern (Ophioglossum concinnum). The second, ohai or (Sesbania tomentosa), has been reported at the Polihale State Park north of the KTF. If any of these species are found near activities at the KTF they are left undisturbed, if possible or transplanted to other areas of the PMRF.[41]

2.1.1.7 Wildlife

Forty species of birds have been identified in the general PMRF area (although not specifically at the KTF). Six species are native to Kauai. The remaining 34 species include 24 exotic (introduced), four migratory, and six indigenous species. No rookeries or raptor sites have been sighted within the PMRF. [42]

Thirteen species of mammals exist on the island of Kauai. Eleven of these species are exotic. During a species survey in July 1990, three species of mammals were observed within the KTF study units: one dog, two cats, and mice. At least four species of rodents are expected to be present at the KTF: House Mouse, Norway Rat, Roof Rat, and Pacific Rat. Feral dogs are also likely to inhabit the areas around the KTF. Table 2.2. lists those species of wildlife that are federally listed as threatened or endangered. [43]

Table 2.2

Federally Listed Threatened or Endangered Wildlife Species in the KTF Area [44]

Common Name	Scientific Name	Federal Status
Hawaiian Duck	Anas wyvilliana	Endangered
American (Hawaiian) coot	Fulica americana ssp. alai	Endangered
Hawaiian gullinule (common moorhen)	Gallinula chloropus ssp. sandvicensis	Endangered
Hawaiian black-necked stilt	Himantopus mexicana ssp. knudseni	Endangered
Newell's shearwater	Puffinus auricularis newelli	Threatened
Humpback whale	Megaptera novaeangliae	Endangered
Hawaiian monk seal	Monachus schauinslandi	Endangered
Hawaiian hoary bat	Lasiurus cinereus ssp. semotus	Endangered
Pacific green sea turtle	Chelonia mydas	Threatened

2.2 Facility Location

The SNL/KTF site is located between Vandenburg Air Force Base in California and the U.S. Army's Kwajelein Area facilities. It is on the island of Kauai, Hawaii 135 mi. northwest of Honolulu, Oahu island.[45] The Pacific Missile Range extends out in all directions from the KTF. Illustration 2-2 shows the initial azimuths that a missile or rocket can be launched in order to avoid potential hazards to people on Kauai or another near by island. It should be noted that from these original azimuths a missile or rocket may be programmed to go in any desired direction within the energy bounds of the system once it has cleared designated population areas. Hawaii comprises 132 islands, reefs, and shoals stretching 1,523 mi. (~2,451 km.) southeast to northwest across the tropic of Cancer between 154° 40' and 178° 25' W longitude, and 18° 54' to 28° 15' N latitude. The eight main islands, of which Kauai is the fourth largest and northern most make up over 99% of the total land area of 6,424 square (sq.) mi. or ~16,446 sq. km. Kauai is over 627 sq. mi. (1,605 sq. km.) in area. The KTF is on the western side of the island of Kauai at an area known as Barking Sands on the PMRF. An Interservice Support Agreement between the PMRF and the DOE allows for the operation of KTF. An agreement between DOE/Albuquerque and DOE/Nevada allows SNL to provide the Resident Range Manager as directed by DOE Headquarters.[46]

The island of Kauai is a single shield volcano, and has been eroded over millions of years. Waimea Canyon and the Na Pali Coast with its cliffs, are products of the rain that falls on Kauai's Mount (Mt.) Kawaikini and Mt. Waialeale, which are twin peaks and are approximately 5,200 ft. (~1,576 m) at the summits of the old volcano see Illustration 2-3. Rainfall on Mt. Waialeale has been measured at more than 450 inches (in.) or (~11.4 m) per yr.[47]

The 1990 census identified the population of the island of Kauai to be 50,947.[48] According to the 1980 census the largest towns are Kapaa (4,467), Lihue (4,000), Hanamaula (3,227), Kalaheo (2,500), Wailua (1,587), Waimea (1,569), Koloa (1,457), and Hanapepe (1,417).[49]

2.3 Facility Mission

The KTF provides a high-quality, integrated facility for conditioning a wide range of test operations including the following:

- Launching of rockets carrying experimental payloads for observation by the Air Force Maui Optical Station (AMOS) located on Mount Haleakala.
- Conducting suborbital co-experiments with launches from Vandenburg Air Force Base (AFB) in California or the Eastern Test Range (ETR) in Florida (aka. Cape Canaveral).
- Performing ICBM-type launch simulations targeted to areas in the U.S. Army Kwajelein Atoll (USAKA) region in the Republic of the Marshall Islands.
- Conducting scientific experiments on phenomena occurring in the upper atmosphere over the mid-Pacific.
- Implementing high-velocity water impact and underwater trajectory experiments in conjunction with U.S. Navy instrumentation capabilities.

Initial Launch Azimuths From The Kauai Test Facility

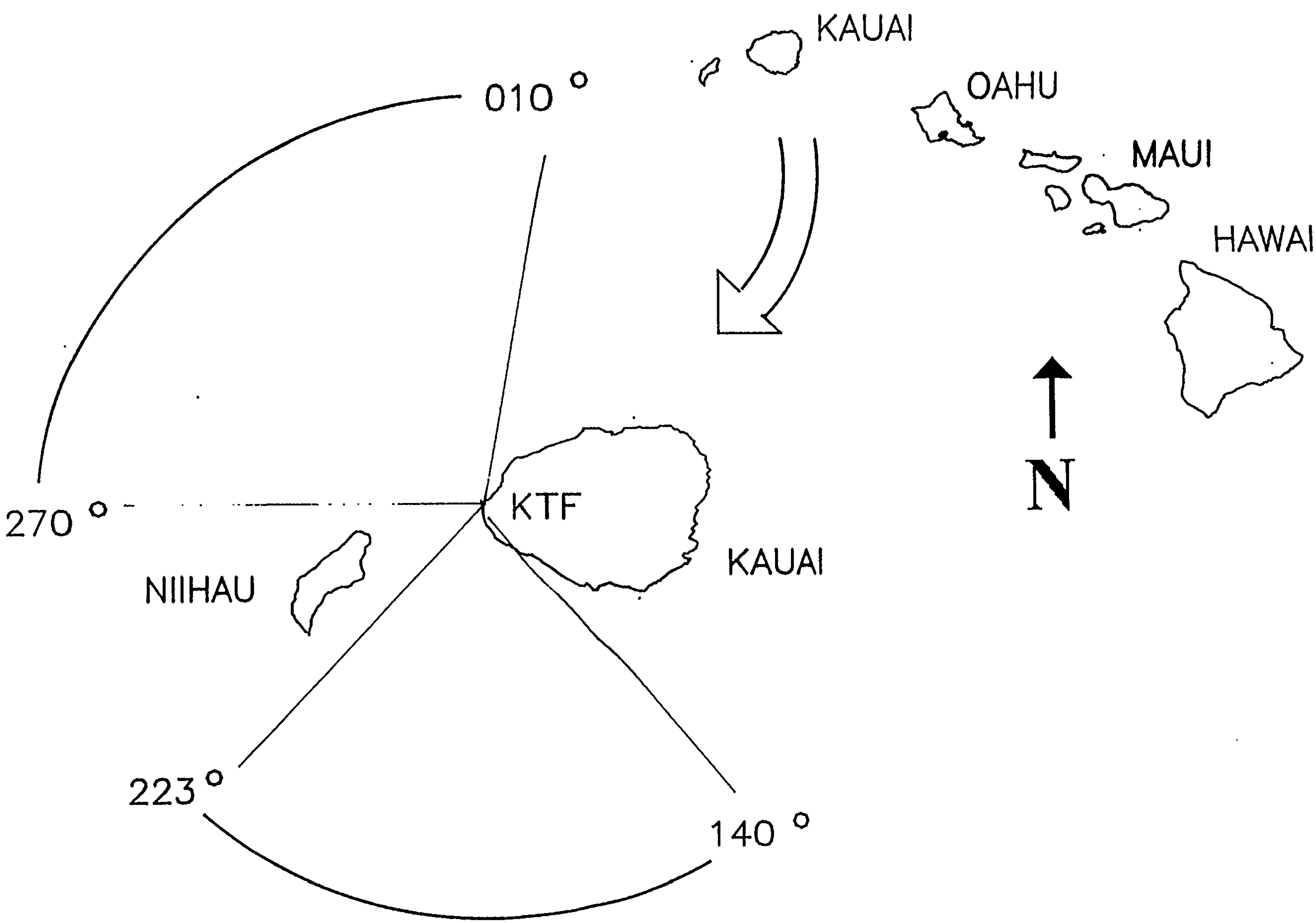


Illustration 2-2: The KTF Launch Azimuths.

The Island of Kauai, Hawaii

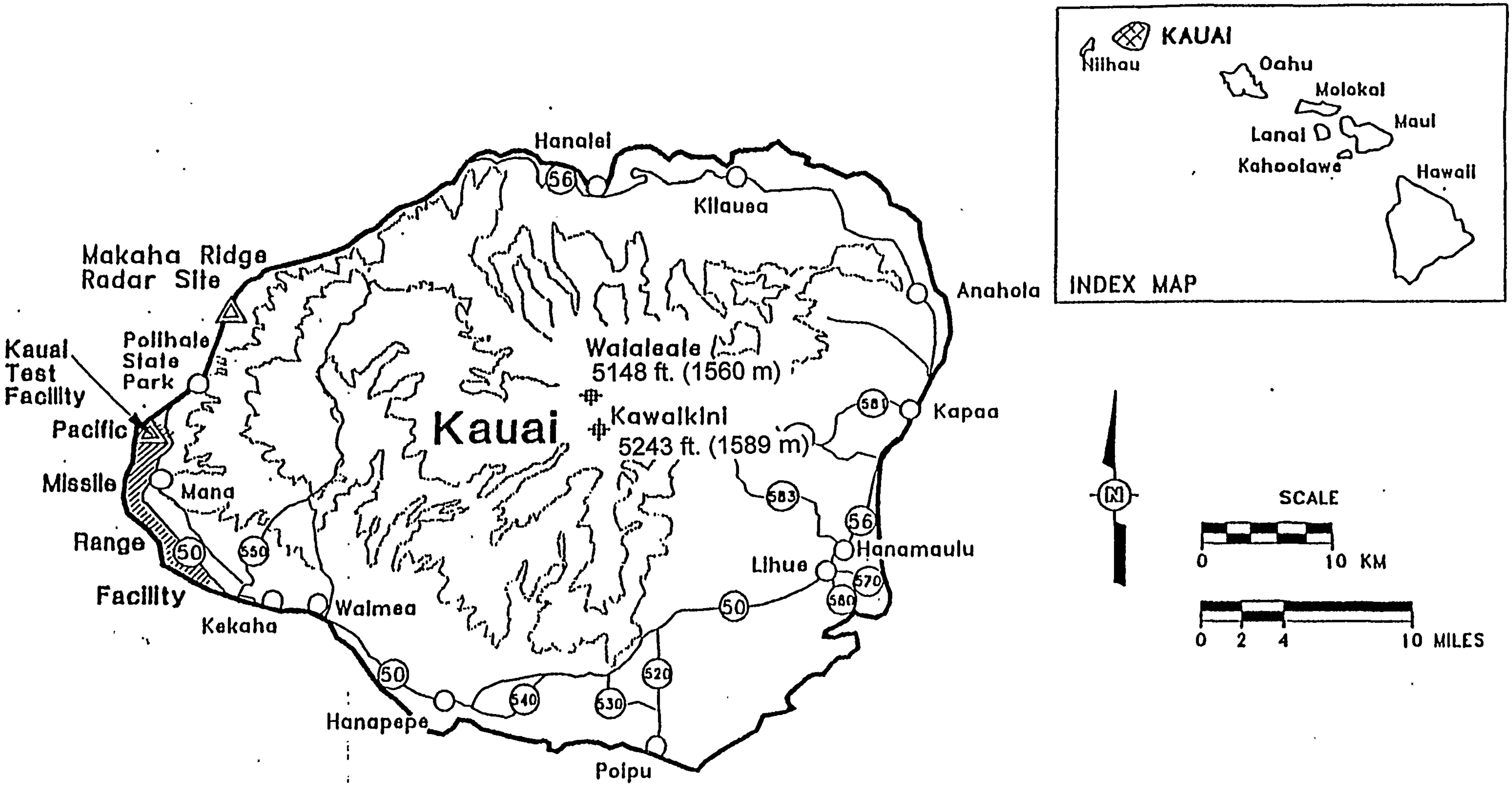


Illustration 2-3

These activities support DOE weapons research and development programs and selected reimbursable projects from other government agencies. Resources at the KTF are available for assembling, testing, launching, tracking, and recovering instrumented rockets, rocket payloads, and aircraft payloads. The facility provides a high-quality capability for receiving, recording, and quick-look playback of radio telemetered test data. In addition, combined resources at the PMRF and KTF feature extensive radar tracking and telemetry receiving and recording capabilities as well as radio communication system access to worldwide facilities of the DOD. Together, they provide a high quality, integrated capability for conducting a wide range of test operations.[50]

2.4 Facility Description

The KTF occupies approximately 125 acres (~500,000 sq. m) at the "Main Complex" and 2 acres (~8,000 sq. m) at the Kokole Point launch site approximately 6.5 mi. (~10.4 km.) south of the principle site. Both sites are contained within the PMRF.[51] The majority of the features and facilities, were constructed in 1962 in support of the National Nuclear Test Readiness Program (NNTRP).[52] Currently KTF has 87,000 sq. ft. (~8,172.6 sq. m) under roof in 21 major buildings and 73 minor buildings and trailers.[53] At the "main complex", two distinctly separate operational areas exist at KTF. The SNL "Main Compound" engaging in administrative activities and the "Launcher Field Area" engaging in launch activities. For a more detailed explanation of the KTF refer to Chapter 4 of SAND89-2548.[54]

2.4.1 SNL "Administrative" Compound

The KTF administrative area, or the Sandia Compound, is located within a fence near the North Nohili access road on the PMRF as shown in Illustration 2-4.

Note: The following information is from SAND89-2548.[55]

2.4.1.1 Balance Building

The Balancing Building is a "Permanent" 22X22 ft. (~6.6X6.6 m) steel structure with an eave height of 19 ft. (~5.75 m). It has corrugated aluminum roof and siding and is insulated with 2 ft. (~60 cm.) foil-faced fiberglass insulation. The building is equipped with a 2-ton (~1.8 metric ton) monorail and Class II, Division 2 electrical fixtures. The Treble Balance Machine is located in this building and is used to spin-balance payload assemblies.

2.4.1.2 Cable Termination Shelter (CTS)

The Cable Termination Shelter is a "Permanent" 14X28 ft. (~4.2X8.5 m) insulated wood frame structure, with an eave height of 9 ft. (~2.7 m), clad with corrugated aluminum roofing and siding. The Building functions as the main junction area for all of the range cabling, including signal and communication networks.

2.4.1.3 Payload Assembly Building

The Payload Assembly Building is a "Permanent" 40X81 ft. (~12.1X24.5 m) insulated wood frame structure, with an eave height of 10 ft. (~3.0 m), clad with corrugated aluminum roofing and siding. The facility is primarily used to assemble and test nonexplosive payloads for use in missile assemblies.

The Kauai Test Facility "Administrative" Compound

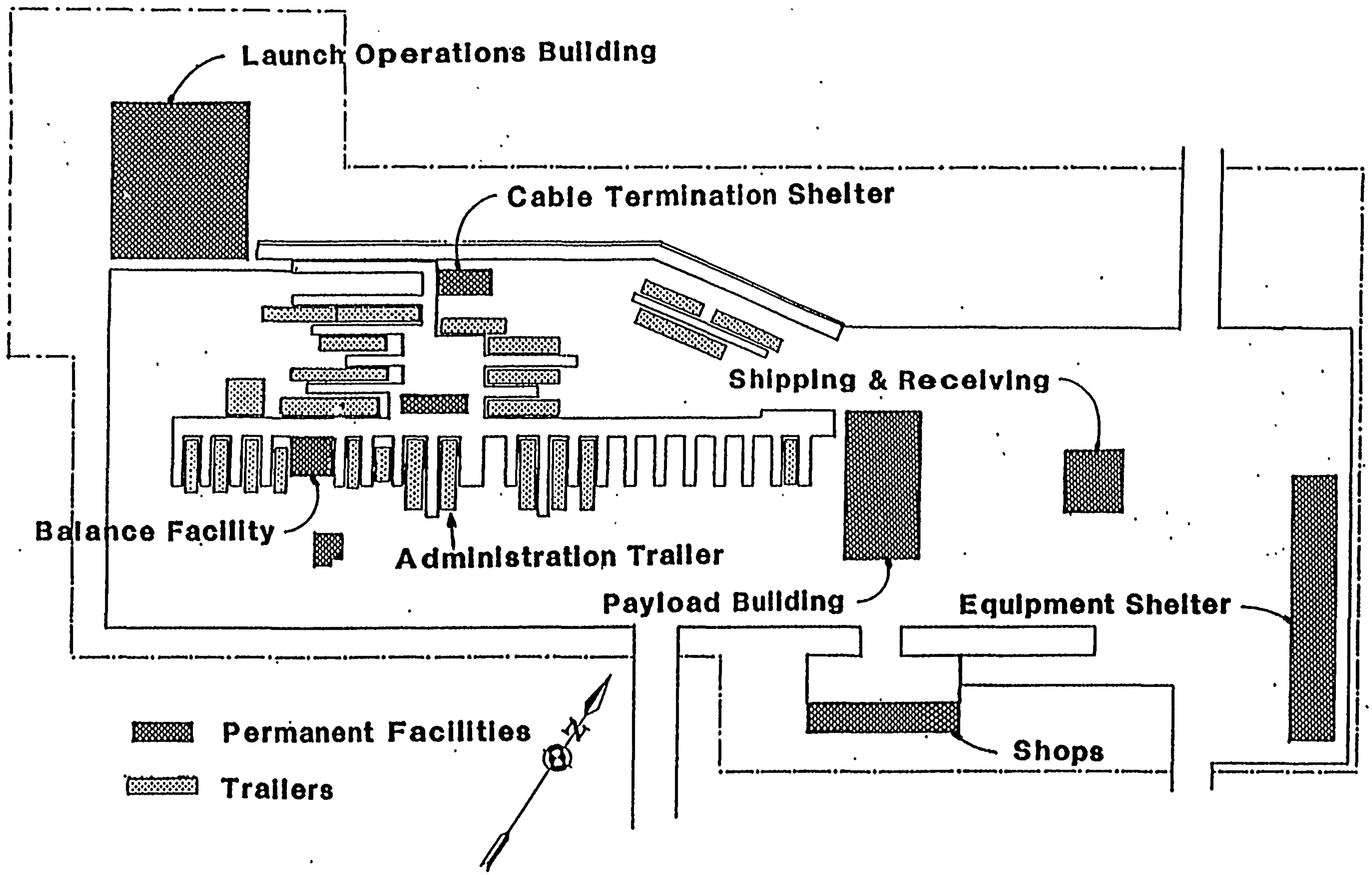


Illustration 2-4: **The Administrative Compound at the KTF Main Complex**

2.4.1.4 Maintenance Building

The Maintenance Building is a "Permanent" 16X75 ft. (~4.8X22.7 m) wood frame structure, with an eave height of 10 ft. (~3.0 m), with plywood exterior and corrugated aluminum roofing. It provides office/work area for the crafts support personnel and includes the KTF machine shop. The area outside the building is covered for storage and work area.

2.4.1.5 Shipping and Receiving

The Shipping and Receiving Building is a "Permanent" 30X58 ft. (~9.1X17.6 m) insulated pre-engineered metal building, with an eave height of 14 ft. (~4.2 m), clad with corrugated aluminum roofing and siding. It functions as the central shipping and receiving area for nonexplosive KTF Shipments.

2.4.1.6 Launch Operations Building (LOB)

The Launch Operations Building is a "Permanent" 56X74 ft. (~17X22.4 m) earth-covered, reinforced concrete structure with an eave height of 10 ft. (~3.0 m) . It is the central facility for all aspects of rocket launching and data-gathering at the KTF. The hardened building houses all of the computer, telemetry, command, transmitter, control console, and associated consoles to direct and control the missile launches at the KTF. It serves as operations control during launch activities. During launches of motor systems with smaller fuel inventories than a STARS Rocket personnel may be outside the LOB under designated covered areas

2.4.1.7 Latrine

The Lautrine is a "Permanent" 13X16 ft. (~3.9X4.8 m) wood frame structure, with an eave height of 8 ft. (~2.4 m), clad with aluminum roofing and siding. It has one shower, four toilets, three urinals and four sinks that outlet to the compound septic system.

2.4.1.8 Vehicle Shelter

The Vehicle Shelter Building is a "Permanent" 36X266 ft. (~10.9X80.6 m) wood roof structure supported by steel columns and enclosed on three sides. It is clad with aluminum roofing and siding. It functions as the parking/storage area for the wheeled equipment used for range maintenance.

2.4.1.9 Temporary Facilities

Within the fenced compound, a number of trailers and vans are interconnected with a network of concrete docks and covered walkways.

The KTF administrative offices are presently located in MO86. A number of the other trailers are used for administrative support and storage of radio equipment, supplies, drawing files, etc. The remainder of the trailers in the compound are used primarily to support personnel transient to the KTF for operations. They serve as office area for personnel not assigned a permanent operational station. During non-operational periods, they are in standby condition with only dehumidifiers in operation.

2.4.1.10 Transportainer Storage

Throughout the "compound" are a number of relocatable storage containers used primarily for supplies.

2.4.1.11 Revetment

The "compound" has a protective barrier separating it from the launcher field. The revetment is 300 ft. (~91 m) long, 15 ft. (~4.5 m) high, and constructed of timber and sand fill. It is 9 ft. (~2.7 m) wide at the base and 6 ft. (~1.8 m) wide at the top, and sloped on the launcher field side.

2.4.1.12 Security Fencing

The "compound" has a chain link fence with three strands of barbed wire on the outriggers. The fence has five locking gates in various locations, with two used on a daily basis.

2.4.1.13 Perimeter Lighting

The "compound" has perimeter lighting installed and is used primarily for lighting the compound for night operations.

2.4.1.14 Antenna Towers

Ther are three antenna towers, between the revetment and the security fence, used for communicating with rocket systems. The steel towers are 25, 28.6, and 38.6 ft. (~7.6, 8.6, and 11.7 m) high.

2.4.1.15 Generator Building

The site generation equipment is housed in the Generator Building a "Permanent" 32X32 ft. (~9.7X9.7 m) pre-engineered steel structure, with an eave height of 14 ft. (~4.2 m), with corrugated aluminum roofing, and concrete masonry walls. It houses all of the main switch-gear for the KTF power distribution system including the two 300 kilowatt (kw) generators sets used during launch operations.

2.4.2 Launcher Field Area

The KTF Launcher Field Area, shown in Illustration 2-5, lies between the "Main Compound" and the Pacific Ocean to the west. The launcher field was originally designed to accommodate 40 launch pads, but only 15 pads were constructed. Since the original plan, two additional pads have been constructed, Pad 41 at Kokole Point and Pad 42, the STARS launch pad. The site has a number of permanent facilities used to support the rocket operations.

2.4.2.1 Launcher Pad 1

Launcher Pad 1 is a "20k" or 20,000 pound (lb.) capacity rail launcher and concrete launch pad with blast plate. Adjacent to the pad is a small equipment shelter that houses electronic equipment.

2.4.2.2 Launcher Pad 15

Launcher Pad 15 is unique in that it can accommodate both a "7.5k" (7,500 lb.) or a "20k" (20,000 lb.) capacity rail launcher. A concrete launch pad with blast plate, is located at Pad 15. Adjacent to the pad is a small equipment shelter that houses electronic equipment.

The Kauai Test Facility Main Launcher Field

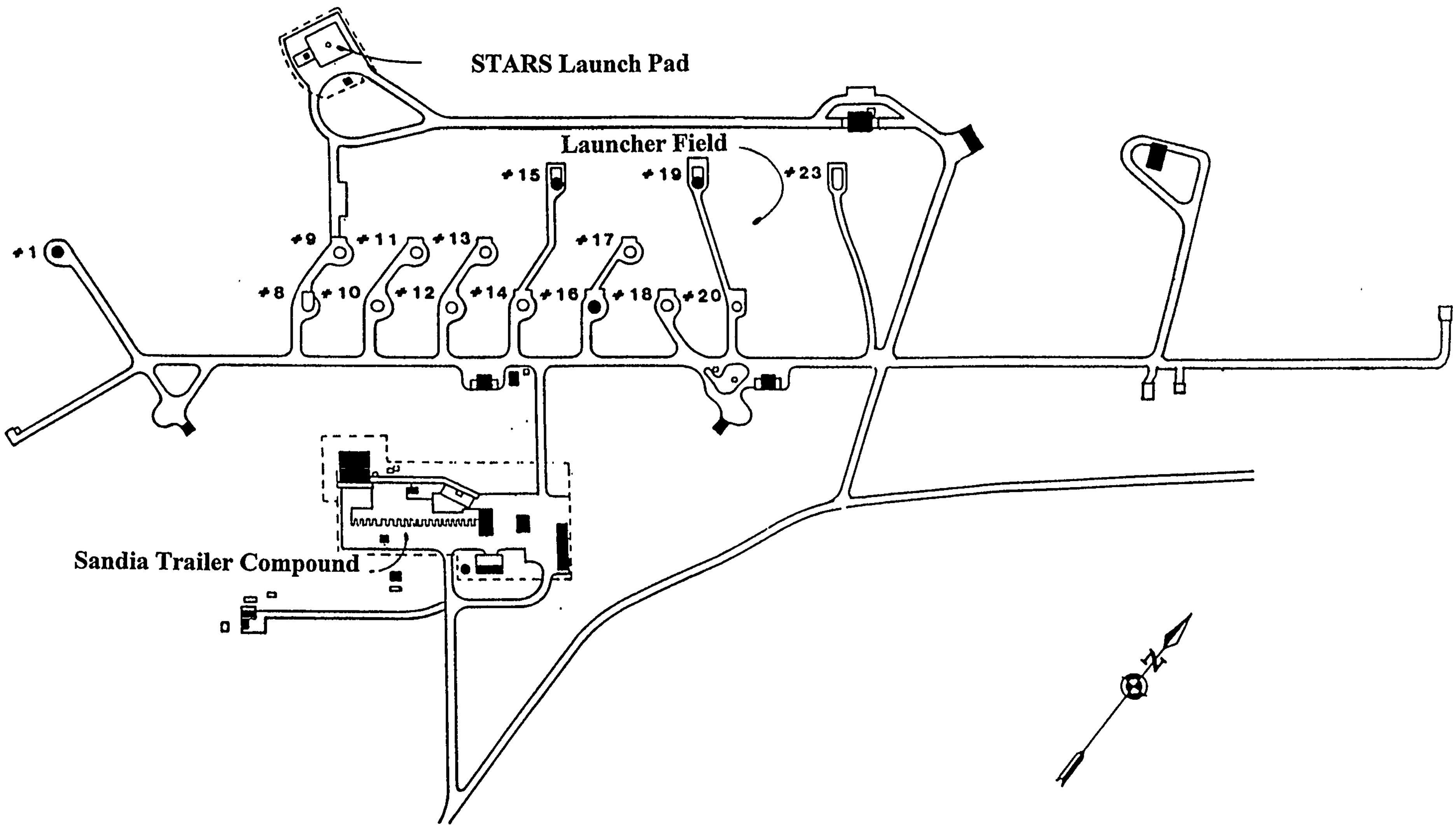


Illustration 2-5: KTF Site Plan

2.4.2.3 Launcher Pad 19

Launcher Pad 19 is a rail launcher used for small rockets and has a capacity of "7.5k" (7,500 lb.). It is mounted on a concrete pad and has a small container housing electrical equipment nearby.

2.4.2.4 Launcher Pad 41, (Kokole Point Pad)

Launcher Pad 41 is similar in construction and configuration as Pad 19 with an associated equipment building. It has a "7.5k" (7,500 lb.) rail launcher and is used to launch at different azimuths than any other launchers at the main launch area. It is located remote to the KTF on the southern end of the PMRF as shown in Illustration 2-6.

2.4.2.5 Launcher Pad 42, (STARS Pad)

Launcher Pad 42 (STARS Pad) is a 100X100 ft. (~30X30 m) concrete slab with a 3/4 in. (~1.9 cm.) thick steel blast plate, missile launch ring, and an umbilical mast located in the center section. The concrete slab varies in thickness from 20 in. (~51 cm.) to 30 in. (~76 cm.). It is used to support vertical STARS launches.

2.4.2.6 Assembly Buildings II and III

Assembly Buildings II and III are "Permanent" buildings, identical in size and construction, are 36X36 ft. (~10.9X10.9 m) wood frame structures, with an 8 ft. (~2.4 m) eave height, with corrugated aluminum roof and siding. Each building has two monorails with chain hoists installed. The buildings are used to assemble the test payloads and small rocket assemblies.

2.4.2.7 Missile Assembly Building (MAB)

The Missile Assembly Building is a "Permanent" building is also known as the MAB for the STARS operations. It is a 50X68 ft. (~15.1X20.6 m) pre-engineered, 2,400 sq. ft. (~220 sq. m) metal building, with an eave height of 27 ft. (~8.2 m), high bay area containing 10 and 20 ton (~6 and 12.1 metric ton) overhead bridge cranes. The remaining balance of the facility provides office and light laboratory space for calibration, instrumentation and guidance systems assembly and checkout. It provides the staging and assembly area for the rocket system components.

2.4.2.8 (MAB) Equipment Shelter

The MAB Equipment Shelter is a "Permanent" 40X75 ft. (~12.1X22.7 m) pre-engineered metal building, with a eave height of 14 ft. (~4.2 m), is enclosed on three sides with enameled steel siding. The roof is covered with galvanized sheets. It is used to store handling equipment used in the STARS program.

2.4.2.9 Annex Buildings 1, 2 and 3

Annex Buildings 1, 2, and 3 are "Permanent" 21X30 ft. (~6.4X9.1 m) wood frame storage buildings, with a eave height of 8 ft. (~2.4 m), possesses plywood sides and corrugated aluminum roofing. Building 2 and 3 are adjacent to Assembly Buildings 2 and 3. Building 1 is located southwest of 2 and does not have an associated assembly building. All are equipped with standard electrical fixtures and cannot be used to handle explosives. They are presently used to store nonexplosive components used in various missile configurations.

The Kauai Test Facility Kokole Launch Site

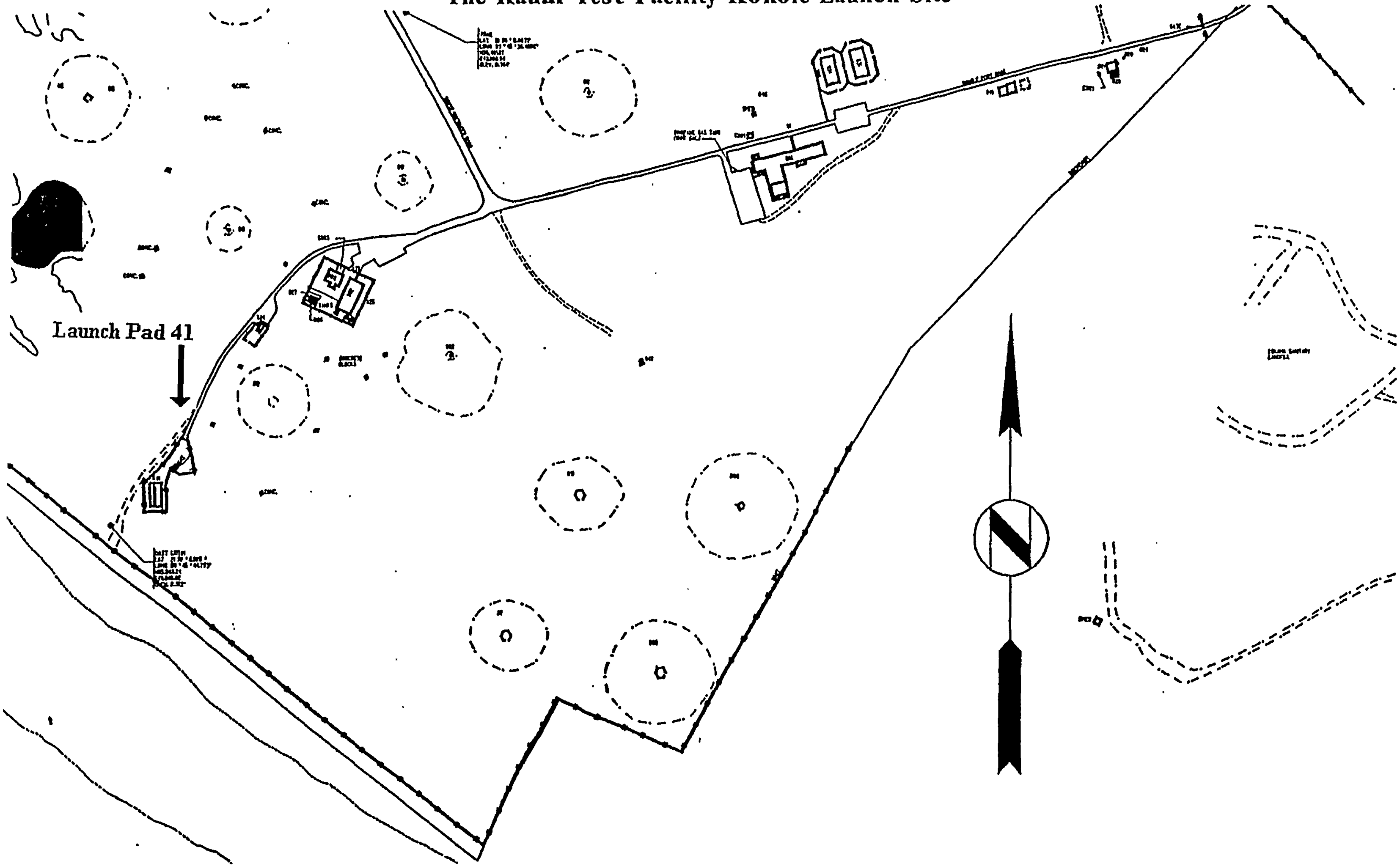


Illustration 2-6: **The KTF's Kokole Launch Site on the South End of the PMRF**

2.4.2.10 Rocket Motor Staging Area

The Rocket Motor Staging Area is a "Permanent" 40X82 ft. (~12.1X24.8 m) pre-engineered metal building, with a eave height of 21 ft. (6.4 m), possesses openings in the sides for ventilation. It is equipped with a 4 ton (~3.6 metric ton) bridge crane with pendant controls. The facility is used to assemble missiles when other facilities are in use.

2.4.2.11 Auxiliary Equipment Building, Pad 42 (AEB)

The Auxiliary Equipment Building is a "Permanent" 12X24 ft. (~3.6X7.3 m) concrete masonry structure, with a eave height of 9 ft. (~2.7 m), is used to house direct current (DC) power supplies and associated electronic equipment racks.

2.4.2.12 Balloon Release Building

The Balloon Release Building is a "Permanent" 13X13 ft. (~3.9 m) wood frame structure, with a eave height of 11 ft. (~3.3 m), is sided with plywood, and provides a protected area to inflate balloons that carry radar reflectors into the atmosphere.

2.4.2.13 Radar Site

The site includes two X-band tracking radar, control trailers, and adjacent work trailers connected with a concrete dock and a roof. They functions to provide aeroballistics wind information through balloon tracking.

2.4.2.14 Ignitor Building

The Ignitor Building is a 9X9 ft. (~2.7X2.7 m) radio frequency (rf) shielded steel, pre-manufactured shelter, with a eave height of 8 ft. (~2.4 m), is used for the testing and checkout of initiators and ignitors used in missile assemblies.

2.4.2.15 Missile Service Tower (MST)

The Missle Service Tower is a 16X16 ft. (4.8X4.8 m) steel-framed, metal-panel, enclosed, mobile 54 ft. (~16.4 m) tall tower, located at Pad 42. It provides service access to the STARS missile before launch. Four levels are provided to gain access to all of the missile components.

2.4.2.16 Launcher Field Security Fencing

The chain-link fencing provides security and asset protection at the beach access, the launch pad complex, and at the North Nohili access road.

2.4.2.17 Security Lighting

Many of the buildings at the KTF (e.g. the MAB, MST, AB II, RMSA) have security lighting attached to the buildings that illuminate the surrounding sites. In addition, the launch pads have lights around the perimeters to illuminate the pads and the missiles.

2.4.3 General KTF Site Features

Utilities that are common to both the SNL Compound and the Launcher Field are as follows:

2.4.3.1 Fuel Storage

The KTF has a 2,500 gallon (gal.) or 9,500 liter (l) underground fiberglass tank for unleaded gasoline, a pump, and a leak detection system.

2.4.3.2 Electrical Supply

The KTF electrical system is fed from the Kauai Electric Co. (KECO) through a transformer and switching network located in the main substation via a 12,470-volt line. Two 300-kw generators, located in the substation, are tied to this switching network to provide emergency power. From the main substation, power is distributed to the SNL compound and the launcher-field substation transformers through direct burial cables.

2.4.3.3 Diesel Storage

Site diesel fuel is provided by a 10,000 gal. (~38,000 l) above ground, steel storage tank. It has a direct line to the emergency generator day tanks and a pump for vehicle refueling.

2.4.3.4 Roads

The KTF compound's main access road called the D.O.E. Trail branches off North Nohili road. The Launcher fields have two main access roads, one from the compound and the other northeast of the compound off North Nohili. In the launcher field, there is a loop road connecting the major facilities with several service roads to the launch pads.

2.4.3.5 Domestic Water

Water for the domestic consumption and fire fighting purposes at the KTF is provided by the PMRF through the KTF water mains. An 8 in. (~20.3 cm.) loop water main supplies domestic and fire water service to the LOB, MAB, and MST. The PMRF obtains its water from two sources: the Mana Well and Kauai County. The Mana Well, owned and maintained by the Kekaha Sugar Company, is a backup water supply for the northern portion of the PMRF via 2 mi. (~3.2 km.) of large-diameter pipeline. The Mana Well is a high-level water tunnel located at Kamakala Ridge in the mountainous area east of the KTF. Kauai County, the other water source, maintain wells in the town of Kakaha.

2.4.3.6 Septic System (SNL Compound, LOB, and MAB)

Sanitary wastes from facilities are disposed of by on-site septic systems. Numerous studies have shown that 2 to 4 ft. (~60 to 120 cm.) of unsaturated soil is sufficient to remove bacteria, viruses, and phosphorus to acceptable levels. The on-site soil is capable of treating the effluent and does not pollute the groundwater. The total volume of effluent is small and the groundwater is not used for any purpose on or off-site.

The compound is served by a 2,100 gal. (~7,980 l) capacity, concrete septic tank with an 8 ft. (~2.4 m) dia. leaching pit. It services the latrines, sinks, a water cooler, and a residential size washing machine.

The LOB is served by a 1,200 gal. (~4,560 l) capacity, concrete septic tank with a distribution box and three 115 ft. (~34.8 m) leach lines. It is fed from two toilets, two urinals, three sinks, a water cooler, and eight floor drains.

The MAB is served by a 750 gal. (~2,850 l) capacity, concrete septic tank with a distribution box and three 55 ft. (~16.6 m) leach lines. It is fed from one water cooler, one toilet, one sink, one shower, and one floor drain.

2.4.3.7 Communications Systems

Multiple systems for communication at the KTF are present in the following forms:

- 10 telephone lines connected to the KTF switch (a solid-state digital switch) with 200 station lines Touch-Call Telephone System
- 3 telephone lines with limited distribution at the KTF
- 1 telephone line connected directly to the Haleakala Facility
- Cellular telephones (currently 2)
- Pagers (currently 10)
- 5 DOD/Department of the Navy (DON) telephone lines limited to the KTF
- A site wide Public Address system
- A nearly site wide intercom system
- 4 Simplex Nets (VHF) for communications at KTF. Two of the nets are local area only (wherever the radios are within line-of-sight communications), while 2 of the nets provide island wide communications (currently Kauai, Oahu, and Maui; Hawaii and Johnston Atoll are options that could be implemented given program requirements). DOE/PASO (and their M&O, RSN) on Oahu also have access to the inter-island nets.
- HF radio (for emergency communications with the mainland)

2.4.3.8 Fire Detection and Alarms

The fire alarm systems (installed in the AEB, MAB, and LOB) consist of ionization, photoelectric-type detectors. Detectors are located in the ceilings, and under the floor in computer areas. Pull stations are also located at building exits.

All fire detection devices alarm and ring fire bells. In turn, the Fire Alarm Control Panel signals the PMRF fire department.

Panic switches which operate a "deluge system" and fire alarm are located on the MST's second, third, and fourth floors. Pull stations are located at the exits of all buildings.

2.4.3.9 Explosion Protection

All explosive-handling facilities have electrical systems installed that comply with DOD and DOE Standards. They are tested once a year and/or before each use. Personnel protection (e.g., grounding wrist bands) are utilized in compliance with SOPs and DOE requirements.

Dragging ground straps are installed on all explosive transport dollies. All cranes, hoists, lifting equipment, and ground handling equipment is inspected and tested before any operation.

2.4.3.10 Potential Gradient System

To warn personnel of high-potential gradients, three field mills are installed on the KTF site to monitor potential gradient in the atmosphere. The system has audible alarms and is monitored in the LOB.

2.5 Process and Operations

Three general operations at the KTF involve hazardous processes at the KTF. These operations are categorized as follows: solid rockets, liquid propellants, and payload assembly. Rarely are there recovery operations, as most payloads impact in the Pacific Ocean in deep water. Operations requiring recovery of potentially hazardous items are controlled with operation-specific SOPs. [56]

2.5.1 Solid Rockets

Note: Both Rail Launches and Vertical Launches of solid propellant motor configurations are assembled and flown from the KTF. Other than differences in mission, stages, payloads, and hardware, they are all handled, tested, and assembled basically in the following process.

Process Number 1: (Ordnance Receival) Rocket Motors and associated explosives for the initiating train are shipped to the PMRF via surface transportation or military aircraft. All initiating devices are packaged separately for transportation and kept separately at the KTF until required for final rocket ordinance installation.

After the ordnance is off-loaded, the shipments are uncrated and taken to their assigned assembly building.

Process Number 2: (Rocket Assembly) In the assembly building (depending on the rocket system), some rocket motors are tested for leaks by pressurizing the motor with inert gas. After any such required inspection or test, the motor ignitors are installed along with the related structural and guidance components.

All electronic subsystems are tested and qualified for flight during the final test. All of the assembly activities are done in accordance with a vehicle-specific Standard Operationg Procedures (SOPs).

Process Number 3: (Rocket Staging "Rail Launches") The first-stage assembly is moved to the launch pad and installed on the launcher rails using the appropriate ground-handling equipment and chain falls suspended from beams on the launcher.

In the assembly building, the payload and the remaining rocket stages are mated and readied for final assembly on the launcher.

The payload assembly is moved to the launch pad and elevated to the approximate level of the first stage. All electrical connections are made and the stages are mechanically mated.

Upon completion of all assembly operations and before final arming, the launcher is elevated to its programmed position, and final system tests are completed.

Final arming of the rocket first-stage is completed about 30-minutes before scheduled launch.

(Rocket Staging "Vertical Launches") The assembled missile is moved to the Missile Launch Pad on the transporter/erector, hydraulically elevated to the vertical position, then lifted onto the launch stool with a crane. The MST is moved into position around the missile and provides access to the missile during launch preparation. Launch preparations include missile/range compatibility tests and final missile arming. During the last hour of launch countdown, the MST is moved back to its stowed position, exposing the missile for launch.

2.5.2 Liquid Propellants

Process Number 1: (Hypergolic Propellant Receival) Hypergolic propellants have been shipped to the KTF in two basic ways: in non-bulk packages (vehicle stage fueling takes place at the KTF); or as a pre-fueled assembly (e.g., payload with hydrazine used as a monopropellant). Packaging and transport of these propellants meet or exceed federal requirements. Shipments to the KTF of non-bulk UDMH and NTO have included movement by truck, ship, and charter air. The air leg, from Oahu to Kauai, required a DOT exemption, use of multiple physical barriers, in-flight monitoring, and crew protection measures. Shipment of pre-fueled assemblies has been by military aircraft. (Use of hypergolic propellants at KTF to date has been for various Work-For-Others programs. Other government agencies arranged for procurement and transportation to the KTF. Sandia direct oversight responsibility does not occur until the propellant arrives at the KTF.) Transport of these materials on the PMRF or KTF is accompanied by a spill response team (typically NASA WSTF personnel for the STARS program), and a structural fire truck (dilution with water rapidly removes fire and toxicity hazards). Emergency planning, response equipment, and training (including evacuation) are in place before new hypergolic propellant shipments arrive. Once hypergolic propellants are received at the KTF they are placed in designated storage areas. Non-bulk packages have specially designed and built holding pads to provide additional containment and weather protection. While these propellants are in storage (non-bulk or pre-filled), weekly sampling is conducted to assure that the primary container is intact.

Process Number 2: (Fueling) When non-bulk packages of propellants are supplied for a vehicle, a fueling operation at the KTF must take place. This is accomplished by employment of and strict adherence to vehicle-specific SOPs. All onsite movement of propellants and the fueling process are carried out with strict personnel access controls and accountability, direct support of spill response teams and structural fire trucks, and a high-level of oversight. Fueling takes place in paved areas that have secondary containment and water sprays (rapid wash-down to remove health and safety concerns if propellant is spilled). Emergency response equipment and evacuation procedures are in place during fueling.

Note: Fueling is defined as the process in which a fuel, and an oxidizer, are loaded into a vehicle.

Process Number 3: (Final Assembly and Test) Fueled vehicle stages and payloads may require additional assembly and testing before installation on the vehicle stack. Such processes are always done in accordance with specific SOPs, and have provisions for secondary containment and personnel safety. This step may also include temporary storage while awaiting further processing. During such times, sampling programs of secondary containments and buildings are conducted to assure primary vessel integrity.

Process Number 4: (Upload) At the appropriate point in vehicle processing, the hypergolic fueled assembly will be uploaded and mated. This is accomplished with direct oversight, use of specific SOPs, and has a spill response team and structural fire truck standing by. Final STARS vehicle assembly and test (which takes place inside the MST) is supported by a water deluge system in case of a propellant leak.

2.5.3 Payload Processing

Process Number 1: (Ordnance Receival) After the ordnance is off-loaded, the shipments are uncrated and taken to their assigned assembly building. Payload Motors and associated explosives for the initiating train are loaded during final rocket ordinance installation.

Process Number 2: (Payload Assembly for Rail Launches) In the assembly building, the payload and the remaining rocket stages are mated and readied for final assembly on the launcher.

Process Number 3: (Payload Installation for Rail Launches) The payload assembly is moved to the launch pad and elevated to the approximate level of the first stage. All electrical connections are made and the stages are mechanically mated.

Process Number 4: (Payload Assembly for STARS Launches) Payloads are assembled and checked out independently of any missile stages.

Process Number 5: (Installation for STARS Launches) The stages are then moved to either the missile or the PBV for mating with the propulsion system.

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 Emergency Management Program for the KTF and to screen out those hazards that pose minimal risk to the health and safety of the onsite worker or general public. Those hazards identified by the screening process that pose a significant risk are further evaluated in Section 4.0.

3.1 Identification and Screening of Onsite Hazards

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

- immediately threaten those who are in close proximity to the release,
- have the potential for dispersal beyond the immediate vicinity in quantities which threaten the health and safety of onsite personnel or 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 KTF consisted of the following steps: (a) reviewing the most current PHAs, (b) reviewing past chemical inventories to determine the maximum historical quantities, (c) reviewing the most recent chemical inventories, and (d) conducting walkthroughs of the facility to verify that the current inventory was complete and accurate.

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

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

3.1.1 Screening Criteria

The Emergency Management Guide (EMG) for Hazard Assessments states, in part, "...screening quantities or thresholds should be used to eliminate the need to analyze insignificant hazards." 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. Therefore, for the purpose of hazards assessments, such chemicals can be eliminated from further evaluation.

Quantity of Material

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

Toxicity of Material

For those chemicals exceeding one pound, the MSDS and/or the Hazardous Chemical Desk Reference 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 (212 ° F),
- be a powder of greater than 10 microns, or
- cannot conceivably be involved in a high energy event such as 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. 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 m (~100 ft.). The distance of 30 m (~100 ft.) was selected because the facility boundaries existing at all SNL/NM facilities are, at a minimum, 30 m (~100 ft.). An ERPG-1 at 30 m (~100 ft.) or greater would constitute a minimum of an alert emergency classification. Emergency classifications are described in section 6.2.2.

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

3.1.1.2 Radiological Hazards

For radioactive materials, the screening criteria is based on 10 CFR, Part 30.72, Schedule C which lists radioactive materials that require consideration for emergency planning. Any radioactive materials that exceed the quantity in curies in 10 CFR, Part 30.72, Schedule C, are kept for further evaluation and characterization. All other radioactive materials are considered insignificant hazards and are removed from further evaluation.

3.2 Identification and Evaluation of Hazards not Owned or Controlled by SNL/KTF

The objective of a hazards assessment is to determine the type and extent of planning and preparedness that is appropriate for each facility/site. Hazards originating outside the DOE facility and/or site that could impact the health and safety of onsite personnel or other DOE interests are identified and examined.

Facilities with hazards not owned or controlled by the KTF (e.g., PMRF waste water treatment plant and agricultural activities), airways, highways, railroads and utility transportation arteries were considered as possible locations of hazardous material accidents that could impact the KTF.

Once offsite facilities that could have a potential impact in the operation of the KTF were identified, facility visits were made to obtain hazardous material information and determine the appropriate contacts for the future. Additional personnel were consulted to provide information on any airways,

Highways, railways and utility routes could have an impact on the operations of the KTF. The effects on the facility by 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 and joint response.

3.2.1 PMRF Facilities

The PMRF SARA Title III Community Right-To-Know List was utilized to identify offsite facilities with hazardous material inventories large enough and within a reasonable distance of either of the two KTF EPZs (5 km. or ~3.12 mi. for the "Main Complex" and the PMRF site boundary for Kokole Point) that could have a negative impact on the operation of the KTF. As additional information becomes available it will be incorporated into the HAD as needed. The materials and their locations are listed below:

- Building 415 on the northwestern end of the PMRF runway is located approximately 5,000 ft. (~1.5 km.) from the KTF "Main Complex" and approximately 23,350 ft. (~7.0 km.) from the Kokole Point launch site. The only hazardous material located at this facility with the potential to affect the KTF's operations is a 150 lb. (~68.2 kg.) cylinder of Chlorine.

- Building 419 on the northwestern end of the PMRF runway is located approximately 5,000 ft. (~1.5 km.) from the KTF "Main Complex" and approximately 23,350 ft. (~7.0 km.) from the Kokole Point launch site. The only hazardous material located at this facility with the potential to affect the KTF's operations is 200 gal. (~760 l) of Sodium Hydroxide.

- Building 394 just north of the PMRF main gate is located approximately 8,000 ft. (~2.4 km.) from the KTF "Main Complex" and approximately 20,000 ft. (~6.1 km.) from the Kokole Point launch site. The only hazardous material located at this facility with the potential to affect the KTF's operations is a 150 lb. (~68.2 kg.) cylinder of Chlorine.

- Building 338 just west of the PMRF main gate is located approximately 10,000 ft. (~3.0 km.) from the KTF "Main Complex" and approximately 18,350 ft. (~5.6 km.) from the Kokole Point launch site. The only hazardous material located at this facility with the potential to affect the KTF's operations are four 150 lb. (~68.2 kg.) cylinders of Chlorine.

- Building 821 in the southeastern corner of the PMRF is located approximately 1,800 ft. (~546 m) from the KTF Kokole Point launch site and approximately 36,500 ft. (~10.1 km.) from the "Main Complex". The only hazardous material located at this facility with the potential to affect the KTF's operations is a 150 lb. (~68.2 kg.) cylinder of Chlorine.

Note: As a result of flight activities materials may be present on the PMRF in quantities that could affect the KTF's operations. However, they are transient and only on the PMRF site for brief periods of time usually due to refueling activities. Additional information concerning these materials will be incorporated, as it becomes available.

3.2.2 Agricultural Activities

Agricultural activities utilizing chemical fertilizers could pose a hazard to KTF personnel. An example of one such chemical commonly employed in agriculture is listed below.

- Anhydrous Ammonia is commonly transported and stored in tanks as large as 1,000 gal. (~3,800 l) in agricultural applications. This material is stored in gaseous form under pressure. Chemical fertilizers could be involved in an incident in a field as close as 200 m (~660 ft.) from the KTF "Main Complex".

Note: There is some question as to whether or not sugar cane farming will continue in the future. Therefore, this hazard would not be of concern to the KTF. However, additional hazards may result. Attention to such hazards may be warranted at that time.

3.2.3 Transportation and Utilities

Airways, highways, railroads and utility transportation arteries were considered as possible locations of hazardous material accidents that could impact the KTF.

3.2.3.1 Airways

Note: Information concerning airways near the PMRF and KTF is referenced from SAND89-2548.[57]

The PMRF runway flight paths are situated so the KTF lies just outside the high hazard zones at the end of the run ways. However aircraft often do pass over the KTF on takeoffs, landings, training exercises (e.g., helicopters and jet aircraft engaging in evasive maneuvers). The airspace to 10,000 ft. (~3,030 m) Mean Sea Level (MSL) over the PMRF and the KTF is controlled by the PMRF air-traffic controller. Commercial Aircraft are allowed into this controlled airspace only if authorized.

The PMRF maintains a launch facility that is used to prepare and launch target drones and small weather rockets for Navy operations. The launches occur at launch azimuths of the 290° to 350° and do not include the KTF in the flight paths. However, the KTF is evacuated for launches of Vandal motors at this facility. Operations are coordinated with the KTF to provide timely notification of launch operations.

The PMRF conducts operations on the beach area to the west of the KTF. These include target practice with 20mm Vulcan antiaircraft, 7.62mm and 5.56mm ammunition and the firing of Stinger and Redeye missiles at ballistic aerial targets.

3.2.3.2 Highways/Cane Roads/PMRF Roads

Route 50, a paved two lane road, runs approximately 35 mi. (~56 km.), in a westerly direction, from Lihue along the south end of the island ending just outside the PMRF. Route 50 can be an additional route of delivering resources which are off-loaded, from ocean going vessels, at Port Allen, Kauai.[58]

The pavement continues from the PMRF to caves in the cliffs east of the PMRF. These caves are used as long-term storage of Navy and KTF explosives and are far enough away to pose no hazard to the facility.[59] These caves belong to and are the responsibility of the PMRF.

A road continues beyond the pavement to the Polihale State Park North of the PMRF. The majority of this road is unimproved (dirt) and supports recreational and agricultural traffic.

3.2.3.3 Sea

Resources that cannot be shipped via air transport directly to the PMRF can travel by sea and be off loaded on the beach at the PMRF.[60] In addition the ocean in front of the KTF are for commercial fishing and recreational purposes.[61]

3.2.3.4 Utilities

Electricity under normal conditions is supplied to the KTF by the Kauai Electric Company (KECO) during non-operational periods. Electricity is supplied to the KTF via above ground lines. In the event of commercial power failure or during critical or high demand periods (exceeding 75 kW or a preset level), backup generation (two 300 kW generators) will automatically start and the total peak load is shifted to on-site generation, in-phase, make before break. During operational periods, peak loads occur early each working day, initiating generation. At the end of the work day reduced loads return the system to KECO.[62]

Diesel and unleaded gasoline are delivered to the KTF via tanker truck.

3.2.4 Natural Phenomena

The island of Kauai is located in the Pacific Ocean and has a land mass of 627 sq. mi. (~1,605 sq. km.) It is subject to several types of Natural Hazards. These hazards are described below and were referenced from SAND89-2548. [63]

3.2.4.1 Floods (Caused by Rain Run-Off)

The KTF is not an area prone to flooding. The average rainfall at the KTF is 20 in./yr. (~51 cm./yr.) and as such, most rains drain off rapidly. However, because of its large asphalt pad the SNL compound is drained with a number of dry wells. On the rare occasion that the wells cannot accommodate the volume, portable sump pumps are available to assist in removing the water from the compound. The only facility in the compound in jeopardy from flooding caused by rain is the LOB (because it is at ground level). In the event water entered the building, it would drain to the subfloor area in the computer room and drain out through the network of under-floor drains. Because all power and signal cabling is elevated above the subfloor, little or no damage would result.[64]

3.2.4.2 Hurricanes/High Winds

As mentioned previously (in Section 2.1.2.1) the Hawaiian Islands are located in an area of the Pacific Ocean that possess semistationary atmospheric eddies and, therefore, are not often subjected to severe weather.[65]

However, in November of 1982 and September of 1992 Kauai suffered substantial damage from Hurricane Iwa and Iniki respectively. The winds of Iwa were in excess of 80 mi. per hour (mph.) or ~128 km./hr. while those of Iniki were in excess of 100 mph. (~160 km./hr.). There is a hurricane warning system in place to allow for personnel to evacuate the area.[66]

3.2.4.3 Tidal Waves and Tsunamis

The facilities at the KTF are not designed to withstand tidal waves generated by hurricanes or seismic events (due to the low probability of their occurrence). A tidal wave of extreme proportions could certainly pose a threat to the KTF. However, Kauai has a tsunamis warning system, therefore, time to evacuate endangered personnel and secure equipment to reduce damage or loss should exist.[67]

3.2.4.4 Volcanic Eruptions

Kauai and the rest of the Hawaiian chain were formed by volcanic eruptions. The only volcanoes in the eight major Hawaiian Islands that have shown activity this century are Mauna Loa and Kilauea on the big island of Hawaii. Volcanic eruptions on the island of Hawaii are commonly preceded and accompanied by thousands of earthquakes, but only a few are strong enough to be felt.[68]

3.2.4.5 Earthquakes

The largest recorded earthquake in the Hawaiian Islands was on April 2, 1868. It was estimated at 7.5 to 7.75 on the Richter Scale. The earthquake was felt at Kauai, but no damage was reported. Since Kauai is the oldest of the eight major islands, it is considered to be well suited for the KTF, and has received little damage due to earthquakes.[69]

All buildings constructed since 1987 have been designed to withstand seismic events expected to occur in Seismic Zone 2 areas. Structural failures are not expected to occur should a typical Zone 2 seismic event occur. Seismic Zones for the Hawaiian Islands range from Zone 0 to Zone 3, with Kauai categorized as a Zone 0.[70]

3.2.4.6 Lightning

No lightning strikes at the KTF have been recorded in recent history. All of the explosive-handling facilities have lightning protection in the form of lightning air terminals and counterpoise ground systems. These systems are designed to protect the facilities and its contents if they are stuck. A potential radiant measuring system is in place and monitored during all hazardous operations.

Operations are stopped if the potential exceeds 2,000 v/m.[71]

3.2.4.7 Fire

Fires, primarily ground cover or electrical, could be initiated by any one of several methods (i.e., lightning, rocket launch, electrical systems, hot equipment, careless persons, etc.). Fire poses a credible hazard to SNL personnel and property. Although, the KTF personnel are the first responders to a fire the PMRF Fire Department is the primary responders.[72]

3.3 SUMMARY

3.3.1 Onsite Hazards

As a result of the screening of chemical and radiological hazards at the KTF, two chemicals from inventory and six chemicals in the form of exhaust byproducts, resulting from combustion of various rocket systems utilized at the KTF, were found to exceed the chemical screening criteria. No radiological materials exceeded the radiological screening criteria. Hazards summarized on Table 3.1 will be further evaluated and characterized in Section 4.0.

Table 3.1

KTF Hazardous Material Summary

MATERIAL	LOCATION	INVENTORY	
CHEMICAL			
Inventory			
1. Unsymmetrical Dimethylhydrazine	UDMH Storage Pad	412.5 lb. 55.0 Gal.	(~188 kg.) (~209 l)
2. Nitrogen Tetroxide	NTO Storage Pad	665.5 lb. 55.0 Gal.	(~302.5 kg.) (~209 l)
EXHAUST BYPRODUCT			
1. Aluminum Oxide	Atmosphere	11,246.0 lb.	(~5,112 kg.)
2. Chlorine	Atmosphere	45.0 lb.	(~20.5 kg.)
3. Carbon Monoxide	Atmosphere	8,358.0 lb.	(~3,800 kg.)
4. Hydrogen Sulfide	Atmosphere	11.22 lb.	(~5.1 kg.)
5. Hydrogen Chloride	Atmosphere	3,771.14 lb.	(~1,714 kg.)
6. Lead	Atmosphere	47.65 lb.	(~26.7 kg.)

3.3.2 Offsite Hazards

As a result of examination of offsite hazards, the SNL/KTF Emergency Plan should provide channels of communication with offsite agencies. SNL/KTF interfaces with the LEPC, and provides EPA compliance reports. Development of local plans should be in progress, and the contemplation of both KTF hazards and offsite hazards should be incorporated in this process. Therefore, no offsite hazards were considered for characterization or further evaluation. Table 3.2 provides a list of those hazards that the KTF niether own or controll which may impact the KTF operations. This table also provides the distances to and potential concentrations at both the "Main Complex and the Kokole Launch Site as well as each releases calculated consequences .

Table 3.2

Hazards not Owned or Controlled by the KTF and Their Respective "Worst Case" Consequences

Building	Chemical	Quantity	Distance to the KTF "Main Complex"	Distance to the KTF Kokole Point launch site	Distance to ERPG-1 Concentration	Distance to ERGG-2 Concentration	Distance to ERPG-3 Concentration	Potential Concentrations at the "Nearest" KTF Boundary
415	Chlorine	150 lb. (~68.2 kg.)	~5,000 ft. (~1.5 km.)	~23,350 ft. (~7.0 km.)	~14,190 ft. (4.3 km.)	~6,600 ft. (2.0 km.)	~1,950 ft. (587 m)	4.96 ppm
419	Sodium Hydroxide	200 gal. (~760 l)	~5,000 ft. (~1.5 km.)	~23,350 ft. (~7.0 km.)	~980 ft. (976 m)	~460 ft. (139 m)	~250 ft. (75 m)	0.981 ppm
394	Chlorine	150 lb. (~68.2 kg.)	~8,000 ft. (~2.4 km.)	~20,000 ft. (~6.1 km.)	~14,190 ft. (4.3 km.)	~6,600 ft. (2.0 km.)	~1,950 ft. (587 m)	2.45 ppm
338	Chlorine	600 lb. (~272.7 kg.)	~10,000 ft. (~3.0 km.)	~18,350 ft. (~5.5 km.)	~27,060 ft. (8.2 km.)	~13,200 ft. (4.0 km.)	~3,960 ft. (1.2 km.)	3.24 ppm
821	Chlorine	150 lb. (~68.2 kg.)	~36,500 ft. (~10.1 km.)	~1,800 ft. (~546 m)	~14,190 ft. (4.3 km.)	~6,600 ft. (2.0 km.)	~1,950 ft. (587 m)	23.3 ppm
Sugar Cane Field	Anhydrous Ammonia	1,000 gal. (~3,800 l)	~660 ft. (~200 m)	~1,200 ft. (~363 m)	~3,650 ft. (1.1 km.)	~884 ft. (268 m)	~314 ft. (95 m)	70.3 ppm

4.0 HAZARD CHARACTERIZATION

The screening process completed in the previous section identified the liquid fuels and some of the combustion byproducts from the solid fuels used in the rockets launched at the KTF as substances that exceeded the applicable screening thresholds. These propellants and propellant byproducts present both toxicological as well as explosive hazards and are characterized (i.e., quantity on hand, physical properties, storage and use) in this section to support the development of accident scenarios and analysis of possible airborne releases.

4.1 Chemical Hazards

4.1.1 Unsymmetrical Dimethylhydrazine (UDMH)

Inventory: UDMH is shipped in individual 55 gal. (~209 l) stainless steel drums. In addition, because of the small quantities used in launch operations, 55 gal. (~209 l) or ~412.5 lb. (~187.5 kg.) is the maximum inventory expected to be on site at any one time.

Properties of Unsymmetrical Dimethylhydrazine (UDMH): UDMH ($C_2H_8N_2$) is a flammable, highly toxic, corrosive, carcinogenic, clear colorless liquid that sensitizes the liver, kidneys, nervous system, blood, reproductive and lung toxin; skin and eye hazard with an ammonia like or fish odor (the odor is not considered a reliable warning property). It has a freezing point of -57 ° C (~-45 ° F), a boiling point of 63 ° C (~145 ° F), and a decomposition temperature of 371° C (~700 ° F). It's specific gravity is 0.78, with a bulk density of 0.784 (g/cc), and a pH of 9.5-10.5 at 25 ° C (~77 ° F) (5% in neutral distilled water). It is stable for at least one year if stored under nitrogen and in an air tight container. UDMH is incompatible with oxidizing agents, metal oxides, and organic materials with large surface areas or porous surfaces such as rags, cotton waste, and sawdust. It can be stored in mild steel, stainless steel, aluminum, TEFLON (R), and polyethylene. [73]

UDMH's major component (95-99%) is 1.1-dimethylhydrazine (CAS Number 57-14-7) with an OSHA (PEL) of 0.5 ppm/mg/m^3 and a ACGIH (TLV) of 0.5 ppm/mg/1.2 m^3. The second component is (1-5%) Dimethyl amine (CAS Number 124-40-3) with an OSHA (PEL) and a ACGIH (TLV) of 10 ppm/mg/m^3. The remaining material (0.1-1%) is water (CAS Number 7732-18-5). UDMH calculated ERPG values are as follows:

ERPG-1 = (TWA)(ERPG-1 Factor) = 0.5 x 1.25 = 0.625 ppm
ERPG-2 = (TWA)(ERPG-2 Factor) = 0.5 x 3.75 = 1.875 ppm
ERPG-3 = (TWA)(ERPG-3 Factor) = 0.5 x 3.75 x 2.33 = 4.36875 ppm

Conditions of Storage and Use: Drums are offloaded onto the concrete pad. The pad is designed to contain any spilled liquid thereby providing an extra safeguard against an uncontrolled release into the environment. A sunshade is provided in accordance with accepted design practices. Drum are electrically grounded to guard against static discharge. [74] The storage pad has a perimeter fence with a gate that is kept locked.

The fuel is loaded by NASA White Sands personnel, in accordance with NASA Standard Operating Procedures (SOPs), into the Post-Boost-Vehicle (PBV) before launch. The hypergolic fuel is utilized in maneuvering the fourth stage of the STARS Rocket.

Engineered Safety Features: The drum in which the UDMH is transported and stored is constructed of stainless steel. This drum is then placed into a plastic overpack drum as an added precaution against uncontrolled spillage and rupture. The over pack is equipped with a "sniffer" port to allow detection of vapors.[75]

Waste Management Systems: Historically, wastes generated by operations at the KTF have been small, enabling disposal via PMRF personnel in accordance to the agreements of the ISA. However, because of the quantity of waste generated by decontamination of liquid fueling equipment, the KTF now operates (during STARS II launches) as a Hazardous Waste Management Facility (EPA ID# HI0000363309).

Administrative Controls: UDMH is transported and stored separate from the oxidizer (NTO) until it is loaded into the PBV. Response equipment and personnel must participate in all transportation and fueling activities. Lines of communication are established with KTF, SNL, DOE, PMRF, local, and State authorities in case of an incident involving UDMH. In addition, Safety Operating Procedures (SOPs) are employed during each phase of launch operations.

4.1.2 Nitrogen Tetroxide (NTO)

Inventory: NTO is shipped in individual 200 gal. (~760 l) stainless steel cylinders containing a maximum of 55 gal. (~209 l), which is calculated to be approximately 666 lb. (~303 kg.), of NTO at a time. Because of the small quantities used in launch operations, 55 gal. (~209 l) is the maximum inventory expected to be on site at any one time.

Properties of Nitrogen Tetroxide: NTO (N_2O_4) is a highly toxic, highly corrosive, non-flammable, dark green or brown liquid that is soluble in water and produces an acid odor. It has a specific gravity of 1.49 @ 32° F (0° C), with a melting of 11.8° F (~-11.2° C), a boiling point of 70° F (~21° C), a vapor pressure of 17.7 psia @ 77° F (~25° C), and a vapor density of 1.58 (Air = 1). It is stable under conditions of normal use and storage. It is important to avoid moisture when transporting or storing NTO. It is also incompatible with bases, most metals, and organics. It has a Short Term Exposure Level (STEL) of 1 ppm. The American Industrial Hygienists Association (AIHA) has recommended ERPG values for oxides of nitrogen as follows:

ERPG-1 = 2 ppm
ERPG-2 = 15 ppm
ERPG-3 = 30 ppm

Conditions of Storage and Use: Cylinders, inside the steel secondary containment, are offloaded onto the concrete pad. The pad is designed to contain any spilled liquid thereby providing an extra safeguard against an uncontrolled release into the environment. A sunshade is provided in accordance with accepted design practices. Cylinders are electrically grounded to guard against static discharge.[76] The storage pad has perimeter fencing with a gate that is kept locked.

NTO is loaded, into the PBV before launch, by NASA White Sands personnel according to NASA SOPs. The hypergolic propellant is utilized in maneuvering the PBV of the STARS II Rocket.

Engineered Safety Features: NTO cylinders are placed into an overpack cylinder as an added precaution against rupture.[77]

Waste Management Systems: Historically the wastes generated by operations at the KTF have been small enabling disposal via PMRF personnel in accordance to the agreements of the ISA. However, because of the quantity of waste generated by decontaminating liquid fueling equipment, the KTF is now operating (during STARS II launches) as a Hazardous Waste Management Facility (EPA ID# HI0000363309).

Administrative Controls: The NTO is transported and stored separate from the (UDMH) until it is loaded into the PBV. Response equipment and personnel must participate in any transportation or fueling activities. Lines of communication are established with KTF, SNL, DOE, PMRF, local, and State authorities in case of an incident involving the NTO. In addition, SOPs are employed during each phase of launch operations.

4.2 Explosive Hazards

Explosions are not a primary concern of the Hazards Assessment. Because an incident involving a detonation will usually result in recovery efforts. However, if a detonation can be a potential initiating event constituting a release of hazardous materials, from another source or as byproducts of the combustive materials, then those hazardous materials that could pose a threat to the personnel, and the general public are analyzed.

The following characterization of potential overpressures is provided for additional understanding when addressing the credibility and possible consequences that may be associated with a detonation. Overpressure generated by motor failure before or immediately after a rocket is launched a credible ground hazard. Detonations can occur from several different initiating events.

4.2.1 Solid Fuels

The following is a characterization of the explosive or combustive ability of the Solid Propellant employed at the KTF. The solid fuels, before combustion, present minimal toxicological hazards to personnel, the general public or the environment. However, they do present toxicological hazards to persons in the immediate vicinity as a result of the combustion process.

The solid fuels utilized in the launching of rockets at KTF are categorized by their Hazard Classification. In order to ease identification of hazard characteristics and thus promote safe storage and transportation of ammunition and explosives, the DOD & DOE uses the international system of classification devised by the United Nations Organization (UNO) for the transport of dangerous goods. The UNO classification system consists of nine hazard classes.[78]

The HAD will characterize Class 1 because it applies to solid fuels which are employed at the KTF. In addition Class 1 is categorized by divisions that indicate the character and predominance of associated hazards.[79] The KTF has utilized solid fuel systems that are Class 1, Division 1, 2, and 3.

- Division 1 - Mass Detonation
- Division 1 - Non-Mass Detonating Fragment Producing
- Division 3 - Mass Fire

Note: *Detonation* - Occurs when the flame and shock wave travel together through the mixture at supersonic speed. "A violent chemical reaction within a chemical compound or mechanical mixture evolving heat and pressure. A detonation is a reaction that proceeds through the reacted material toward the unreacted material at a "supersonic" velocity. The result is exertion of extremely high pressure on the surrounding medium, forming a propagating shock wave that is originally of supersonic velocity. When the material is located on or near the surface of the ground, a detonation is normally characterized by a crater." [80]

Deflagration - (Mass Fire) "A rapid chemical reaction in which the output of heat is sufficient to enable the reaction to proceed and be accelerated without input of heat of heat from another source. Deflagration is a surface phenomenon with the reaction products flowing away from the unreacted material along the surface at "subsonic" velocity. The effect of a true deflagration under confinement is an explosion. Confinement of the reaction increases pressure, rate of reaction, and temperature and may cause transition into detonation." [81]

DOD 6055.9, Chapter 9, Section B, Part 1, Sub-part c. states "When Hazard Divisions 1.1 and 1.3 are located in the same site determine the distances for the total quantity as 1.1. However, when the HE equivalent of the 1.3 is known the HE equivalent weight of the 1.3 items may be added to the total explosive weight of 1.1 items to determine the NEW for 1.1 distance determination."

Note: Table 4.1 provides information as to propellant weight and explosive hazard classification associated with some of the major booster rockets previously utilized at the KTF. [82]

Table 4.1

" Some Motor Propellants Used in Past KTF Operations "

Name	Designation	Weight (lb)	Explosive Hazard Class/Div.
Alcor 1B	Anb-3066	916	1.3
Antares II	VID	2,440	1.1
Antares IIIA	TP-H-3340	1,285	1.3
Apache Mod 1	TP-G3016D	131	1.3
BE-3	DDP-80	191	1.3
Cajun Mod I	TP-E-3001	118	1.3
Castor	TP-H8038A	7,313	1.3
Genie	ANP-512DS Mod 3	327	1.3
Honest John	OIO	2,050	1.3
Malemute	TP-H1142	1,115	1.3
Nike Hercules	OIO	750	1.3
Polaris A3 1st. Stg.	ANP-2969KHI	20,778	1.3
Polaris A3 2nd. Stg.	78-DS-31935	8,872	1.1
Orbus 1	UTP-19687A	911	1.3
Recruit	TP-E8035	264	1.3
Sandhawk	TP-H-3172-A	1,106	1.3
STAR 13B	TP-G-3129	90	1.3
STAR 26	TP-H-3114	508	1.3
STAR 27	TP-H-3135	735	1.3
Talos	ARP/AHH	2,803	1.3
Terrier	CAP/AHH	1,220	1.3
Tomahawk	TP-H-3095-A	387	1.3

4.2.2 Small Explosives and Initiating Devices

In addition to large quantities of solid propellant, smaller exploding devices such as initiators, cutters, gas valves, etc., are employed at the KTF. Their explosive capabilities are limited when compared to the large inventories of solid propellant, and they are not characterized in this HAD. The "worst case" scenario would identify these small explosive devices as potential initiators of larger volumes of solid propellant.

This incident would constitute an ***Alert*** at the KTF. Which means no consequences would be expected beyond the KTF fence line from an incident involving an initiating device.

Note: In addition to the hazards presented by overpressures created by an exploding rocket on or just off the launch pad, toxicological hazards will exist in aerosol form as the result of solid propellant exhaust byproducts. Toxicological hazards from exhaust byproducts are characterized in the Exhaust Byproduct Section (Section 4.3) of this HAD.

4.3 Exhaust Byproduct Hazards

Chemical hazards could exist in the form of exhaust byproducts resulting from detonation/combustion of solid propellant employed in various motors utilized at the KTF. Table 4.2 lists of all chemicals postulated to exist after detonation/combustion of the various motors launched at the KTF. [83]

Note: The assumption of fuel detonation is a conservative approach, however, an incident involving solid fuel employed at the KTF would probably result in a fire. Therefore, the term combustion will be employed when appropriate throughout this document.

The following characterization addresses those hazards that would potentially exist after combustion of solid fuel before or shortly after a launch. These chemicals were identified as chemical hazards via the screening process previously completed in Section 3.0.

4.3.1 Aluminum Oxide (Al_2O_3)

Inventory: The quantities can range from no inventory to a maximum potential inventory of approximately 11,246 lb. (~5,112 kg.) with the combustion of solid propellant employed in a STARS Rocket. [84]

Properties of Aluminum Oxide: (Al_2O_3) is a white powder with a melting point of 2,050 ° C (~3,722 ° F) and a boiling point of 2,977 ° C (~5,390 ° F) and a molecular weight of 101.96.

Aluminum Oxide has a OSHA PEL of total dust equaling (5 mg/m^3 transitional) TWA of 10 mg/m^3 with a Respirable Fraction TWA of 5 mg/m^3. It's ACGIH TLV has a TWA (nuisance Particulate) of 10 mg/m^3 of total dust, when toxic impurities are not present (e.g., quartz <1%). It's DFG MAK is 6 mg/m^3 in a gaseous state. Aluminum Oxide's calculated ERPG values are as follows:

ERPG-1 = (TWA)(ERPG-1 Factor) = 5.0 x 1.25 = 6.25 mg/m^3
ERPG-2 = (TWA)(ERPG-2 Factor) = 5.0 x 3.75 = 18.75 mg/m^3
ERPG-3 = (TWA)(ERPG-3 Factor) = 5.0 x 3.75 x 2.33 = 43.6875 mg/m^3

Inhalation of finely divided particles may cause lung damage. It is a questionable carcinogen with experimental neoplastigenic and tumorigenic data by implantation. It is incompatible with hot chlorinated rubber. Exothermic reaction above 200° C (~392° F) with halocarbon vapors produces toxic HCl and phosgene.[85]

Engineered Safety Features: Safety Systems have failed if this incident has occurred.

Waste Management Systems: An incident involving combustion of solid fuel will not employ a Waste Management System.

Administrative Controls: Administrative controls exist in depth in the form of launch specific Step-by-Step Standard Operating Procedures and Safety Operating Procedures. However, administrative controls have failed if this incident has occurred.

4.3.2 Chlorine (Cl)

Inventory: The quantities can ranges from no inventory to a maximum potential inventory of approximately 45 lb. (~20.5 kg.) with the combustion of solid fuel employed in a STARS Rocket.[86]

Properties of Chlorine: Chlorine exists as a greenish-yellow gas, liquid or rhombic crystals with a molecular weight of 70.9. It has a melting point of -101° C (~-150° F) and a boiling point of -34.5° C (~-30° F). It's density in liquid form is 1.47 at 0° C (32° F) and at 3.65 atmospheres. Chlorine's vapor pressure is 4,800 mm at 20 ° C (~68° F) and a vapor density 2.49. It is soluble in water.

Chlorine's OSHA PEL has a 0.5 ppm. TWA (1 ppm. transitional TWA) and a STEL of 1 ppm. It's ACGIH TLV has a TWA 0.5 ppm. and a STEL of 1 ppm. The DFG MAK for Chlorine is 0.5 ppm. (1.5 mg/m^3) while the NIOSH REL is 0.5 ppm/15 M. The DOT classifies Chlorine as a nonflammable and poisonous gas. The AIHA has established the following ERPG values for Chlorine:

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

Its moderately toxic to humans by inhalation. Very irritating by inhalation. Human mutation data reported. Human respiratory system effects by inhalation: changes in the trachea or bronchi, emphysema, chronic pulmonary edema or congestion. Chlorine is extremely irritating to the mucous membranes of the eyes and the respiratory tract at 3 ppm. Combines with moisture to liberate Oxygen and forms Hydrogen Chloride. Both these substances, if present in quantity, cause inflammation of the tissues with which they come in contact. A concentration of 3.5 ppm. produces a detectable odor; 15 ppm. causes immediate irritation of the throat. Concentrations of 50 ppm. are dangerous for even short exposures; 1,000 ppm. may be fatal.

Chlorine reacts violently with alcohols. Ignition or explosive reaction with metals (e.g, aluminum, antimony powder, bismuth powder, brass, calcium powder, copper, germanium, iron, manganese, potassium, tin, vanadium powder). Mixtures with hydrogen and other gases (e.g., air, hydrogen chloride, oxygen) are explosive. Can react to cause fires or explosions upon contact with turpentine, illuminating gas, polypropylene, rubber, sulfamic acid and many other chemicals.[87]

Engineered Safety Features: Safety Systems have failed if this incident has occurred.

Waste Management Systems: An incident involving combustion of solid propellant will not allow for the employment of a Waste Management System.

Administrative Controls: Administrative controls exist in depth in the form of launch specific Step-by-Step Standard Operating Procedures and Safety Operating Procedures.

4.3.3 Carbon Monoxide (CO)

Inventory: The quantities can ranges from no inventory to a maximum potential inventory of approximately 8,358 lb. (~3,800 kg.) with the combustion of solid propellant employed in a STARS Rocket. [88]

Properties of Carbon Monoxide: CO is a colorless, odorless gas with a molecular weight of 28.01. It has a melting point of -207 ° C (~-340.6 ° F) and a boiling point of -191.3 ° C (~-312° F). It has a lower explosive limit of 12.5% and an upper explosive limit of 74.2%. In a gaseous state it has a density of 1.250 g/L at 0 ° C (32 ° F), and a density of 0.793 as a liquid. The autoignition temperature of Carbon Monoxide is 1,128° F (~609 ° C).

Carbon Monoxide's OSHA PEL has a TWA of 35 ppm.; CL 200 ppm. (50 ppm. transitional TWA). It's ACGIH TLV has a TWA of 50 ppm. and a STEL of 400 ppm. (BEI: less than 8% carboxyhemogloben in blood at end of shift; less than 40 ppm. CO in end-exhaled air at end of shift). The DFG MAK for Carbon Monoxide is 30 ppm. (33 mg/m^3), (BAT: 5% in blood at end of shift), while the NIOSH REL has a TWA of 35 ppm.; CL 200 ppm. The DOT classifies Carbon Monoxide as a flammable and poisonous gas. The AIHA has established ERPG values for CO as follows:

ERPG-1 = 200 ppm
ERPG-2 = 350 ppm
ERPG-3 = 500 ppm

Carbon Monoxide is mildly toxic by inhalation in humans but has caused many fatalities. Teratogenic and reproductive effects have been observed in laboratory animals. Human systemic effects by inhalation (e.g., changes in psychophysiological tests and methemoglobinemia-carboxhemoglobinemia) can cause asphyxiation by preventing hemoglobin from binding oxygen. After the victim is removed from exposure, the half-life of its elimination from the blood is one hour.

Carbon Monoxide is a dangerous fire and explosive hazard when exposed to flame. Violent or explosive reaction on contact with bromide trifluoride, bromine pentafluoride, chlorine dioxide, or peroxodisulfuryl difluoride. Mixtures of liquid CO with liquid Oxygen is explosive. Reacts with sodium or potassium to form explosive products sensitive to shock, heat, or contact with water. Mixture with copper powder + copper(II) perchlorate = water forms an explosive complex. Mixture of liquid CO with liquid dinitrogen oxide is a rocket propellant combination. Ignites on warming with iodine heptafluoride. Ignites on contact with sodium oxide = water. Potentially explosive reaction with ClF3, ($Li = H_2O$), NF_3, OF_3, ($K + O_2$), Ag_2O, ($Na + NH_3$). To fight fires stop the flow of gas.[89]

Engineered Safety Features: Safety Systems have failed if this incident has occurred.

Waste Management Systems: An incident involving combustion of solid fuel will not allow for the employment of a Waste Management System.

Administrative Controls: Administrative controls exist in depth in the form of launch specific Step-by-Step Standard Operating Procedures and Safety Operating Procedures.

4.3.4 Hydrogen Sulfide (H_2S)

Inventory: The quantities can ranges from no inventory to a maximum potential inventory of approximately 11.22 lb. (~5.1 kg.) with the combustion of solid propellant employed in a Recruit Missile. [90]

Properties of Hydrogen Sulfide: H_2S is a colorless, flammable gas with an offensive odor. It has a molecular weight of 34.08. It has a melting point of -85.5° C (~-122 ° F) and a boiling point of -60.4 ° C (~-76.7 ° F). H_2S has a lower explosive limit of 4% with a upper explosive limit of 46%. It's auto ignition temperature is 500 ° F (~260 ° C). It has a density of 1.539 g/L @ 0 ° C (32 ° F) with a vapor pressure of 20 atmospheres @ 25.5 ° C (78 ° F) and a vapor density of 1.189.

Hydrogen Sulfide's OSHA PEL has a TWA of 10 ppm.; (transitional: CL 20 ppm.; 50/10M) and a STEL of 15 ppm. It's ACGIH TLV has a TWA of 10 ppm. The DFG MAK for Hydrogen Sulfide is 10 ppm. (15 mg/m^3), while the NIOSH REL is (CL) 15 mg/m^3/10M. The DOT classifies Hydrogen Sulfide as a flammable and poisonous gas. The AIHA has established ERPG values for H_2S as follows:

ERPG-1 = 0.1 ppm
ERPG-2 = 30 ppm
ERPG-3 = 100 ppm

Hydrogen Sulfide is a poison by inhalation and asphyxiation, and a severe irritant to the eyes and mucous membranes. Human systemic effects by inhalation are : coma, chronic pulmonary edema. Low concentrations of 20-150 ppm. cause irritation of the eyes; slightly higher concentrations may cause irritation of the upper respiratory tract, and if exposure is prolonged, pulmonary edema may result. The irritant action has been explained on the basis that H_2S combines with the alkali present in moist surface tissues to form sodium sulfide, a caustic. With higher concentrations, the action of the gas on the nervous system becomes more prominent. A 30 minute exposure to 500 ppm. results in headache, dizziness, excitement, a staggering gait, diarrhea and dysuria, followed sometimes by bronchitis or bronchopneumonia.

The action of small amounts on the nervous system is one of depression; in larger amounts, it stimulates, and with very high amounts the respiratory center is paralyzed. Exposures of (800-1,000) ppm. may be fatal in 30 minutes, and high concentrations are instantly fatal. Fatal hydrogen sulfide poisoning may occur even more rapidly than that following exposure to a similar concentration of HCN. H_2S does not combine with the hemoglobin of the blood; its asphyxiant action is due to paralysis of the respiratory center. With repeated exposure to low concentrations, conjunctivitis, photophobia, corneal bullae, tearing, pain, and blurred vision are common findings. High exposures may cause rhinitis, bronchitis, and occasionally pulmonary edema. Very high concentrations results in immediate death. Chronic poisoning results in headache, inflammation of the conjunctivae and eyelids, digestive disturbances, weight loss and general debility. It is a common air contaminant.

H_2S is an insidious poison since sense of smell may be fatigued. The odor and irritating effects do not offer a dependable warning to workers who may be exposed to gradually increasing amounts and therefore become insensitive to it.

Hydrogen Sulfide is a very dangerous fire hazard when exposed to heat, flame, or oxidizers. It is also moderately explosive when exposed to heat or flame. H_2S explodes on contact with oxygen diffllouride; nitrogen trichloride; bromine pentaflouride; chlorine trifluoride; dichlorine oxide; silver fulminate. Potential explosive reaction with copper + oxygen. Explosive reaction when heated with perchloryl fluoride above 100° C (~212° F); oxygen above 280° C (~536° F). Reacts with 4-bromobenzenedia-zonium chloride to form an explosive product. Ignites on contact with metal oxides (e.g., barium peroxide, chromium trioxide, copper oxide, lead dioxide, manganese dioxide, nickel oxide, silver (I) oxide, silver (II) oxide, sodium peroxide, thallium (III) oxide, mercury oxide, calcium oxide), oxidants (e.g., silver bromate, heptasilver nitrate octaoxide, dibismuth dichromium nonaoxide, mercury (I) bromate, lead (II) hypochlorite, copper chromate, fluorine, nitric acid, sodium peroxide, lead (IV) oxide), rust soda-lime + air. Reacts violently with NI_3, NF_3, p-bromobenzenediazo-nium chloride, OF_2, F_2, Cu, ClO, BrF_5, acetaldehyde, ($BaO + Hg_2O$ + air), ($BaO + NiO$ + air), hydrated iron oxide, phenyl diazonium chloride, ($NaOH + CaO$ + air). Incandescent reaction with metal powders (e.g., copper, tungsten). When heated to decomposition it emits toxic fumes of SO_x. To fight fires, stop the flow of gas. [91]

Engineered Safety Features: Safety Systems have failed if this incident has occurred.

Waste Management Systems: An incident involving combustion of solid fuel will not allow for the employment of a Waste Management System.

Administrative Controls: Administrative controls exist in depth in the form of launch specific Step-by-Step Standard Operating Procedures and Safety Operating Procedures.

4.3.5 Hydrogen Chloride (HCl)

Inventory: The quantities can ranges from no inventory to a maximum potential inventory of approximately 3,771.14 lb. (~1,714.2 kg.) with the combustion of solid propellant employed in a STARS Rocket. [92]

Properties of Hydrogen Chloride: HCl is a colorless. corrosive, nonflammable gas with a pungent odor and a molecular weight of 36.46. It's boiling point is -154° C (~-123.8° F) @ 1.0 mm. As fumes in air the density of HCl is 1.639 @ -1,377.77° C (~-2,448° F).

Hydrogen Chloride's OSHA PEL is (CL) 5 ppm. It's ACGIH TLV (CL) 5 ppm. It is assigned a DFG MAK value of 5 ppm. (7 mg/m^3). The AIHA has established ERPG values for HCl as follows:

ERPG-1 = 3.0 ppm
ERPG-2 = 20 ppm
ERPG-3 = 100 ppm

Hydrogen Chloride is a highly corrosive irritant to the eyes, skin, and mucous membranes. Mildly toxic by inhalation. Explosive reaction with alcohols + hydrogen cyanide, potassium permanganate, sodium (with aqueous HCl), tetraselenium tetranitride, Ignition on contact with aluminum-titanium alloys (with HCl vapor), fluorine, hexalithium disilicide, metal acetylides or carbides (e.g., cesium acetylide, rubidium acetylide). Violent reaction with 1,1-difluoroethylene. Vigorous reaction with aluminum, chlorine + dinitroanilines (evolves gas). Potentially dangerous reaction with sulfuric acid releases HCl gas. Absorption of the acid onto silicon dioxide is exothermic. [93]

Engineered Safety Features: Safety Systems have failed if this incident has occurred.

Waste Management Systems: An incident involving solid fuel will not allow for the employment of a Waste Management System.

Administrative Controls: Administrative controls exist in depth in the form of launch specific Step-by-Step Standard Operating Procedures and Safety Operating Procedures.

4.3.6 Lead (Pb)

Inventory: The quantities can ranges from no inventory to a maximum potential inventory of approximately 47.65 lb. (~21.7 kg.) with the combustion of solid fuel employed in a Talos Missile. [94]

Properties of Lead: Pb is a bluish-gray, soft metal. With an atomic weight of 207.19. It has a melting point of 327.43 ° C (~621.4 ° F) and a boiling point of 1,740 ° C (~3,164 ° F). The vapor pressure of Pb is 1 mm @ 973 ° C (~1,783.4 ° F).

Lead's OSHA PEL TWA is 0.05 mg(Pb)/m^3. It's ACGIH TLV TWA is 0.15 mg/m^3 (BEI: 50 ug(Pb)/L in blood; and 150 ug(Pb)/g creatinine in urine). The DFG MAK is 0.1 mg/m^3 (BAT: 70 ug(Pb)/L in blood; 30 ug(Pb))/L in blood of women less than 45 years old. The NIOSH REL TWA is (Inorganic Lead) 0.10 mg(Pb)/m^3. The calculated ERPG values for Lead are as follows:

ERPG-1 = (TWA)(ERPG-1 Factor) = 0.15 x 1.25 = 0.1875 mg/m^3
ERPG-2 = (TWA)(ERPG-2 Factor) = 0.15 x 3.75 = 0.5625 mg/m^3
ERPG-3 = (TWA)(ERPG-3 Factor) = 0.15 x 3.75 x 2.33 = 1.310625 mg/m^3

Lead is a suspected carcinogen. Poison by ingestion. Moderately toxic by intraperitoneal route. Human systemic effects by ingestion and inhalation: loss of appetite, anemia, malaise, insomnia, headache, irritability, muscle and joint pains, tremors, flaccid paralysis without anesthesia, hallucinations and distorted perceptions, muscle weakness, gastritis and liver changes. The major organ systems affected are the nervous system, blood system, and kidneys. Lead encephalopathy is accompanied by severe cerebral edema, increase in cerebral spinal fluid pressure, proliferation and swelling of endothelial cells in capillaries and arterioles, proliferation of glial cells, neuronal degeneration and areas of focal cortical necrosis in fatal cases. Experimental evidence now suggested that blood levels of lead below 10 ug/dl can have the effect of diminishing the IQ scores of children. Low levels of lead impair neurotransmission and immune system function and may increase systolic blood pressure. Reversible kidney damage can occur from acute exposure. Chronic exposure can lead to irreversible vascular sclerosis, tubular cell atrophy, interstitial fibrosis, and glomerular sclerosis. Sever toxicity can cause sterility, abortion and neonatal mortality and morbidity. Experimental teratogenic and reproductive effects. Human mutation data reported.

Lead is flammable when it is in the form of dust and is exposed to heat or flame. Moderately explosive in the form of dust when exposed to heat or flame. Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Rubber gloves containing lead may ignite in nitric acid. Violent reaction on ignition with chlorine trifluoride; concentrated hydrogen peroxide; ammonium nitrate (below 200 ° C (~392 ° F) with powdered lead); sodium acetylide (with powdered lead). Incompatible with NaN_3; Zr; disodium acetylide; oxidants. Can react vigorously with oxidizing materials. A common air contaminant. When heated to decomposition it emits toxic fumes of Pb.[95]

Engineered Safety Features: Safety Systems have failed if this incident has occurred.

Waste Management Systems: An incident involving combustion of solid fuel will not allow for the employment of a Waste Management System.

Administrative Controls: Administrative controls exist in depth in the form of launch specific Step-by-Step Standard Operating Procedures and Safety Operating Procedures.

Table 4.2 Rocket Motors and Composition of Exhaust Products (In Pounds)

Constituent	Alcor 1B	Antares II	Antares IIIA	Apache	Aries	BE-3-B1	Cajun	Castor I
Al_2O_3	259.61	959.54	420.03	49.49	3,216.00	75.41	1.36	1,934.29
Cl	1.28	0	3.69	0.24	23.00	0.45	0	0
CO	195.26	999.15	244.43	32.23	2,690.00	60.43	10.37	2,043.98
CO_2	38.13	48.86	42.62	2.07	325.00	7.39	30.03	315.19
COS	0	0	0	0	0	0	0.54	0
Cu_2O_3	0	0	0	0	0	0	0	0
CuO	0	0	0	0	0	0	0	0
$FeCl_2$	0	0	0	0	0	0	0	0
H	0	0	0.22	0.02	0	0.08	0	0
H_2	17.33	50.91	22.98	3.47	253.00	2.85	0.80	179.17
H_2O	114.22	78.70	126.88	6.87	2,169.00	12.20	28.21	614.29
H_2S	0	0	0	0	0	0	8.51	0
HCl	206.07	56.41	268.13	26.12	0	11.49	27.00	1,587.65
HS	0	0	0	0	0	0	0.15	0
KCl	0	0	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0
N_2	80.21	368.42	106.02	10.49	882.00	20.50	10.37	636.96
OH	0	0	0	0	0	0.14	0	0
Pb	0	0	0	0	0	0	0	0
S_2	0	0	0	0	0	0	0.57	0
SO_2	0	0	0	0	0	0	0.57	0
Totals	912.11	2,561.99	1,235.00	131.00	9,558.00	190.94	118.48	7,311.53

Table 4.2 (Continued) Rocket Motors and Composition of Exhaust Products (In Pounds)

Constituent	Castor II	Genie	Honest John	Malemute	Nike	Polaris A3	Polaris A3	Orbus 1
Al_2O_3	3,098.94	0	0	368.73	0	7,838.08	3,065.28	342.95
Cl	24.66	0	0	0.22	0	43.43	0.89	0.45
CO	1,841.28	31.39	865.57	275.96	407.70	5,189.10	2,963.25	205.48
CO_2	156.18	91.23	727.27	33.34	135.90	424.29	377.95	19.98 68.23
COS	0	0	0	0	0	0	0	0
Cu_2O_3	0	0.16	0	0	0	0	0	0
CuO	0	0.07	0	0	0	0	0	0
$FeCl_2$	0	0	0	0	0	0	0	0
H	0	0	0	0	0	0	2.66	0
H_2	189.06	81.42	50.53	27.43	13.05	483.92	129.53	20.97
H_2O	517.86	2.62	136.57	76.94	97.58	1,317.95	558.05	50.03
H_2S	0	0	0	0	0	0	0	0
HCl	1,701.54	70.63	0	238.50	0	3,471.80	136.63	162.71
HS	0	0	0	0	0	0	0	0
KCl	0	21.58	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0
N_2	674.04	28.12	252.91	93.44	92.03	1,925.71	1,633.34	104.78
OH	0	0	0	0	0	0	4.44	0
Pb	0	0	10.19	0	3.75	0	0	0
S_2	0	0	0	0	0	0	0	0
SO_2	0	0	0	0	0	0	0	0
Totals	8,203.56	327.22	2,043.04	1,114.56	750.01	20,694.28	8,872.02	907.35

Table 4.2 (Continued) Rocket Motors and Composition of Exhaust Products (In Pounds)

Constituent	Recruit	Sandhawk	Star 13B	Star 26	Star 27	Talos	Terrier	Tomahawk
Al_2O_3	0	376.75	27.52	153.79	222.46	0	87.11	124.81
Cl	0	0	0	0	0.10	0	0	1.01
CO	14.92	322.62	23.59	131.84	148.37	1,017.49	484.34	107.28
CO_2	68.23	15.30	2.92	15.93	43.70	1,025.90	338.67	4.73
COS	0.62	0	0	0	0	0	0	0
Cu_2O_3	0	0	0	0	0	0	0	0
CuO	0	0	0	0	0	0	0	0
$FeCl_2$	8.44	0	0	8.01	0	0	0	0
H	0	0	0	0.02	0	0	0	0.09
H_2	1.14	32.25	2.19	12.36	14.38	47.65	20.98	11.56
H_2O	66.76	40.72	7.29	39.71	78.05	299.92	115.29	16.15
H_2S	11.22	0	0	0	0	0	0	0
HCl	55.76	228.24	19.71	104.04	164.32	0	0	87.00
HS	0	0	0	0	0	0	0	0
KCl	0	00	0	0	0	0	0	0
MgO	2.57	0	0	0	0	0	0	0
N_2	24.41	90.12	7.67	42.29	63.62	370.00	154.70	34.37
OH	0	0	0	0	0	0	0	0
Pb	0	0	0	0	0	47.65	20.25	0
S_2	6.62	0	0	0	0	0	0	0
SO_2	3.31	0	0	0	0	0	0	0
Totals	264.00	1,106.00	90.89	507.99	735.00	2,808.61	1,221,34	387.00

5.0 EVENT SCENARIOS

This section describes and analyzes event scenarios resulting from postulated failures of the primary and secondary barriers containing the hazardous material characterized in Section 4.0. The results of the analysis for each event scenario are summarized at the end of this section. A few generic scenarios are provided below. Analysis of potential scenarios have been performed and are available for the wide range of accidents postulated for a motor system failure. Operating and Safety personnel have assigned each scenario a likelihood of event occurrence. However, regardless of the scenario and its probability of occurrence the EMG dictates that the HAD assumes a probability of one. Therefore, the following scenarios are designed to release a minimal amount of material as well as the maximum inventory of material in order to represent a broad range of consequences. This approach discounts the effects of any engineered safety systems or other mitigative features or actions.

Note: The term "meteorological condition" will hereafter be referred to as "met condition".

5.1 Chemical Event Scenario's

5.1.1 Unsymmetrical Dimethylhydrazine (UDMH)

The release of UDMH, characterized in Section 4.0, from the PBV or the KTF storage facilities is described in the postulated scenarios below.

Failure of Primary Barrier: The UDMH, approximately 412.5 lb. (~187.5 kg.), is stored in a 55 gal. (~209 l) drum, inside a plastic overpack, on a storage pad and employed in PBVs. The 55 gal. (~209 l) drum serves as the primary barrier while the UDMH is in transit or storage. The UDMH is not stored under pressure. A PBVs fuel tank serves as the primary barrier when the UDMH is employed.

Note: The KTF is an open air facility. Thus, the modes of barrier failure (i.e., misoperation of a valve or puncture of the drum) described below address the release of UDMH to the open environment. This is not an all inclusive list of possible scenarios, however, the result is the same regardless of the scenario.

Sabotage, Misoperation or Damage of a drum valve or port. This scenario could result from an incident involving sabotage. In the case of sabotage the event could hypothetically occur while in transport, storage or use. It is also conceivable that a valve could be inadvertently operated or damaged. The limiting case of this scenario would result in the entire contents of the drum being released (via a spill) at a rate determined by the degree to which the valve was opened.

Puncture or Fracture to the drum and external overpack while in transport or storage is not a likely scenario, however, it could occur (e.g., aircraft crash). However, if such an incident did occur it would conceivably allow a release of UDMH. Regardless of the location of the puncture, without mitigative efforts, the entire inventory would be released to the atmosphere at a rate dictated by atmospheric conditions, the size of the whole, and the materials vapor pressure.

Note: The postulated inventories available for release in the following scenarios are a maximum expected inventory of 55 gal. (209 l) calculated to be approximately 412.5 lb. (~187.5 kg.) and 1 pint (0.47 l) calculated to be approximately 0.94 lb. (~0.427 kg). A pint represents a minimal quantity of spilled fuel as identified in the NASA Spill Response Document.[96]

Effects on Other Barriers: The plastic overpack equipped with a sniffer port utilized for the detection of toxic vapors associated with the liquid propellant serves as a second barrier. The KTF UDMH fuel storage pad is an open air facility. Therefore, no other barriers exist. An incident occurring during storage while at the KTF, which breached both the primary and secondary containment drums, would result in a release of UDMH vapors into the atmosphere and a potential spill of UDMH liquid into the concrete containment area. The PBV has no additional barriers that could conceivably prevent or mitigate the release of UDMH and the associated consequences that accompany such an event.

Range of Possible Releases: Potential failure modes and a range of possible releases and their effects on the KTF personnel, the general public and the environment are summarized below.

- Release of UDMH at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a ground level release of 1 pint (0.47 l), under worst case met conditions (F stability with a 2 mph. or 1 meter per seconds (mps.) wind speed). (Release designation U-1)

- Release of UDMH at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a ground level release of 1 pint (~0.47 l), under "low end" average met conditions (C stability with a 10 mph. or ~4.5 mps. wind speed). (Release designation U-2)

- Release of UDMH at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a ground level release of 1 pint (0.47 l), under "high end" average met conditions (C stability with a 20 mph. or ~9.1 mps. wind speed). (Release designation U-3)

- Release of UDMH at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a spill of 55 gal. (~209 L), through a hole 0.75 in. (~1.9 cm.) in diameter, constituting a ground level release, under worst case met conditions (F stability with a 2 mph. or 1 mps. wind speed). (Release designation U-4)

- Release of UDMH at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a spill of 55 gal. (~209 L), through a hole 0.75 in. (~1.9 cm.) in diameter, constituting a ground level release, under "low end" average met conditions, (C stability with a 10 mph. or 4.5 mps. wind speed). (Release designation U-5)

- Release of UDMH at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a spill of 55 gal. (~209 L), through a hole 0.75 in. (~1.9 cm.) in diameter, constituting a ground level release, under "high end" average met conditions (C stability with a 20 mph. 9.1 mps. wind speed). (Release designation U-6)

5.1.2 Nitrogen Tetroxide (NTO)

The release of NTO, characterized in Section 4.0, from the PBV or the KTF storage facilities is described in the postulated scenarios below.

Failure of Primary Barrier: The NTO shipped in 55 gal. (209 l) quantities calculated to be approximately 666 lb. (302.7 kg.). It is shipped and stored in a 200 gal. (~760 l) cylinder, with its over pack in place, on a storage pad and employed in PBVs. The cylinder serves as the primary barrier while the NTO is in transit or storage . The PBV's oxidizer storage tank serves as the primary barrier when the NTO is employed. The cylinder in which the NTO is stored and transported is a steel vessel. The NTO is not stored under pressure.

Note: The KTF is an open air facility thus, the modes of barrier failure (i.e., misoperation of a valve or puncture of the cylinder) described in the scenarios below address the release of NTO to the open environment. This is not an all inclusive list of possible scenarios, however, the result is the same regardless of the scenario.

Effects on Other Barriers: The steel overpack container serves as a second barrier. The KTF NTO fuel storage pad is an open air facility, therefore, no other barriers exist. An incident occurring during storage while at the KTF, which breached both the primary and secondary containment, would result in a release of NTO vapors into the atmosphere and a potential spill of NTO liquid into the concrete containment area. However, during transportation and storage an overpack container is utilized to ensure against potential impacts. The PBV has no additional barriers that could conceivably prevent or mitigate the release of NTO and the associated consequences that accompany such an event.

Range of Possible Releases: Potential Failure modes and a range of possible releases and their effects on the KTF personnel, the general public and the environment are summarized below.

Note: The postulated inventories modeled for release in the following scenarios are inventories of 55 gal. (~209 l) calculated to be approximately 666 lb. (~302.7 kg.) and 1 pint (0.47 l) calculated to be approximately 1.5 lb. (~0.68 kg.). A pint represents a minimal quantity of spilled fuel as identified in the NASA Spill Response Document. [97]

- Release of NTO at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a ground level release of 1 pint (0.47 l), under with worst case met conditions (F stability with a 2 mph. or 1 mps. wind speed). (Release designation N-1)

- Release of NTO at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a ground level release of 1 pint (0.47 l), under "low end" average met conditions (C stability with a 10 mph. or 4.5 mps. wind speed). (Release designation N-2)

- Release of NTO at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a ground level release of 1 pint (0.47 l), under "high end" average met conditions (C stability with a 20 mph. 9.1 mps. wind speed). (Release designation N-3)

- Release of NTO at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a spill of 55 gal. (~209 l), through a hole 0.75 in. (~1.9 cm.) in diameter, constituting a ground level release, under worst case met conditions (F stability with a 2 mph. or 1 mps. wind speed). (Release designation N-4)

- Release of NTO at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a spill of 55 gal. (~209 l), through a hole 0.75 in. (~1.9 cm.) in diameter, constituting a ground level release, under "low end" average met conditions (C stability with a 10 mph. or 1 mps. wind speed). (Release designation N-5)

- Release of NTO at an ambient temperature of 85 ° F (~29.4 ° C), resulting in a spill of 55 gal. (~209 l), through a hole 0.75 in. (~1.9 cm.) in diameter, constituting a ground level release, under "high end" average met conditions (C stability with a 20 mph. or 9.1 mps. wind speed). (Release designation N-6)

5.2 Solid Rocket Motor Combustion Byproduct Scenarios

Explosions are not a primary concern of the Hazards Assessment. However, combustion of solid propellants utilized in the various motors employed at the KTF would produce hazardous exhaust byproducts. Therefore, the following information is provided to allow for a comprehensive understanding of those hazards associated with the KTF.

Solid propellant is employed in various stages and motors which comprise a specific rocket propulsion system. Each motor has its own fuel load. The lining of the motor serves as the solid propellant primary barrier. An incident involving combustion of solid propellant could be initiated in one of the following ways.

Electrical Discharges - has been identified as a hazard. An electrical discharge could potentially result in the premature initiation of the solid propellant at any stage of assembly or launch. However, precautions are taken in the form of SOPs, such as proper grounding of rockets, equipment, and personnel, to ensure the credibility of the rocket system and the safety of personnel and property.

Sabotage - is a conceivable threat to the integrity of a rocket system at the KTF. Sabotage could be initiated by a terrorist or a disgruntled employee. In such an event it is expected that the entire inventory of solid fuel would be involved.

The phase of assembly that the rocket is in when an incident occurs will dictate to what extent damage to property or loss of life will occur. The KTF launch pads are open air facilities, therefore, the only barriers that exist at the time of the launch are the primary barriers consisting of the walls of the motors fuel containers. The Skin of the rocket is not an additional barrier as it serves no purpose in effectively mitigating or preventing the initiation of or lessening the consequences of such an event. In addition, an incident involving the STARS program could conceivably be initiated while the rocket is still in the MST. This would not constitute an additional barrier because it would serve no mitigative function to alleviate potential consequences and would actually serve as a source of secondary fragmentation. Also, an incident initiated while assembling a missile in one of the missile assembly buildings would result in overpressurization, and the production of primary as well as secondary fragments. The extent of damage would be dictated by the inventory of solid fuel available at the time of the incident.

The combustion of solid propellants, characterized in Section 4.2, during assembly, transportation or launch activities performed at the KTF could lead to the release of exhaust byproducts. Therefore, a range of possible releases and consequences on the KTF personnel, the general public, and the environment are summarized in the following section.

Note: The following scenarios as well as the associated consequences identified in Section 6.0 are total fuel combustion scenarios. This results in all exhaust byproducts being jettisoned into the atmosphere. Therefore, the following should be noted. Widely scattered propellant (mass fire) burns are potentially much more hazardous than localized propellant explosions, because the near-ground concentrations of both toxic gases and particulate are substantially higher. Large propellant burns should not be extinguished because of the benefits of the thermally-induced buoyant rise will be lost (but the propellant will continue to decompose) and near-ground concentrations may increase.[98]

5.2.1 Exhaust Byproducts Produced by Launches at the KTF Main Facility

Exhaust byproducts are postulated to be present in gas or aerosol form resulting from the combustion of solid propellant before or immediately after launch. The scenarios postulated below represent the maximum inventories available from combustion of a wide spectrum of rockets launched at the KTF in the past.[99]

Note: The following releases involve maximum quantities of hazardous materials, representing maximum consequences. The following releases do not involve every rocket launched at the KTF. But it is representative of the variety of hazardous exhaust byproducts available from every rocket previously launched at the KTF.

Failure of Primary Barriers: The primary barriers identified in Section 5.2 have all been breached, by the overpressure discussed in the previous section, resulting in exhaust byproducts being jettisoned into the Atmosphere.

Effects on Other Barriers: No other barriers exist.

Range of Possible Releases: Potential Failure modes and a range of possible effects on the KTF personnel, the general public, and the environment can be summarized as follows:

Note: The following scenarios are not an all inclusive list of potential accidents that could occur at the KTF. However, it does represent a spectrum of possible events, as proposed by the EMG, within which any incident that would occur at the KTF should fall within. In addition to the varying wind speeds at various altitudes a wind speed of 1 meter per seconds (2.2 mph.) was utilized for Release Designation B-6. The results were not significantly different than the average values and can be referenced in Appendix B under Release Designation B-6 "worst case". Therefore, the average met data was utilized rather than adding worst case wind speeds.

- Combustion of a STARS Rocket, consisting of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (comprising the 3rd Stg. motor), shortly before or immediately after launch, resulting in approximately 11,246 lb. (~5,112 kg.) of the exhaust byproduct "Aluminum Oxide" (Al_2O_3) being jettisoned, as an aerosol, into the atmosphere, under average met conditions (F Stability with wind speeds and corresponding elevations found in table 5.1). (Release designation B-1)

  Note: Al_2O_3 is a particulate byproduct. Because it is a particulate it will fall out much quicker than the gaseous byproducts. The resulting area of exposure will be well within that of the gaseous byproduct plume. Therefore, as a result of rapid deposition of this byproduct and due to resource constraints no dispersion modeling is provided.

- Combustion of a STARS Rocket, consisting of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (comprising the 3rd Stg. motor), shortly before or immediately after launch, resulting in approximately 45 lb. (~20.5 kg.) of the exhaust byproduct "Chlorine" (Cl) being jettisoned, as an aerosol, into the atmosphere, under average met conditions (F Stability with wind speeds and corresponding elevations found in table 5.1). (Release designation B-2)

- Combustion of a STARS Rocket, consisting of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (comprising the 3rd Stg. motor), shortly before or immediately after launch, resulting in approximately 8,358 lb. (~3,799 kg.) of the exhaust byproduct "Carbon Monoxide" (CO) being jettisoned, as an aerosol, into the atmosphere, under average met conditions (F Stability with wind speeds and corresponding elevations found in table 5.1). (Release designation B-3)

- Combustion of a Recruit motor shortly before or immediately after launch, resulting in approximately 11.25 lb. (~5.1 kg.) of the exhaust byproduct "Hydrogen Sulfide" (H_2S) being jettisoned, as an aerosol, into the atmosphere, under average met conditions (F Stability with wind speeds and corresponding elevations found in table 5.1). (Release designation B-4)

- Combustion of a STARS Rocket, consisting of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (comprising the 3rd Stg. motor), shortly before or immediately after launch, resulting in approximately 3,771 lb. (~1,714.1 kg.) of the exhaust byproduct "Hydrogen Chloride" (HCl) being jettisoned, as an aerosol, into the atmosphere, under average met conditions (F Stability with wind speeds and corresponding elevations found in table 5.3). (Release designation B-5)

- Combustion of a Talos motor shortly before or immediately after launch, resulting in approximately 48 lb. (~21.8 kg.) of the exhaust byproduct "Lead" (Pb) being jettisoned, as an aerosol, into the atmosphere, under average met conditions (F Stability with wind speeds and corresponding elevations found in table 5.1). (Release designation B-6)

Note: Pb is a particulate byproduct. Because it is a particulate it will fall out much quicker than the gaseous byproducts. Therefore, the resulting area of exposure will be well within that of the gaseous byproduct plume. Therefore, as a result of this rapid deposition of this byproduct and due to resource constraints no dispersion modeling is provided.

TABLE 5.1

Five Layers of Wind Speeds Affecting the Material Within the Postulated Fireball

Height	**Wind Speed**
0 - 10 feet	3.7 meters per seconds
10 - 30 feet	5.0 meters per seconds
30 - 100 feet	7.0 meters per seconds
100 - 300 feet	9.4 meters per seconds
300 - 999 feet	12.1 meters per seconds

Note: Wind speeds are horizontal with a vertical gradient in speed and were identified via SNL's particulate model "DILFOUT".

5.2.2 Exhaust Byproducts Produced by Launches at the KTF Kokole Point launch site

Exhaust byproducts are postulated to be present in aerosol form resulting from the combustion of solid propellant before or immediately after launch. The scenarios postulated below represent the byproduct inventories, of hazardous materials not screened, and present after the combustion of the most powerful missile previously launched from the Kokole Point launch site. [100]

Failure of Primary Barriers: The primary barriers identified in Section 5.2.1 have all been breached, by the overpressure discussed in Section 5.2, resulting in the exhaust byproducts being jettisoned into the Atmosphere.

Effects on Other Barriers: No other barriers exist.

Range of Possible Releases: Potential Failure modes and a range of possible effects on the KTF personnel, the general public, and the environment can be summarized as follows:

Note: The following scenarios represent the launch of a Terrier Missile. A Terrier Missile is the largest motor system that has ever been launch at the Kokole Point launch site. Motor systems with larger fuel inventories are not projected to be launched from this site because of encroachment concerns. However, due to resource limitations and to ensure the greatest level of conservatism the consequences previously identified for the KTF "Main Complex" (a STARS Rocket) will be utilized at Kokole Point. The STARS Rocket has a solid fuel inventory over 25 times larger than the Terrier motor system mentioned below. Even though the larger STARS inventory was applied no offsite consequences were identified. Therefore, the highest emergency classification that could ever occur at the Kokole Point launch site is a ***Site Area Emergency***.

- Combustion of a Terrier motor shortly before or immediately after launch, resulting in approximately 87.11 lb. (~39.6 kg.) of the exhaust byproduct "Aluminum Oxide" (Al_2O_3) being jettisoned, as an aerosol, into the atmosphere, under average met. conditions (F Stability with wind speeds and corresponding elevations found in Table 5.1). (Release designation K-1)

- Combustion of a Terrier motor shortly before or immediately after launch, resulting in approximately 484.34 lb. (~220.2 kg.) of the exhaust byproduct "Carbon Monoxide" (CO) being jettisoned, as an aerosol, into the atmosphere, under average met. conditions (F Stability with wind speeds and corresponding elevations found in Table 5.1). (Release designation K-2)

- Combustion of a Terrier motor shortly before or immediately after launch, resulting in approximately 20.25 lb. (9.2 kg.) of the exhaust byproduct "Lead" (Pb) being jettisoned, as an aerosol, into the atmosphere, under average met. conditions as identified in the (F Stability with wind speeds and corresponding elevations found in Table 5.1). (Release designation K-3)

Note: Al_2O_3 and Pb are particulate byproducts. A particulate will fall out much quicker than the gaseous byproducts. The resulting area of exposure will be well within that of the gaseous byproduct plume. Therefore, as a result of this rapid deposition of this byproduct and due to resource constraints no dispersion modeling is provided.

Table 5.2

Atmosheric Dispersion Summary Table

Scenario	Source Term Parameter	Meteorological Conditions	Release Designation
1 pt. UDMH identified by NASA as a minimal spill	Direct	Worst Case	U-1
1 pt. UDMH identified by NASA as a minimal spill	Direct	Low End Average	U-2
1 pt. UDMH identified by NASA as a minimal spill	Direct	High End Average	U-3
55 gal. UDMH released from storage drum	Direct	Worst Case	U-4
55 gal. UDMH released from storage drum	Direct	Low End Average	U-5
55 gal. UDMH released from storage drum	Direct	High End Average	U-6
1 pt. NTO identified by NASA as a minimal spill	Direct	Worst Case	N-1
1 pt. NTO identified by NASA as a minimal spill	Direct	Low End Average	N-2
1 pt. NTO identified by NASA as a minimal spill	Direct	High End Average	N-3
55 gal. NTO released from 200 gal. storage drum/cylinder	Direct	Worst Case	N-4
55 gal. NTO released from 200 gal. storage drum/cylinder	Direct	Low End Average	N-5
55 gal. NTO released from 200 gal. storage drum/cylinder	Direct	High End Average	N-6
11,246 lb. of Aluminum Oxide release as exhaust byproducts	Direct	Average	B-1
45 lb of Chlorine release as exhaust byproducts	Direct	Average	B-2
8,358 lb of Carbon Monoxide release as exhaust byproducts	Direct	Average	B-3
11.25 lb of Hydrogen Sulfide release as exhaust byproducts	Direct	Average	B-4
71 lb of Hydrogen Chloride release as exhaust byproducts	Direct	Average	B-5
48 lb. of Lead release as exhaust byproducts	Direct	Average	B-6
78.11 lb. of Aluminum Oxide release as exhaust byproducts	Direct	Average	K-1
483.3 lb. of Carbon Monoxide release as exhaust byproducts	Direct	Average	K-2
20.25 lb. of Lead release as exhaust byproducts	Direct	Average	K-3

6.0 EVENT CONSEQUENCES

The consequences of the release scenarios developed in Section 5.0 are estimated in this section to determine the area(s) potentially affected, the need for personnel protective actions, and the time available to take those actions. They were derived from the computer data base CAMEO (Computer-Aided Management of Emergency Operations) and it's calculational plume model ALOHA (Areal Locations Of Hazardous Atmospheres), by utilizing many of the assumptions and theories utilized in the computer model DIFOUT originally created by SNL in 1969 to project particulate fallout of radioactive material. Output data from these models is summarized at the end of this section for each Release Designation previously identified.

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 material released using the most readily available resources for users and reviewers of this Hazards Assessment Document. The methodology employed is that commonly used in emergency management practices and set forth by DOE and other Federal Agencies. For example, the EMG requires a release of all material under worst case met conditions. Common Emergency Management practices identify this as being a Stability Factor of F and a wind speed of 1 meter per seconds (2.2 mph.). In addition, a pool depth of 1 cm. (3/8 in.) is accepted as worst case condition for a spill of hazardous material according to the Technical Guidance for Hazards Analysis document for emergency planning for extremely hazardous substances published in December 1987, by the U.S. EPA, Federal Emergency Management Agency and U.S. DOT. This methodology is employed in all spill scenarios.

6.1.1 Calculational Models

Toxicological consequences of the events and conditions identified in Section 5.0 were estimated by using the data base CAMEO (Computer-Aided Management of Emergency Operations) and its computational modeling program ALOHA (Areal Locations of Hazardous Atmospheres) for evaporation resulting from a spill of hypergolic fuel. CAMEO and ALOHA were also applied for the dispersion of exhaust products resulting from the combustion of solid rocket fuel on the launch pad by employing the assumptions and methodology utilized in the SNL computer model DIFOUT.

Note: CAMEO is a data base containing toxicological profiles to over 4,000 chemicals. CAMEO has an associated calculational computer model that projects plume dispersion called ALOHA.

The chemical model, CAMEO was developed 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.

ALOHA is a tool for estimating the movement and dispersion of gases from a single source. 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 (e.g., rural or urban setting), the atmospheric conditions and the circumstances of the incident. ALOHA does allow the option of modeling with either a heavy gas or gaussian program. However, ALOHA lacks the ability to analyze fire and explosion hazards. Detailed information about CAMEO and ALOHA are contained in the Computer-Aided Management of Emergency Operations, U.S.E.P.A. and N.O.A.A., October 1992; [101] and the Areal Locations of Hazardous Atmospheres, U.S.E.P.A. and N.O.A.A., October 1992[102].

ALOHA's gaussian modeling program was utilized for the dispersion of combustion byproducts utilizing data derived from the computer model DIFOUT. This information was then applied as input data for ALOHA. This data includes:

- Percentage of materials at certain heights
- Wind speeds between specific elevations
- Plume geometry

DIFOUT is a model for the computation of aerosol transport and diffusion in the atmosphere. It was created for the DOE by Sandia National Laboratories in 1969. DIFOUT is a revision of an original model (DIFFAL) created in a joint effort between the United States (Sandia Laboratories) and the United Kingdom. DIFFAL was designed to model gravitational fallout of a log-normal size distribution of particulate in a vertically varying wind field with the dispersion of a particulate cloud by atmospheric turbulence. DIFOUT is refined to streamline the task of information input. It also allows for a more realistic accounting of the wind directional shear than was possible in DIFFAL. Originally the program was employed to perform analyses of the hazards which might result from dispersal of radioactive nuclide in the atmosphere from a near-ground failure of a nuclear device or from the accidental non-nuclear detonation of a nuclear device during transportation or storage. In addition, recently a Personal Computer (PC) version of DIFOUT was developed and utilized in the July 1992, KTF, Environmental Assessment. DIFOUT allowed for the dispersal of aerosol exhaust byproduct in a scenario in which solid rocket fuel totally burns on a launch pad. Information concerning DIFOUT can be found in the Sandia Laboratories, Research Report, SC-RR-68-555 published in January of 1985. [103]

All of the values utilized in the consequence analysis to establish thresholds at which exposures to personnel, and the general public are of concern for planning purposes are Emergency Response Planning Guidelines level 2 (ERPG-2). These values are either established by the American Industrial Hygiene Association (AIHA), their recognized equivalents, or calculated as recommended by the DOE at their Hazards Assessment and Event Classification Workshop in Idaho Falls, Idaho, November 2 through 4, 1993. [104] However, if the AIHA has not established ERPG values for a chemical, a conversion calculation employed by SNL/NM in their critical systems analysis will be utilized as it allows for a more conservative analysis. [105]

6.1.2 Calculational Methods

The transport of hazardous materials in the atmosphere from the KTF to personnel or the general public during an accident is a concern. Several factors affect the downwind dose calculations. These include: the quantity of material released or available for release, the release rate and the duration of release, the release height, the atmospheric transport, atmospheric diffusion and deposition and atmospheric stability.

There are three states of atmospheric stability: unstable, neutral and stable. Simplistically, these three states relate to the rate of mixing of the atmospheric surface layer. Seven classes of atmospheric stability are used to indicate the mixing in the atmosphere. Six classes are referred to as the Pasquill-Gifford Stability Classes. A seventh has been added by the United States Nuclear Regulatory Commission (USNRC).

Pasquill - Gifford Stability Classes

A = Extremely unstable (bright, sunny days)
B = Moderately unstable (sunny days/higher winds or some cloudiness)
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)

USNRC Stability Class

G = Very stable (night, very low wind)

As recommended in the EMG, a range of dispersion conditions were considered for each receptor location and spill source term. The dispersion conditions that will be used for the Hazards Assessment Documents associated with the KTF are:

Note: The following meteorological conditions are applicable to spills only and do not apply to detonations as the average area meteorological conditions applicable to the various heights were utilized. The "worst case" meteorological conditions applied to the same quantity of material jettisoned to pre-defined heights provided minimal differences in down wind concentrations, therefore, the average and most realistic values were utilized. These findings can be referenced in Appendix B under Release designation B-1.

- Worst case meteorological conditions "F Stability Factor" at 2.2 mph. (1 mps.) wind speed. Identified as the scenario that rendered the worst case consequences.

- "Low End" meteorological conditions at C Stability with a 10 mph. (4.5 mps.) wind speed. Identified because the trade winds are normally between 10 and 20 mph. [106]

- "High End" meteorological conditions C with a 20 mph. (9.1 mps.) wind speed. Identified because the trade winds are normally between 10 and 20 mph. [107]

6.2 Consequence Thresholds

The consequence thresholds are based upon the Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA). [108]

6.2.1 ERPGs

The ERPG values are intended to provide estimates of concentration ranges above which one could reasonably anticipate observing adverse effects as a consequence of exposure to the 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 one hour without experiencing other anything 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 one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

- ERPG-3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing 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 Timed Weighted Average (TWA) value. [109]

6.2.2 Application of ERPGs

The ERPG-1 and ERPG-2 values are used to classify 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-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 facility boundary, the event is considered an alert. 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

The event consequences involving the release of hypergolic liquid propellants described in Section 5.1.1 and 5.1.2 were run on the computer model CAMEO utilizing its dispersion model ALOHA as a ground level single source point release. The principles applied to potential scenarios were based on the concentration of released hypergolic components (fuel/oxidizer) to air mixtures rich enough in hazardous material to constitute a hazard to personnel and/or the general public. The hazardous concentrations are 1.8 ppm. for UDMH (a calculated ERPG 2 value) and 15.0 ppm. for NTO (an assigned ERPG value for Oxides for Nitrogen). The supporting information for spill consequences can be found under the U and N Release Designations in Appendix B.

The event consequences involving the release of solid fuel exhaust byproducts, described in Section 5.2, were run on ALOHA employing methodology and assumptions applied to the computer model DIFOUT. The principles applied to potential scenarios were based on the concentration of exhaust byproducts in aerosol form, which result from a detonation of a rocket before or immediately after launch, rich enough in hazardous material to potentially constitute a hazard to personnel and/or the general public. The hazardous concentrations are based on assigned, calculated or recognized equivalent ERPG 2 values. Information for exhaust byproduct consequences can be found under the B and K Release Designations in Appendix B.

Facility Boundary: There is a combination of man made and natural physical barriers that define the KTF facility boundary. A chain-link fence surrounds the KTF "Main Compound", parts of the launch field area, and gates serve to block all road entrances to the facility. Large sand dunes, concrete rebutments, and thick groves of Kiawa Trees, possessing large thorns surround the launch field in all areas with exception of the "Main Complex and those roads that have gates. The beach is closed during working hours year round and 24 hours a day seven days a week when the beach is included in a rocket/missile systems Ground Hazard Area. The defined facility boundary is approximately 100 ft. (~30 m) from Pad 42. However, because of the physical barriers present described earlier the closest members of the general public could find clear beach is approximately 330 ft. (~100 m) away from the STARS Launch Pad (Pad 42) which is approximately 1,240 ft. (~375.8 m) from the LOB. Many of the smaller launch facilities are closer to the KTF compound but further from the general public access beach.

The Kokole Point Launch Facility has a fence around the pad. Therefore, the Kokole Point facility boundary is the fence. The fence is approximately 30 ft. (~9.1 m) from the launcher at its closest point. Any incident at the Kokole Point Launch Site would exceed the facility boundary.

Note: As used in this hazards assessment, the term general public refers to persons who are not DOE/Sandia, customers, employees or contractors assigned to or visiting the KTF.

Site Boundary: The KTF is located on the PMRF and SNL actually supports the operations of the DOD by launching rockets at the KTF. Motor systems employed by the KTF actually belong to the DOE or DOD before they arrive and "become the U.S. Navy's once it is launched" (the Navy provides flight/range safety). In addition the PMRF is the primary responder to an incident at the KTF. Therefore, the PMRF boundary has been determined to be the KTF site boundary. The STARS launch pad (pad 42) is 1,000 ft. (~300 m) from the Pacific Ocean representing the nearest area not owned by the PMRF.

Onsite Receptors: The population at the KTF fluctuates between 10 and 140, depending on launch schedules. The PMRF population ranges from 700 to 1,100 workers and their dependents, with an additional 600 to 700 transient workers on the PMRF at any point in time while in transit, leave or exercises (these figures do not include Air National Guard or National Guard). As described in Section 6 of this document, members of the general public reside 24 hours a day at the PMRF's Main Gate approximately 12,500 ft. (~3.8 km.) from the KTF "Main Complex". The PMRF Base Housing is approximately 5,250 ft. (~1.6 km.) away from the "Kokole Point launch site". In addition, a local landfill is approximately 1,500 ft. (~455 m) away from the remote site from the Kokole Point Launch Site.

In evaluating results of postulated events from ALOHA the amount of time available to take protective actions will vary depending upon the type of release, (spill/combustion) the amount of material involved, and the met, conditions. The amount of time that will be available between the initial incident and the ramifications will vary from instantaneous to 1 hour and 40 minutes 6.2 km. (~3.87 mi.) down wind for a spill of 55 gal. (~209 l) of UDMH under worst case met conditions. All other scenarios will be of a shorter duration, thus, allowing less time for protective actions. NASA is the first and primary responders when hypergolic propellant is being employed. If an incident involving hypergolic propellant occurs during stand-down or other types of launch (i.e. solid fuel motor systems) the U.S. Navy will respond until NASA personnel can respond. PMRF personnel have been trained and gear has been provided for incidents involving hypergolic propellant. The Navy's SOPs recommend actions to be taken for the protection of personnel and the general public for incidents that have consequences off the KTF.

The KTF's SOPs recommend actions to be taken for the protection of personnel and the general public on the KTF that do not produce consequences beyond the KTF.

The consequences associated with the maximum inventories of each of the chemical hazards identified in the Event Scenarios in Section 5.0 are summarized in Table 6.1.

KTF "Main Complex" Receptors: Offsite receptors have been defined at points of interest outside of the KTF "Main Complex". The receptors and their respective distances from the KTF "Main Complex" are as follows.

Note: The distances identified below are approximations from the nearest launch pad or the nearest liquid hypergolic propellant storage pad, whichever is closest to the identified receptor. Receptors that lie within an EPZ are seen in bold.

- Polihale Spring, ~20,500 ft. (~6.2 km.)
- **Polihale State Park, ~5,000 ft. (~1.5 km.)**
- **Navy Launch Site (North of the KTF), ~1,000 ft. (~0.3 km.)**
- **Sugar Cane Field East of the KTF, ~500 ft. (~0.15 km.)**
- **Pacific Ocean, ~1,000 ft. (~0.3 km.)**
- **Nohilli Dunes and Public Access Beach, ~100 ft. (~0.03 km.)**
- **PMRF Main Gate, ~12.500 ft. (~3.8 km.)**
- **PMRF Control Tower, ~12,000 ft. (~3.6 km.)**
- **Navy Storage Caves, ~13,000 ft. (~3.94 km.)**
- PMRF Base Housing, ~30,750 ft. (~9.3 km.)

KTF Kokole Point Receptors: Offsite receptors have been defined at points of interest outside of the KTF Kokole Point Facility. The receptors and their respective distances from the KTF "Kokole Point launch site" are listed below.

- KTF "Main Complex", ~36,000 ft. (~10.91 km.)
- PMRF Main Gate, ~23,500 ft. (~7.1 km.)
- PMRF Base Housing, ~5,250 ft. (~1.6 km.)
- Kekaha Airstrip, ~5,000 ft. (~1.515 km.)
- Public Landfill, ~1,500 ft. (~0.455 km.)
- Kekaha Village, ~10,500 ft. (~3.2 km.)

Table 6.1

Summary of Consequences

Event Consequences for the KTF						
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)		
U-1	1,580	8.93	543	401	1 pt. UDMH leaked from motor	Site Area
U-2	25.6	0.266	116	76	1 pt. UDMH leaked from motor	Site Area
U-3	12.8	0.133	81	53	1 pt. UDMH leaked from motor	Site Area
U-4	697,000	3,930	6,200	4,200	55 gal. UDMH leaked from drum	General
U-5	11,300	177	1,900	1,400	55 gal. UDMH leaked from drum	General
U-6	5,640	58.6	1,800	1,200	55 gal. UDMH leaked from drum	Genaral
N-1	1,660	9.33	255	196	1 pt. NTO leaked from motor	Site Area
N-2	26.8	0.279	41	29	1 pt. NTO leaked from motor	Site Area
N-3	13.4	0.139	29	20	1 pt. NTO leaked from motor	Alert
N-4	735,000	4,140	2,500	1,900	55 gal. NTO leaked from drum	General
N-5	11,900	124	871	630	55 gal. NTO leaked from drum	General
N-6	5,940	61.8	633	442	55 gal. NTO leaked from drum	General
B-1	**N/A	**N/A	<205	<114	Combustion of STARS solid fuel	Site Area
B-2	6.62	0.0704	41	16	Combustion of STARS solid fuel	Site Area
B-3	46,400	262	175	114	Combustion of STARS solid fuel	Site Area
B-4	8.02	0.0504	10	<10	Combustion of Recruit solid fuel	Alert
B-5	612	10.3	205	90	Combustion of STARS solid fuel	Site Area
B-6	**N/A	**N/A	<205	<114	Combustion of Talos solid fuel	Site Area
K-1	**N/A	**N/A	<205	<114	Combustion of Terrier solid fuel	Site Area
K-2	46,400	262	175	114	Combustion of Terrier solid fuel	Site Area
K-3	**N/A	**N/A	<205	<114	Combustion of Terrier solid fuel	Site Area

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

** Release Designations B-1, B-6, K-1, and K-3 are particulate releases. Because of particulate modeling constraints a conservative approach of utilizing the distance to ERPG-2 and ESHE gas concentrations are identified for these materials. It is accepted that concentrations of particulates will be within this area of impact.

7.0 THE EMERGENCY PLANNING ZONE

The results of the consequence analysis performed in Section 6.0 was used to develop two proposed Emergency Planning Zones (EPZs). One for the KTF's "Main Complex" and the second for the KTF's Kokole Point launch site. Each EPZ is based on analyzed potential hazards which provides assurance that required resources are available and dedicated to the proper areas and issues. Consideration of the impact to the populace and the environs resulting from the consequence analysis is an important factor in establishing an EPZ.

The general public can have unescorted access to areas as close as 100 ft. (~33 m) to Launch Pad 42 (the STARS Pad) via the beach to the west. The nearest general public that resides continually near the KTF "Main Complex" is the PMRF Main Gate 12,500 ft. (~3.8 km.) south-east of the KTF STARS Launch Pad.

Many recreational facilities which the general public have unescorted access are located within 1 mi. (~1.6 km.) of the KTF "Main Complex". These include the beach ~1,000 ft. (~303 m) west of the KTF "Main Complex and the Polihale State Park ~5,000 ft. (~1.5 km.) north of the KTF "Main Complex". The most obvious offsite facility within 3,300 ft. (~1 km.) of the KTF's Kokole Point launch site is the public landfill ~1,500 ft. (~455 m) east-south-east of launch pad 41.

The main hard surface road leading to the PMRF is Highway 50. It originates near the town of Lihue, Kauai. From Lihue north it turns into Highway 56. Highway 50 runs west along the south and southwestern coastal land from the town of Lihue which is located on the southeastern coast of Kauai. It terminates ~2,650 ft. (~800 m) past the PMRF main gate, at an auxiliary gate, approximately 8,000 ft. (~2,424 m) from the KTF "Main Complex". On the PMRF the North Nohli Road, a hard surface road, runs from the main gate right to and past the KTF "Main Complex". This road intersects with Highway 50 at the spot at which Highway 50 terminates. From the PMRF's main gate this road is called South Sidewinder Road. It runs south and ends into the Kokole Point Road. From this intersection the KTF's Koloke Point launch site is accessible ~500 ft. (~151 m) to the west and the PMRF's south gate is accessible ~1,500 ft. (~454 m) to the east. The Kokole Point Road ends into Highway 50 approximately 1,000 ft. (~303 m) east of the PMRF's south gate. This would be the prime evacuation route for all persons within either of the KTF's EPZs.

The protection of personnel inside the KTF's "Main Complex", especially the LOB is excellent. The KTF has trained and qualified personnel, effective warning systems, an excellent personnel accountability system, and an effective short-term sheltering area within the LOB. Communications outside the complex are maintained by telephone and two-way radio.

The time required to take protective actions will vary depending on the event. Response time inside the complex is almost immediate. Notification to the closest facilities that are open to the general public, would occur within 20 minutes of the event recognition.

7.1 The Minimum EPZ Radius

In accordance with the EMG, the results of the consequence analyses are to be used to develop a proposed EPZ for the KTF. As can be perceived from the summary tables in Section 6.0, the highest facility emergency class is a General Emergency at the KTF's "Main Complex" and a Site Area Emergency at the Kokole Point launch site. The minimum distance at which an EPZ can be established according to the EMG (the EPZ flow chart) is 5 km. (~3.12 mi.) or the distance to ESHE (ERPG 3 concentration) which ever is greater. For a Site Area Emergency the EPZ should be established at the site boundary or 2 km. (~1.25 mi.) which ever is the least. Therefore, the KTF "Main Complex" has a 5 km. (~3.12 mi.) EPZ while the Kokole Point launch site has an EPZ that conforms to the PMRF site boundary.

Note: The EPZ established for the KTF "Main Complex" and the "Kokole Point launch site" is shown in Illustration 7-1.

7.2 Tests of Reasonableness

The EPZ is required to meet the following five tests.

1. Are the maximum distances to the **<u>PAG/ERPG 2</u>** level impacts for <u>most</u> of the analyzed accidents equal to or less than the EPZ radius selected?

   Yes. The results of the consequences summarized in Section 6.0 Tables show that approximately 96% of all scenario producing ERPG 2 concentrations are well within the established EPZs. In addition, all ESHE (ERPG 3) concentrations fall well within the respective EPZs. The greatest ERPG 3 consequence is associated with UDMH under "worst case" met conditions at a distance of 4.2 km. (~2.62 mi.) as found in Appendix B in the U release designation modeling section.

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

   Yes. Both the "Main Complex" and the Kokole Point Emergency Planning Zones involve the coordination of the various organizations across the same jurisdictional boundaries that would be utilized to aid in response to any incident that could propagate outside a 5 km. (~3.12 mi.) EPZ. In addition, lines of communication and decision processes involving PMRF, as well as village, county and state 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 or near the scene of the emergency?

   Yes. Each EPZ encompasses the respective KTF launch site, as well as all access routes leading to it from each direction. Planning should provide for evacuation (if necessary and or possible) of all non-essential personnel, who might otherwise complicate the on-scene response by their presence. The response to such an incident should follow those procedures already established by the PMRF and KTF.

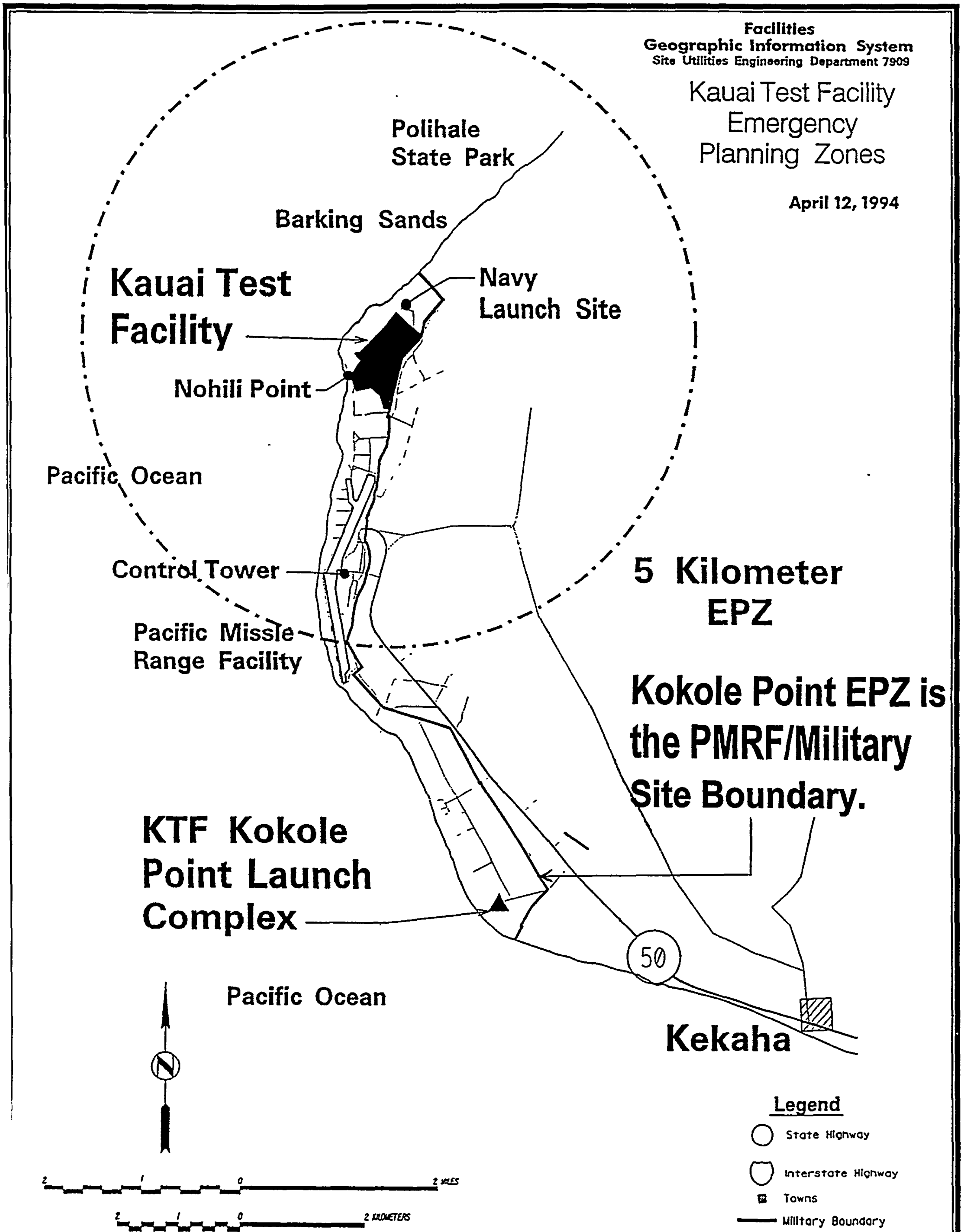


Illustration 7-1

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

   Yes. The PMRF responders, identified as second responders when NASA personnel are on site and primary responders in all other instances, possess and are trained in the use of appropriate protective suites with SCBAs purchased by the KTF. In Addition, cliffs approximately 3,000 m (~9,900 ft.) east of the KTF would constitute a natural boundary that would influence and inhibit any down wind exposures as well as any response efforts. In addition, the area surrounding the PMRF is very sparsely populated and primarily utilized for agriculture. The Kokole Point launch site EPZ conforms to the PMRF site boundary as all consequences are projected to stay well within PMRF property.

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

   The proposed EPZs 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 Section 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 and Protective Actions

There are three classes of operational emergencies listed in order of increasing severity: Alert, Site Area Emergency, and General Emergency. Differentiation of these classes by severity is 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

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

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 evacuation 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

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 The KTF Release Events and EALs

The KTF is part of a joint DoD/DOE rocket launch facility on the Island of Kauai, Hawaii. It has been the site of over 355 launches since its induction in 1962. Both the liquid and byproducts from spent solid propellants were identified as toxicological hazards that potentially exist at the KTF. The worst case scenario (a spill of 55 gal. (~209 l) of UDMH 1 cm. (~3/8 in.) thick with F Stability and a wind speed of 1 meter per seconds (~2 mph.)) provide concentrations equivalent to ERPG 2 out to 6.2 km. (~3.87 mi.). Time available to initiate protective actions range from less than one minute to approximately 1 hour and 40 minutes at the outer edge of the KTF "Main Complex's" EPZ. Appendix B provides modeling information for postulated scenarios, the consequences associated with an incident and the time available to take protective actions.

An incident involving a detonation/combustion of a motor system would result in instantaneous consequences. In such cases as detonation/combustion, the only response efforts would be attempts to contain various grass fires (without putting out the source of the combustion) resulting from burning debris. Recovery efforts would commence immediately. All consequences (ERPG 2 concentrations) from toxic byproducts are projected to be well within the PMRF site boundary.

The KTF's LOB is equipped with multiple systems that provide local audible and visual warnings for events that occur out of the norm.

Anything that occurs within the KTF facility boundary, shown in Illustration 8-1, but does not exceed the facility boundary is classified as an Alert.

An incident producing ERPG 2 concentrations beyond the KTF facility boundary and yet within the PMRF or site boundary would constitute a Site Area Emergency.

An incident producing ERPG 2 concentrations beyond the PMRF site boundary would constitute a General Emergency.

8.2.1 KTF "Main Complex" General Emergency EALs

The consequence analysis identified 6 of the 18 postulated incidents which could precipitate a General Emergency classification.

- All scenarios identified as causing an offsite hazard involve the instant release (spill) of large quantities of hypergolic fuels (UDMH and NTO) from their storage pad or while in transport.

8.2.2 KTF "Main Complex" Site Area Emergency EALs

The consequence analysis determined that 7 of the 18 scenarios postulated (either spilled hypergolic fuels or exhaust byproducts) would constitute a Site Area Emergency.

8.2.3 KTF "Main Complex" Alert EALs

The consequence analysis found that 5 scenarios (all exhaust byproduct incidents) would be limited to Alerts. The results of these incidents did not exceed the KTF facility boundary.

8.2.4 KTF Kokole Point Site Area Emergency EALs

The consequence analysis determined that any incident would constitute a Site Area Emergency. All three scenarios (byproduct) reflect this fact.

8.3 Summary of Protective Actions

The majority of incidents postulated above will fall within the PMRF site boundary. Time should be available to respond to most scenarios as each hazardous operation whether fuel transport, motor assembly or actual launch is accompanied by a SOP and usually an associated hazard area. Within these specific hazard areas only pertinent personnel are allowed. In addition lines of communications between the various organizations (e.g., KTF, PMRF, NASA, Kauai, Hawaii, DOE) are open and primary and secondary responders are on standby in case an incident should occur. All personnel within this area are equipped with the appropriate protective equipment while personnel within the LOB are protected by a HVAC system that limits the outside environment.

Protective actions should be implemented (if time allows) for both onsite and offsite personnel who are within the predefined impact area. The time available for implementation of protective actions will range from minutes to 1 hour and 40 minutes at 6.2 km. (~3.87 mi.) for a release of UDMH under "worst case" met conditions. Protective actions for personnel should be evacuation if at all possible. Emergency response activities should follow established guidelines for incidents involving the materials (byproducts or liquid hypergolic propellant) identified in this hazard as appropriate for the event that occurs (fuel combustion or spill). Emergency personnel should monitor the activities and transmit the related emergency information to the Sandia Duty Officer, Incident Commander and/or the Emergency Response Director in the SNL Emergency Operations Center (EOC).

The emergency response personnel in the SNL/EOC will ensure the prompt notification of the Albuquerque Field Office an the Nevada Field Office of the Department of Energy emergency response staff while also ensuring that the coordinated actions of the Sandia DOE emergency plans are initiated. SNL EOC Cadre will recommend and transmit to DOE the Protective Action Guidance (PAG) for the personnel in the affected offsite area.

The DOE EOC personnel will establish and maintain contact with the USN command structure outside the PMRF. DOE is responsible for transmitting to the USN and other DOE contractors the recommended SNL PAG, revising/supplementing the Sandia PAG, or preparing an entirely different PAG. During an incident at the PMRF direct communication is already established among the active participants.

After SNL personnel have successfully mitigated the event, the Emergency Response Director will recommend termination of the emergency and prepare to initiate recovery actions.

DOE emergency response personnel will concur with the SNL Emergency Response Director's recommendations and relay the appropriate information to all other emergency response organizations.

8.4 Emergency Planning and Preparedness Concerning Hazards not Owned by SNL/KTF

A release of materials identified in Section 3.2, which are not owned or controlled by SNL/KTF, could produce consequences within one or both KTF launch sites that would constitute protective actions for KTF personnel and visitors. Thus, the development of Protective Actions, EALs, and emergency planning and preparedness efforts (for these non-KTF hazards as well as KTF hazards) should be coordinated with the PMRF, sugar cane companies, local authorities, the state, as well as the federal government.

Postulated consequences resulting from the release of materials (identified in Section 3.2) not owned or controlled by SNL/KTF are provided in Table 3.2. Consequences range from ERPG-3 concentration levels on site resulting from the release of 600 lb. of Chlorine under "worst case" met conditions to less than ERPG-1 concentrations due to a 200 gallon release of Sodium Hydroxide under "worst case" met conditions. The later scenario does not require KTF personnel or visitors to take protective actions, however, it should be noted that response capabilities to an incident on the KTF may be decreased by this or any other event postulated in Section 3.2 in two ways.

1) Due to limited access to the KTF, an incident releasing any of the materials identified in Section 3.2 may require response organizations and resources to pass through a plume in order to respond to an incident at the KTF.

2) An order of priority must be established as to which incident takes priority in the case of simultaneous events (e.g., does an UDMH incident at the KTF take precedence over a chlorine leak at a PMRF facility and are there qualifying events and or factors to be considered in prioritizing an incident). All of these factors should be evaluated and response activites predetermined so that response to each event is quick and effective with minimal impacts to personnel, the general public, property, and the environment.

9.0 MAINTENANCE AND REVIEW OF THIS HAZARDS ASSESSMENT

The Risk Management and NEPA Department is responsible for ensuring that this Hazards Assessment Document is regularly reviewed and maintained current.

It is the responsibility of the Facility Managers 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 manager.

REFERENCES

1. U.S. Department of Energy Order 5500.3A, Planning and Preparedness for Operational Emergencies, dated 2/27/92.

2. Helgesen R. F., *Safety Assessment for the Kauai Test Facility at Barking Sands, Kauai, SAND89-2548*, Sandia National Laboratories Albuquerque, New Mexico and Livermore, California, April 1990, Chapter 6 Section B.

3. *Operations at Kauai Test Facility, SP472378*, Kauai Test Facility Barking Sands, Kauai, HI, Sandia National Laboratories Albuquerque, New Mexico, December 2, 1992, Section 2.1.

4. Ref. 2, Chapter 3, Section B, Part 3.

5. Ibid.

6. 1994 Kauai Test Facility Comment and Resolution Fax, Dave Beck, Resident Range Manager Kauai Test Facility.

7. Ref. 2, Chapter 3, Section C, Part 4.

8. Ref. 2, Chapter 3, Section D Part 1.

9. Ref. 2, Chapter 3, Section D Part 2.

10. Ref. 2, Chapter 3, Section B, Part 5.

11. *Kauai Test Facility (KTF) Environmental Assessment, DOE/EA-0492*, Sandia National Laboratories, Albuquerque, New Mexico, July 1992, Page 1 of Section 1.

12. Ref. 2, Chapter 3, Section E, Part 1.

13. Ibid.

14. Ibid.

15. Ibid.

16. Ref. 2, Chapter 3, Section E, Part 2 and 3.

17. Ibid.

18. Ref. 2, Chapter 3, Section E, Part 3.

19. Ref. 2, Chapter 3, Section B, Part 4.

20. Ref. 12, Page 8.

21. Ref. 2, Chapter 3, Section H, Part 1

22. Ref. 12, Page 25.

23. Ibid.

24. 1994 Kauai Test Facility Original HAD Comments, Dave Beck, Resident Range Manager Kauai Test Facility.

25. Ref. 2, Chapter 3, Section H, Part 2.

26. Ibid.

27. Ibid.

28. Ibid.

29. Ibid.

30. Ref. 2, Chapter 3, Section F, Part 1.

31. Ibid.

32. Ibid.

33. Ref. 2, Chapter 3, Section G.

34. Ref. 2, Chapter 3, Section F, Part 2.

35. Ibid.

36. Ibid.

37. Ibid.

38. Ibid.

39. Ref. 2, Chapter 3, Section E, Part 1.

40. Ref. 12, Page 33.

41. Ref. 12, Page 31.

42. Ref. 12, Page 32.

43. Ibid.

44. Ref. 12.

45. Ref. 2, Chapter 3, Section B, Part 1.

46. Ref. 2, Chapter 3, Section B, Part 2.

47. Ref, 12, Page 45.

48. America Online, 12, May 1995.

49. Ref. 12, Page 1 of Section 1.

50. Ref. 12.

51. Ref. 2.

52. Ref. 8.

53. Ref. 2.

54. Ref. 2, Chapter 1, Sec. F, and Sec. G.

55. Ref. 2, Chapter 5, Section B.

56. Ref. 2.

57. Ibid.

58. *Kauai Test Facility (KTF) Transportation Safety Requirements for Liquid Hypergolic Propellants, Draft, WSTF-KTF-PROP-91-01*, Operations and Deployment Experiments Simulator (ODES) Program, Lyndon B. Johnson Space Center, White Sands Test Facility, Las Cruces, New Mexico, May 30, 1991, (Overview Section, Paragraph 1).

59. Ref. 2.

60. Ibid.

61. Ibid.

62. Ibid.

62. Ibid.

63. Ibid.

64. Ibid.

65. Ibid.

66. Ibid.

67. Ibid.

68. Ibid.

69. Ibid.

70. Ibid.

71. Ibid.

72. Ibid.

73. Ref. 58.

74. Ibid.

75. Ref. 58, Fuel Shipments Section, Paragraphs 1 & 8.

76. Ibid.

77. Ibid

78. U. S. Department of Defense, Order 6055.9, Ammunition and Explosive Safety Standards, dated October 30, 1992, (Chapter 3, Section A, Parts 1 &2).

79. Department of Energy, Explosive Safety Manual, dated October, 1991.

80. Ref. 78.

81. Ibid.

82. Ref. 11.

83. Ibid.

84. Ibid.

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

86. Ref. 11.

87. Ref. 85.

88. Ref. 11.

89. Ref. 85.

90. Ref. 11.

91. Ref. 85.

92. Ref. 11.

93. Ref. 85

94. Ref. 11.

95. Ref. 85.

96. I. D. Smith, *The ODES Evacuation Requirements Plan For Liquid Hypergolic Propellant Spills, WSTF-KTF-EVAC-92-01,* Operation and Deployment Experiments Simulator (ODES) Program, Lyndon B. Johnson Space Center white Sands Test Facility, Las Cruces, New Mexico, February 10, 1992.

97. Ibid.

98. A. L. Dudley, and S. A. Sonnieitner, *Dispersal of KTF STARS Combustion Products,* SPECTRA Research Institute, Albuquerque, New Mexico, May 5, 1991.

99. Ref. 11.

100. Ref. 11.

101. *Computer-Aided Management of Emergency Operations (CAMEO),* U.S.E.P.A. and N.O.A.A., October 1992.

102. *Areal Locations of Hazardous Atmospheres (ALOHA),* U.S.E.P.A. and N.O.A.A., October 1992.

103. R. E. Luna and H. W. Church, *DIFOUT: A Model for Computation of Aerosol Transport and Diffusion in the Atmosphere, SC-RR-68-555,* Sandia National Laboratories, Albuquerque, New Mexico, Research Report, dated January, 1985.

104. Correspondence To: V. Everett, From: C. Wood, Subject: Hazards Assessment for EP and Event Classification Workshop, November 8, 1993.

105. M. A. Ma, *Concentration Limit Hierarchy for Toxicological Accident Analysis Project # SNL-MDL-01,* United Energy Services Corporation, August 9, 1993.

106. Ref. 96.

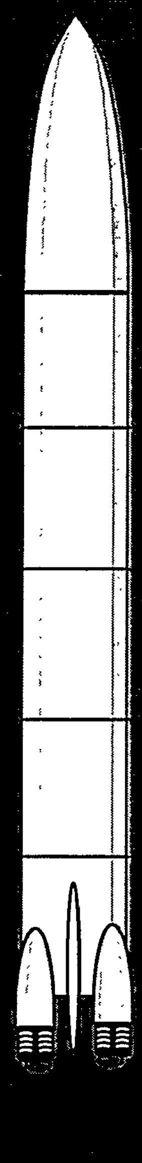
107. Ibid.

108. *Emergency Response Planning Guidelines.* Prepared by the Emergency Response Planning Committee if the American Industrial Hygiene Association. February 1992.

109. Ref. 105.

Appendix A

KAUAI TEST FACILITY



May, 1995

Chemical Inventory Screening

Appendix A

Definitions for Chemical Location Codes:

• SR	Building 669 Room 3 (Warehouse, Payload "C" room)
• SS #1, #2, and #3	Storage rooms 1,2,and 3 in Building CCB1 (chemical containment building, which is a "portable" storage building manufactured by *Safety Storage* and is located under cover at the NW end of Building 671, the Maintenance Shop)
• Paint XP-1, 2 etc.	"XP" refers to transportainers that are used as "portable" temporary storage buildings, the correct prefix of which is "TP" (e.g., TP1, TP2, etc.). The particular transportainers in question are located under cover at the NW end of Building 671, the Maintenance Shop.
• Flam Cab.	Refers to a flammable storage cabinet that is located under cover at the NW end of Building 671, the Maintenance Shop.
• F-14	Flight Battery Trailer that is located at dock space no. 2 of Building 667 (NW end of the Main Dock).
• LOB-RECO	Refers to the "TM" room (Room 103) of Building 648 (LOB).
• AEB	Refers to a flammable storage cabinet located in Room 2 of Building 645 (AEB).

RADIOLOGICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Radiation Sources at the KTF

Hazard Source	Location	Quantity of Material	Screening Criteria (Curies)	Notes/ Additional Screening Criteria	Screen or Keep
Americium - 241 (16 Fire Detectors)	Bldg. 648 (LOB)	1.0 Micro Ci (ea.)	2		S
Americium - 241 (10 Fire Detectors)	Bldg. 647 (MAB)	1.0 Micro Ci (ea.)	2		S
Americium - 241 (3 Fire Detectors)	Bldg. 645 (AEB)	1.0 Micro Ci (ea.)	2		S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy   Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additonal Screening Criteria	Screen or Keep
1,1,1, Trichloroethane	MAB	2.0 (pt)					<EPRG 1 @ 26 m (ALOHA)	S
1,1,1, Trichloroethane	SR	1.0 (pt)					<ERPG 1 @ 19 m (ALOHA)	S
1200 Prime Coat	SS #2	2.0 (gal)	X					S
1204 Prime Coat	SR	28.0 (ozf)	X					S
1251 Part B Epoxy Converter	Paint XP-2	7.0 (gal)				X		S
140 Cove Base Adhesive	Flam Cab	2.5 (gal)	X					S
140 Gear Oil	SS #3	55.0 (gal)	X					S
160 Thinner Rustoleum	SS #2	4.0 (gal)	X					S
2 Cycle Engine Oil P/P 0781-319-8901	Flam Cab	5.2 (ozf)		X				S
3 in 1 Household Oil	SS #1	3.0 (ozf)		X				S
3-6077 RTV Silastic Ablatve Kit	SS #2	390.0 (lbs)				X		S
3-6559 Cure Accelerator	SR	8.0 (lbs)			X	X		S
3140 RTV Coating	SR	3.0 (ozd)		X				S
3145 RTV	SR	3.0 (ozd)		X				S
321 Dry Film Lubricant	SR	11.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Silicone Heat Sink Compound	SR	10.0 (ozd)		X				S
Multi Purpose Floor Covering Adhesive	Flam Cab	1.0 (gal)	X					S
4-Way 765-1607 (NAPA)	SR	5.0 (ozf)		X				S
4700 High Temp Paint White Silicone	SS #2	6.0 (gal)	X					S
522X Powder	SS #1	3.0 (ozd)		X				S
77 Spray Adhesive	SR	34.0 (ozf)	X					S
8004 Symmetro Flow	Paint XP-2	1.0 (gal)	X					S
8098 Synthol Enamel, Grey	Paint XP-2	4.0 (gal)	X					S
8101 Polyurethane Activator	Paint XP-2	5.0 (qt)	X					S
8450 Urethane Hardner	Paint XP-2	1.0 (qt)	X					S
8455 Nitram Retarder	Paint XP-2	1.0 (qt)	X					S
8832 Acrylic Enamel Slow Reducer	Paint XP-2	4.0 (gal)	X					S
9101 Activator Rustoleum	SS #2	10.0 (gal)	X					S
9108 Deeptint Base Rustoleum	SS #2	2.0 (gal)	X					S
9171 Dunestan Rustoleum	SS #2	3.0 (gal)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
93-104 Ablative Material	SR	10.0 (lbs)				X		S
93-104 Catalyst	SR	16.0 (ozf)		X				S
9300 SystemHD Epoxy 9392 White Base Compound	Paint XP-1	15.0 (gal)	X					S
9401 Activator	SS #2	6.0 (gal)					<ERPG 1 @ 30 m (ALOHA)	S
9483 Gray-Base Rustoleum	SS #2	2.0 (gal)	X					S
A W Hydraulic Oil 32	SS #3	5.0 (gal)	X					S
A-33 Dry Desinfectant	XP-5	100.0 (ozd)	X					S
ABS Black Cement, #30917 & #30919	Flam Cab	1.2 (qt)	X					S
Ace Hardware Glazing No. 10922	Paint XP-2	32.0 (ozf)	X					S
Ace Rust Stop Enamel	SS #1	120.0 (ozf)	X					S
Acetone	Flam Cab	1.0 (gal)	X					S
Acetone	Drum Area	11.0 (gal)	X					S
Acetone	MAB	1.0 (qt)	X					S
Acrylic Semi-Gloss Latex Enamel, 186A215 Pastel Base "J"	Paint XP-1	1.0 (gal)	X					S
Adhesive Spray Photo Mount 6092	SR	6.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility   Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Aeroday G Dry Film Lube	SS #1	26.0 (ozf)	X					S
Aeroshell Grease 7 Mil-G-23827B	SS #3	1.0 (lbs)		X				S
Silicone, Polybutene, BPC #2	SS #1	1.0 (qt)	X					S
Air Lube 10W/NR	SS #1	5.0 (pt)	X					S
Air Tool Cleaner, ATC-855	SS #1	96.0 (ozf)	X					S
Air Tool Oil, Amflo 1220-1	SS #1	1.0 (pt)	X					S
Air Tool Oil, P/N 4Z989	MAB	16.0 (ozf)		X				S
Air Tool Oil, Protecto Lube	SS #1	3.0 (pt)	X					S
Aircraft Hydraulic Oil 15	SS #3	5.0 (gal)	X					S
AJAX	MAB	21.0 (ozd)	X					S
AJAX Cleaner	Rest Room	63.0 (ozd)	X					S
Alcohol	MAB	1.0 (pt)	X					S
Alkyd Satin Finish #23617 Beige	Paint XP-2	2.0 (gal)	X					S
All Weather Patch, 702	Paint XP-2	1.0 (gal)	X					S
Alum Tap Cutting Fluid	SS #1	6.0 (pt)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

[illegible]			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Aluminum Asbestos Coating	Paint XP-1	5.0 (gal)				X		S
Aluminum Dipole Adhesive	SS #1	14.0 (ozf)		X				S
Aluminum Putty F, P/N 10610	XP-3	1.0 (pt)	X					S
Anchorlube-G-771	SS #1	200.0 (ozf)	X					S
Anderol 750 SYN Comp. Oil	SS #3	5.0 (gal)	X					S
Anti Seize Compound, Lubrigard P/N 765-1150	XP-3	12.0 (ozf)		X				S
Anti-Seize, P/N Lubg 12	XP-3	12.0 (ozf)		X				S
Anti-Seize, P/N Lubg 6	XP-3	6.0 (ozf)		X				S
Antifreeze/Coolant	XP-3	2.0 (gal)	X					S
Apiezon Frease, P/N 59328	SS #1	13.0 (ozf)		X				S
Armite Anti-Seize White Lead Base	SS # 1	1.0 (lbs)		X				S
Automatic Transmission Fluid, Dextron II	SS #3	6.0 (qt)	X					S
Aviation Hydraulic Fluid A	SS #3	55.0 (gal)	X					S
Ball Paint Marker	SR	14.0 (ozf)		X				S
Batery Cleaner with Acid Indicator P/N 178296	XP-3	112.0 (ozf)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Battery Terminal Protector	XP-3	39.0 (ozf)	X					S
Blue Shower Cleaner/Degreaser	SS #1	24.0 (ozf)	X					S
Boraxo Powdered Hand Soap	XP-5	30.0 (lbs)	X					S
Brake Fluid, DOT 3	XP-3	1.0 (gal)	X					S
Brake Fluid, Wagner Premium DOT #	XP-3	1.0 (gal)	X					S
Brasso (Metal Polish)	SR	8.0 (ozf)		X				S
Bubbles Leak Detector	SS #1	16.0 (ozf)		X				S
C5-A Lubricant	MAB	12.0 (ozf)		X				S
Cadwell Weld Material, #200	SS #1	17.0 Tube	X					S
Cadweld Weld Material, #90	SS #1	15.0 Tube	X					S
Camera Oil	SR	3.0 (ozf)		X				S
Carpet Spotter	SR	1.0 (pt)	X					S
Caulking Compound	XP-16	73.5 (ozf)	X					S
Celuancene Heavy Vacuum Grease	SR	4.0 (ozd)		X				S
Chain Life	XP-3	16.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard			Screening Criteria					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Chemical Activator Cement	SR	0.5 (pt)	X					S
Chempad, P/N CP-400	LOB-RECO	300.0 Pads	X				91% Isopropyl Alchol	S
Chico A3 Sealer	SR	2.0 (lb)	X					S
Chio A 4	SR	1.0 (lb)		X				S
Chromate Putty Mil P-8116, #801 Seam Paste	SS #1	1.0 (pt)	X					S
Cimcool Lathe Lubricant	SR	3.0 (ozd)		X				S
Cindol 2321 Anti-Gall	SR	1.0 (lb)		X				S
Clean-R-Carb	XP-3	48.0 (ozf)	X					S
Cleaning Fluid 23-5111-06	SR	4.1 (l)	X					S
Connector Plus	SR	16.0 (ozf)		X				S
Connector Plus MS-171/CO2	MAB	16.0 (ozf)		X				S
Contact Adhesive 3M 10	Flam Cab	2.0 (qt)	X					S
Contact Cement Dap	SR	32.0 (ozf)	X					S
Contact Cleaner 765-1605 NAPA	SR	30.0 (ozf)	X					S
Corlor Epoxy Enamel	Paint XP-2	5.0 (gal)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Corro Prime 14N White	SS #2	5.0 (gal)	X					S
CRC 2-26 #2005	SS #1	192.0 (ozf)				X		S
CTA 11 Ceramic Tile Adhesive	Flam Cab	1.0 (gal)	X					S
Cutting And Grinding Oil, Soluble	SS #1	12.0 (pt)	X					S
CUZ Body Filter-NAPA 6372	SS #2	1.0 (gal)				X		S
Dawn Dishsoap	MAB	22.0 (ozf)	X					S
Deft White Polyuathane 17925	SS #1	1.0 (qt)	X					S
Delo 400 Motor Oil SAE 30	Drum Area	5.0 (gal)	X					S
Delo 400 Motor Oil SAE 30	XP-3	3.0 (qt)	X					S
Delo Multigrade Motor Oil SAE 10W-40	SS #3	15.0 (gal)	X					S
Desk Top Cleaner	XP-5	3.0 (pt)	X					S
Detergent/Disenfectant, Heavy Duty P/N A-33	XP-5	5.0 (gal)	X					S
Diesel Fuel No. 2	Stg. Tank	10,000.0 (gal)	X					S
Dow Corning 4 Compound	SS #1	80.0 (ozd)				X		S
Drafting Powder	SR	6.0 (ozd)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

acility: Kauai Test Faciltiy Hazard Source: Chemical Inventory

Hazard			Screening Criteria					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	≤ 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Dripless Oil, Cat. # DO-4	SS #1	13.6 (ozf)		X				S
Driveway Sealer Ace	SS #2	5.0 (gal)	X					S
Dry Moly Lube Spray Crown	MAB	16.0 (ozf)		X				S
Dry Moly Lubricant (Crown)	SS #1	100.0 (ozf)	X					S
Dry Moly Lubricant, #6080	SS #1	112.0 (ozf)	X					S
Durakore Liquid, P/N 092789	MAB	16.0 (ozf)		X				S
Duro Super Glue SUP-2B	SR	0.1 (ozf)		X				S
Dursban PT270	SS #1	28.0 (ozf)	X					S
Dust Off II, P/N 5-030-3, Dichlorodifluoromethane	SS #1	276.0 (ozf)			X			S
Electrical Insulating Oil P/N 5-030-3	SS #1	1.0 (gal)	X					S
Elmers Aliphatic Resin Carpenters Wood Glue, P/N E-705	XP-16	4.0 (ozf)		X				S
Epon 828	SR	3.0 (lb)				X		S
Epoxy 5 Minute	SR	40.0 (g)		X				S
Epoxy 5-Minute	SR	3.0 (ozf)		X				S
Epoxy Enamel Activator	F-14	20.0 (gal)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Epoxy Kit 40, P/N 14800	MAB	6.0 (ozf)		X				S
Epoxy Patch Kit Aluminum 6 C	SR	4.0 (ozd)		X				S
Epoxy Spray Paint	SR	40.0 (ozf)	X					S
Ethyl Alcohol	SS #1	1.1 (gal)	X					S
FEL-PRO HI Temp Anti Seize, P/N C-100	SS #1	2.7 (ozf)		X				S
Fend I-2 Barrier Cream P/N FC-37664	XP-5	112.0 (ozf)	X					S
Fend X Skin Conditioner P/N FC-32764	XP-5	160.0 (ozf)	X					S
Flying Insect Killer P/N 1000-53	SS #1	10.0 (ozf)		X				S
Freeze Mist Super 10-702-3	SR	3.0 (ozf)		X				S
Freeze-It P/N 310	SS #1	12.0 (ozf)		X				S
Freon TF Solvent	SS #1	3.0 (gal)	X					S
Freon TMC Cleaner P/N 2009	SS #1	15.0 (ozf)		X				S
Freon TMC Solvent Flux Remover P/N MS-190	SS #1	16.0 (ozf)		X				S
Gas Leak Detector	SS #1	6.0 (ozf)		X				S
Gear Shield Extra Hvy. No. 15263	SS #1	14.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Glade Potpourri Spray	MAB	7.0 (ozf)		X				S
Glazing Compound	Mach. Shop	1.0 (qt)	X					S
Glyptal 1201 Red Enamel	Paint XP-1	1.0 (pt)	X					S
Golden Shell Motor Oil	XP-3	1.0 (qt)	X					S
Goo Gone	SR	16.0 (ozf)		X				S
Goop High Purity Antiseize	SR	3.0 (ozd)		X				S
Graphite Powder, Lub-A-Spray 22X	SS #1	5.5 (ozd)		X				S
Great Stuff Foam Sealant	SS #1	24.0 (oaf)	X					S
Hammer Oil	Flam Cab	1.0 (pt)	X					S
Handy Flux	SR	1.0 (lbs)		X				S
Head Cleaner, P/N 087-007	LOB-RECO	6.0 (ozf)		X				S
Heavy Duty Epoxy System 9301 Activator	Paint XP-2	20.8 (qt)	X					S
Heavy Duty Epoxy System, 9305 Activator	Paint XP-2	9.0 (qt)	X					S
Heavy Duty Epoxy System, 9382 Light Gray	Paint XP-1	1.0 (gal)	X					S
Heavy Duty Epoxy System, 9392 White	Paint XP-2	1.0 (gal)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Hi-Temp RTV Part No. 26B	XP-3	6.0 (ozf)		X				S
High Adhesion Sealant/Caulk #97201	SR	12.0 (ozf)		X				S
High Gloss Enamelized Houst Paint	Paint XP-2	9.0 (gal)	X					S
High Temperature Silicone RTV	MAB	33.0 (ozf)	X					S
HMERITE White Paint	SS #2	4.0 (gal)	X					S
Household Oil	MAB	3.0 (ozf)		X				S
HP 92281B Heads Cleaner	SS #1	36.0 (ozf)	X					S
HY-Gard Transmission and Hydraulic Oil	SS #3	1.0 (gal)	X					S
HY-TRAN Plus	SS #3	5.0 (gal)	X					S
Hydrochloric Acid P/N A144-500	SS #1	500.0 (ml)					Common Lab. Chemicals in <Lab Quantities	S
Hydrolic Oil 15	MAB	1.0 (gal)	X					S
Hypo Tube Cement	SS #1	1.0 (ozf)		X				S
HYSOL 956 Part A	SR	1.0 (lbs)		X				S
HYSOL 956 Part B	SR	16.0 (ozf)		X				S
Impervex Latex High Gloss Enamel	Paint XP-1	11.0 (gal)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

acility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard			Screening Criteria					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	≤ 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Imprervo High Gloss Enamel, Brown 133 60	Paint XP-2	2.0 (gal)	X					S
Incolac II Primer/Sealer	Paint XP-2	1.0 (gal)	X					S
Industrial Enamel 2766 High Gloss White	Paint XP-1	1.0 (qt)	X					S
Industrial Enamel, 470 Aluminum	Paint XP-2	11.0 (gal)	X					S
Industrial Enamel, 964 Federal Safety Red	Paint XP-2	3.0 (gal)	X					S
Insect Repellant	SR	12.0 (ozf)		X				S
INT/EXT Underbody, White Paint 059 00	Paint XP-2	7.0 (gal)	X					S
Ironstone Acrylic Seal	XP-5	5.0 (gal)	X					S
Isopropyl Achohol	SS #1	1.3 (gal)	X					S
Joint Compound	SR	12.0 (lbs)	X					S
Jubilee Kitchen Wax	Rest Room	16.0 (ozf)		X				S
Kenfast #423 Gear Grease	SR	28.0 (ozf)	X					S
Kleenrite Lubrication Oil	SS #1	12.0 (ozf)		X				S
Krazy Glue Pen	SR	0.2 (ozf)		X				S
Krylon #1302 Crystal Clear	Flam Cab	91.0 (ozf)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Krylon Battery Protector P/N 1307	XP-3	22.0 (ozf)	X					S
Lano-Lube	SR	2.0 (ozd)		X				S
Lapping Compound, Timesaver, Yellow, 80 Fine	SS #1	1.0 (lbs)		X				S
Latex Caulk	XP-16	21.0 (ozf)	X					S
Leak Tec Formula #277-C	SS #1	4.0 (ozf)		X				S
Leroy Cleaning Fluid	SS #1	32.0 (ozf)	X					S
Lino-Clean	SR	4.0 (pt)	X					S
Liquid Gold (Scotts)	SR	14.0 (ozf)		X				S
Liquid Metal Siding	Paint XP-2	5.0 (gal)	X					S
Liquid Plumber	SS #1	8.0 (qt)	X					S
Liquid Wrench #1, P/N L1-12	SS #1	11.0 (ozf)		X				S
Lith-Grease	MAB	1.0 (lbs)		X				S
Lo Lubricating Oil GP VVL-820B AM.1	SR	8.0 (ozf)		X				S
Locquic Primer N, P/N 76456	SS #1	24.0 (ozf)	X					S
Loctite 222	SR	2.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

[illegible]			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Loctite 242	MAB	1.0 (ozf)		X				S
Loctite 271	SR	2.8 (ozf)		X				S
Loctite Pipe Sealant No. 92-31	SS #1	50.0 (l)	X					S
Loctite Sealan - Grade A (Red)	SR	5.0 (ozf)		X				S
Loctite Sealant Grade EV Cat #7931	SS #1	4.0 (ozf)		X				S
Loctite Super Bonder 430	SR	1.0 (ozf)		X				S
Lotion Deodorant Soap, P/N SBS-61	Rest Room	3.0 (gal)	X					S
LPS 1 Greasless Lubricant	SS #1	11.0 (ozf)		X				S
LPS 2 General Purpose Lubricant #00216	SS #1	33.0 (ozf)	X					S
LPS 3 Heavy Duty Rust Inhibitor, P/N 00316	SS #1	11.0 (ozf)		X				S
LPS 3 Heavy Duty Rust Inhibitor, P/N 00316	XP-3	121.0 (ozf)	X					S
LPS Cold Galvanize	SS #1	32.0 (ozf)	X					S
LPS Electro Contact Cleaner P/N 00416	XP-3	16.0 (ozf)		X				S
LUB-A-Spray Dry Graphite	SS #1	140.0 (g)	X					S
LUBE-REX White Lubricant	SS #1	26.0 (ozf)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy　　　　Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Lubriko Grease	Paint XP-2	1.0 (lbs)		X				S
Lysol Disinfectant Spay	SR	12.0 (ozf)		X				S
Magic 1622 Suds, Car & Truck Wash	Paint XP-1	15.0 (gal)	X					S
Magnetic Head Cleaning Solution P/N HP 92193F	LOB CMP RM	20.0 (ozf)	X					S
Max Bond Adhesive	Flam Cab	29.0 (ozf)	X					S
Methanol	SR	1.0 (l)	X					S
Mobilear 636 Lube Oil	SS #3	10.0 (gal)	X					S
Molybenum Disulfide Molykote Lubricant Coating	SS #1	24.0 (ozf)	X					S
Molykote 33 Grease	SS #1	5.3 (ozf)		X				S
Molykote G Lubricant	SS #1	12.0 (ozf)		X				S
Molykote Z Powder	SS #1	10.0 (ozd)		X				S
Motor Oil, Non Detergent, SAE30	SS #3	2.0 (qt)	X					S
Motor Oil, STA Lube Non-Detergent	SS #3	16.0 (qt)	X					S
MSA Fogpruf	SR	4.0 (ozf)		X				S
Multi Purpose Wheel Bearing Grease	SS #3	28.2 (qt)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

acility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard			Screening Tools					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	≤ 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Never-Seez, P/N NS-46	SS #1	0.2 (lbs)		X				S
Nitric Acid, P/N A200-500	SS #1	500.0 (ml)					Common Lab. Chemicals in <Lab. Quantities	S
Off Insect Repellent	SR	12.0 (ozf)		X				S
Omega Bond 101 Epoxy Adhesive	MAB	0.5 (ozd)		X				S
P1500 Inorganic Zinc #3	Paint XP-2	10.0 (gal)	X					S
Paint Thinner Mineral Spirits Ace	SS #2	4.0 (gal)	X					S
Paint, Alkyd Interior Semi Gloss, TT-E-509B	Paint XP-1	25.0 (gal)	X					S
Paint, Interior, TT-P-29J	Paint XP-1	15.0 (gal)	X					S
Parker Super Lube	SR	2.0 (ozd)		X				S
Penetrating Oil NAPA No. 6300	XP-3	48.0 (ozf)	X					S
Penetrol Paint Conditioner	Paint XP-2	1.0 (qt)	X					S
Pine-Sol	MAB	1.0 (qt)	X					S
Pinion Grease MS-SP	Flam Cab	60.0 (ozf)	X					S
Pipe Sealant With Teflon, P/N 92-31	SS #1	50.0 Other	X					S
Pledge	MAB	14.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Pneumatic Tool Lubricating Oil, P/N 96291	SS #1	1.0 (qt)	X					S
Polyurea EP Grease-2	SS #3	5.0 (gal)	X					S
Polyurethane Coating, Laminar X-500 Type A	Paint XP-2	1.0 (qt)	X					S
Power Steering Fluid	XP-3	204.0 (ozf)	X					S
Power Steering Fluid No. 9800	SS #3	60.0 (ozf)	X					S
Poxy Lube	SR	15.0 (ozf)		X				S
Prep & Primer For Metal	Paint XP-2	4.0 (qt)	X					S
Prime Coat	Paint XP-2	81.0 (pt)	X					S
Primer Coating, Latex Base Interior, White Type I	Paint XP-1	10.0 (gal)	X					S
Propane Fuel	SS #3	28.2 (ozf)	X					S
Propane Liquid	SS #1	504.0 (ozf)	X					S
Purssian Blue, Non Drying	SS #1	6.0 (ozf)		X				S
Purple Primer for CPVC or PVC, P/N 30796	Flam Cab	3.0 (pt)	X					S
PVC Cement, P/N 31019	Flam Cab	2.0 (pt)	X					S
Raid Ant & Roach Killer	SR	16.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy | Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Red GLPT Varnish	MAB	16.0 (ozf)		X				S
Release Agent/Dry Lubricant MS-122	XP-5	16.0 (ozf)		X				S
Retardo Rust Inhibitive (Black)	SS #2	1.0 (gal)	X					S
Roundup Grass and Weed Killer	Flam Cab	96.0 (ozf)	X					S
Rubber Buffer Compound, (P/N 71	XP-3	32.0 (ozf)	X					S
Rubber Cement (Elmers)	SR	12.0 (ozf)		X				S
Rubyfluid Soldering & Tinning Flux	SS #1	2.0 (pt)	X					S
Rust Breaker, P/N 103	Mach. Shop	12.0 (ozf)		X				S
Rust Preventative	SS #3	350.0 (lbs)	X					S
Rust-O-Thane Aliphatic Polyurethane Coating	Paint XP-1	1.0 (gal)	X					S
Simi Gloss Enamel, Int/Ext, 2023 Ex Deep Base 20227 Brown	Paint XP-1	2.0 (gal)	X					S
Series 22 Galv-Gard, Lt. Gray-Ansi #70, P/N F022-BJ45	Paint XP-2	2.0 (gal)	X					S
Series 22 Galvgard 2050 Lt. Gray Ansi #70	Paint XP-2	1.0 (gal)	X					S
Series 39 Silicone Aluminum	Paint XP-2	2.0 (gal)	X					S
Series 66 Part A Hi-Build Epoxoline F066 CA 26A S. Orange	Paint XP-2	8.0 (gal)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	≤ 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Series 70 & 71 Part B Endura Shield 70B & 71B Converter	Paint XP-2	2.0 (gal)	X					S
Series 70 Part A Endura Shield AA90 White	Paint XP-2	2.0 (gal)	X					S
Series 71 Part A Endura Shield AA90 White	Paint XP-2	3.0 (gal)	X					S
Series 80 Coating, Tneme-Gard 2000 White	Paint XP-2	5.0 (gal)	X					S
Silastic 732 RTV	SR	2.0 (ozd)		X				S
Silicone 44 Grease	SS #1	4.0 (ozf)		X				S
Siliccone 55M Grease	SS #1	8.0 (ozf)		X				S
Silicone Compound #53-307	SS #1	23.0 (ozf)			X			S
Silicone Compound No. 8101	SR	2.0 (ozd)		X				S
Silicone General Prpose Sealant	SS #1	10.3 (ozf)		X				S
Silicone II, 50 Year Clear Caulk	XP-16	16.0 (ozf)		X				S
Silicone Lubricant, DC4 Comp.	SS #1	70.0 (ozf)	X					S
Silcone Lubricant, Stopcock Grease	SS #1	94.0 (ozf)	X					S
Silicone Rubber 732 RTV	MAB	9.0 (ozfd)		X				S
Silicone Rubber Adhesive Sealant, PTV 108	SS #1	12.0 (ozf)		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

acility: Kauai Test Faciltiy

Hazard Source: Chemical Inventory

[illegible]			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Silicone Rubber Sealant Auot /GP 0481	SR	6.0 (ozd)		X				S
Silicone Spray Lub Ace	MAB	11.0 (ozf)		X				S
Silicone Spray Mold Release 2 Pounder	XP-3	8.0 (lbs)				X		S
Silicone Spray, 2 Pounder #S532	SS #1	10.0 (lbs)				X		S
Silicone, Dow Corning 200 Fluid, 300000 CS Viscosity	SS #1	1.0 (lbs)		X				S
Silicone, High Vacuum Grease	SS #1	34.0 (ozf)	X					S
Silver Brazing Flux # S-200	SS #1	96.0 (ozf)	X					S
Simple Green P/N 13006	SS #3	5.0 (gal)	X					S
Slidewire Cleaner 5080-3605	SR	9.0 (ozf)		X				S
Snoop	SR	16.0 (ozf)		X				S
Snoop Leak Det.	MAB	8.0 (ozf)		X				S
Soldering Paste	SS #1	16.0 (ozf)		X				S
Solvent & Flux Remover	SR	16.0 (ozf)		X				S
Solvoil-Solvent	SS #3	5.0 (gal)	X					S
Spra Kleen Contact Cleaner	SS #1	80.0 (ozf)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy　　　　Hazard Source: Inventory Source

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Spra Lube	SS #1	8.0 (ozf)		X				S
Spray Kote Bonded Lubricant	SS #1	16.0 (ozf)		X				S
Sprayon #711 Penetrant-Lubricant P/N 00711	MAB	22.0 (ozf)	X					S
Spread Satin Latex Wall Paint 3413 Bone White	Paint XP-1	2.0 (qt)	X					S
Satin & Wood Preservative Moorewood, Deep Walnut 081 68	Paint XP-2	6.0 (gal)	X					S
Starting Fluid (P/N M35-15	XP-3	33.0 (ozf)	X					S
Starting Fluid, NAPA	XP-3	11.0 (ozf)		X				S
Stay Clean Paste Flux	SS #1	16.0 (ozf)		X				S
STIHL Gear Lubricant	SR	3.0 (ozd)		X				S
STP Vinyl Protectant	SR	10.0 (ozf)		X				S
Super Sock It (Super Chlorinator)	SR	1.0 (pt)	X					S
Tapfree	SS #1	1.0 (pt)	X					S
Tapping Compound, CIM Cool	SS #1	2.0 (pt)	X					S
Thermalcote-Thermal Joint cmpd.	MAB	2.0 (?)	X					S
Thermo-Aid	SS #3	60.0 (ozf)					<ERPG 1 @ 30 m (ALOHA)	S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: .Kauai Test Faciltiy

Hazard Source: Chemical Inventory

[illegible]			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Thinner 325	SS #3	5.0 (gal)	X					S
Thread Cutting Oil, Dark T-2001	SS #1	16.0 (ozf)		X				S
Thread Cutting Oil, Ridgid Dark, P/N 120	XP-3	1.0 (gal)	X					S
Thread Seal P/N 120	XP-3	8.0 (ozf)		X				S
Toilet Chemical, Monochem T-5	XP-5	144.0 (ozd)	X					S
Toluene, P/N 8608	SS #1	1.0 (pt)				X		S
Trewax Furniture Cream	SR	16.0 (ozf)		X				S
Ultra Duty Grease EP #2	SS #3	140. (ozf)	X					S
Universal Gear Lub. SEA 80W-90	SS #3	10.0 (gal)	X					S
Unleaded Gasoline	Flam Lab	2.0 (gal)	X					S
Unleaded Gasoline	Gas Tank	2500.0 (gal)	X					S
UREGLO Automotive Finish	Paint XP-2	3.0 (gal)	X					S
Urathane Adhesive 3549 B/A	SR	4.0 (ozf)		X				S
VAC-SEAL (Epoxy Resin) 288-6000	SR	4.0 (ozd)		X				S
Varian Oil Type GP	MAB	1.0 (qt)	X					S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Faciltiy   Hazard Source: Chemical Inventory

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Screen or Keep
Versamid 140	SR	1.0 (lb)		X				S
Vibratite VC-3	SR	2.0 (ozf)		X				S
Vinyl Wash Primer	SS #2	4.0 (gal)	X					S
Vulcanizing Fluid (Tech)	SR	16.0 (ozf)		X				S
Wasp & Hornet Killer	SR	34.0 (ozf)	X					S
Wasp & Hornet Killer, P/N 00869	SS #1	360.0 (ozf)	X					S
Wasp & Hornet Killer, P/N 00869	MAB	105.0 (ozf)	X					S
Wasp & Hornet Killer, P/N PT515	SS #1	120.0 (ozf)	X					S
Wasp Spray Ace 72676	SR	30.0 (ozf)	X					S
Wasp Spray Hunters	SR	14.0 (ozf)		X				S
WD-40 Lub. Spray	XP-3	27.0 (ozf)	X					S
WD-40 Lub. Spray	MAB	10.0 (ozf)		X				S
Xerox Film Remover 8R26	SR	100.0 (ozf)	X					S
Yellow 77 Mire Pull	AEB	5.0 Other			X			S
Zinc Dust, Tneme-zinc, 90E-92 Part B	Paint XP-2	3.0 (gal)				X		S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Liquid Propellants

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	< 1 Pound	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Unsymmetrical Dimethylhydrazine (UDMH)	KTF Launcher Field and Storage Pad	55 gallon max. apprx. 348 lbs.						K
Nitrogen Tetroxide (NTO)	KTF Launcher Field and Storage Pad	55 gallon max. apprx. 656 lbs.						K

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility — Hazard Source: Alcor 1B Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	259.61 lbs.						K
Chlorine	Aerosol in KTF Airspace	1.28 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	195.26 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	38.13 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	17.33 lbs.			X			S
Water	Aerosol in KTF Airspace	114.22 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	206.07 lbs.						K
Nitrogen	Aerosol in KTF Airspace	80.21 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Antares II Motor (Exhaust By-Products)

[illegible]			Screening Criteria					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	≤10 Pounds	Non-Toxic	Non- Disperible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	959.54 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	999.15 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	48.86 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	50.91 lbs.			X			S
Water	Aerosol in KTF Airspace	78.7 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	56.41 lbs.						K
Nitrogen	Aerosol in KTF Airspace	368.42 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Antares IIIA or Star 31 Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	420.03 lbs.						K
Chlorine	Aerosol in KTF Airspace	3.69 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	244.43 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	42.62 lbs.			X			S
Hydrogen	Aerosol in KTF Airspace	0.22 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	22.98 lbs.			X			S
Water	Aerosol in KTF Airspace	126.88 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	268.13 lbs.						K
Nitrogen	Aerosol in KTF Airspace	106.02 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Apache MOD 1 Motor (Exhaust By-Products)

Hazard			Screening Flags					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	49.49 lbs.						K
Chlorine	Aerosol in KTF Airspace	0.24 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	32.23 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	2.07 lbs.		X				S
Hydrogen	Aerosol in KTF Airspace	0.02 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	3.47 lbs.		X				S
Water	Aerosol in KTF Airspace	6.87 lbs.		X				S
Hydrogen Chloride	Aerosol in KTF Airspace	26.12 lbs.						K
Nitrogen	Aerosol in KTF Airspace	10.49 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Aries Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	3216.00 lbs.						K
Chlorine	Aerosol in KTF Airspace	23.00 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	2,690.00 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	325.00 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	253.00 lbs.			X			S
Water	Aerosol in KTF Airspace	2,169.00 lbs.	X					S
Nitrogen	Aerosol in KTF Airspace	882.00 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: BE-3-B1 Motor (Exhaust By-Products)

Hazard			Screening Items					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	75.41 lbs.						K
Chlorine	Aerosol in KTF Airspace	0.45 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	60.43 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	7.39 lbs.		X				S
Hydrogen	Aerosol in KTF Airspace	0.08 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	2.85 lbs.		X				S
Water	Aerosol in KTF Airspace	12.2 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	11.49 lbs.						K
Nitrogen	Aerosol in KTF Airspace	20.50 lbs.			X			S
Hydroxyl	Aerosol in KTF Airspace	0.14 lbs.		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Cajun MOD 1 Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	1.36 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	10.37 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	30.03 lbs.			X			S
Carbonyl Sulfide	Aerosol in KTF Airspace	0.54 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	0.80 lbs.		X				S
Water	Aerosol in KTF Airspace	28.21 lbs.	X					S
Hydrogen Sulfide	Aerosol in KTF Airspace	8.51 lbs.		X				S
Hydrogen Chloride	Aerosol in KTF Airspace	27.00 lbs.						K
Hydroxyl	Aerosol in KTF Airspace	0.15 lbs.		X				S
Nitrogen	Aerosol in KTF Airspace	10.37 lbs.			X			S
Sulfur	Aerosol in KTF Airspace	0.57 lbs.		X				S
Sulfur Dioxide	Aerosol in KTF Airspace	0.57 lbs.		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility   Hazard Source: Castor I Motor (Exhaust By-Products)

[illegible]			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	1,934.29 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	2,043.98 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	315.19 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	179.17 lbs.			X			S
Water	Aerosol in KTF Airspace	614.29 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	1,587.65 lbs.						K
Nitrogen	Aerosol in KTF Airspace	636.96 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility Hazard Source: Castor II Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	3,098.94 lbs.						K
Chlorine	Aerosol in KTF Airspace	24.66 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	1,841.28 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	156.18 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	189.06 lbs.			X			S
Water	Aerosol in KTF Airspace	517.86 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	1,701.54 lbs.						K
Nitrogen	Aerosol in KTF Airspace	674.04 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility   Hazard Source: Genie Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Carbon Monoxide	Aerosol in KTF Airspace	31.39 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	91.23 lbs.			X			S
Copperous Oxide	Aerosol in KTF Airspace	0.16 lbs.		X				S
Copperic Oxide	Aerosol in KTF Airspace	0.07 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	81.42 lbs.			X			S
Water	Aerosol in KTF Airspace	2.62 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	70.63 lbs.						K
Potassuim Chloride	Aerosol in KTF Airspace	21.58 lbs.			X			S
Nitrogen	Aerosol in KTF Airspace	28.12 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Honest John Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Carbon Monoxide	Aerosol in KTF Airspace	865.57 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	727.27 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	50.53 lbs.			X			S
Water	Aerosol in KTF Airspace	136.57 lbs.	X					S
Nitrogen	Aerosol in KTF Airspace	28.12 lbs.			X			S
Lead	Aerosol in KTF Airspace	10.19 lbs.						K

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Malemute Motor (Exhaust By-Products)

[illegible]			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	368.73 lbs.						K
Chlorine	Aerosol in KTF Airspace	0.22 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	275.96 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	33.34 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	27.43 lbs.			X			S
Water	Aerosol in KTF Airspace	76.94 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	238.50 lbs.						K
Nitrogen	Aerosol in KTF Airspace	93.44 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Nike Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Carbon Monoxide	Aerosol in KTF Airspace	407.70 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	135.90 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	13.05 lbs.			X			S
Water	Aerosol in KTF Airspace	97.58 lbs.	X					S
Nitrogen	Aerosol in KTF Airspace	92.03 lbs.			X			S
Lead	Aerosol in KTF Airspace	3.75 lbs.		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Polaris Stage 1 Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	7,838.08 lbs.						K
Chlorine	Aerosol in KTF Airspace	43.43 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	5,189.10 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	424.29 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	483.92 lbs.			X			S
Hydrogen Chloride	Aerosol in KTF Airspace	3471.80 lbs.						K
Water	Aerosol in KTF Airspace	1317.95 lbs.	X					S
Nitrogen	Aerosol in KTF Airspace	1925.71 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility | Hazard source: Polaris A3, Stage 2 Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	3065.28 lbs.						K
Chlorine	Aerosol in KTF Airspace	0.89 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	2963.25 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	377.95 lbs.			X			S
Hydrogen	Aerosol in KTF Airspace	2.66 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	129.53 lbs.			X			S
Water	Aerosol in KTF Airspace	558.05 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	136.63 lbs.						K
Nitrogen	Aerosol in KTF Airspace	1633.34 lbs.			X			S
Hydroxyl	Aerosol in KTF Airspace	4.44		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Orbus 1 Motor (Exhaust By-Products)

Inputs			Screening Criteria					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	342.95 lbs.						K
Chlorine	Aerosol in KTF Airspace	0.45 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	205.48 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	19.98 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	20.97 lbs.			X			S
Water	Aerosol in KTF Airspace	50.03 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	162.71 lbs.						K
Nitrogen	Aerosol in KTF Airspace	104.78 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility   Hazard Source: Recruit Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Carbon Monoxide	Aerosol in KTF Airspace	14.92 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	68.23 lbs.			X			S
Ferrous Chloride	Aerosol in KTF Airspace	8.44 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	1.14 lbs.		X				S
Water	Aerosol in KTF Airspace	66.76 lbs.	X					S
Hydrogen Sulfide	Aerosol in KTF Airspace	11.22 lbs.						K
Hydrogen Chloride	Aerosol in KTF Airspace	55.76 lbs.						K
Magnesuim Oxide	Aerosol in KTF Airspace	2.57 lbs.		X				S
Nitrogen	Aerosol in KTF Airspace	24.41 lbs.			X			S
Sulfur	Aerosol in KTF Airspace	6.62 lbs.		X				S
Sulfur Dioxide	Aerosol in KTF Airspace	3.31 lbs.		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

acility: Kauai Test Facility

Hazard Source: Sandhawk TP-H-3172 Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	376.75 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	322.62 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	15.30 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	32.25 lbs.			X			S
Water	Aerosol in KTF Airspace	40.72 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	228.24 lbs.						K
Nitrogen	Aerosol in KTF Airspace	90.12 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Star 13B Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	27.52 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	23.59 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	2.92 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	2.19 lbs.		X				S
Water	Aerosol in KTF Airspace	7.29 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	19.71 lbs.						K
Nitrogen	Aerosol in KTF Airspace	7.67 lbs.		X				S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility

Hazard Source: Star 26 TE-ME-442 Motor (Exhaust By-Products)

[illegible]			[illegible]					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	153.79 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	131.84 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	15.93 lbs.			X			S
Ferrous Chloride	Aerosol in KTF Airspace	8.01 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	12.36 lbs.			X			S
Water	Aerosol in KTF Airspace	39.71 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	104.04 lbs.						K
Nitrogen	Aerosol in KTF Airspace	42.29 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility Hazard Source: Star 27 Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazards	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	222.46 lbs.						K
Chlorine	Aerosol in KTF Airspace	0.10 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	148.37 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	43.70 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	14.38 lbs.			X			S
Water	Aerosol in KTF Airspace	78.05 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	164.32 lbs.						K
Nitrogen	Aerosol in KTF Airspace	63.62 lbs.			X			S

CHEMICAL HAZARD SCREENING WORKSHEET

acility: Kauai Test Facility Hazard Source: Talos Motor (Exhaust By-Products)

Hazard			Screening Criteria					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Carbon Monoxide	Aerosol in KTF Airspace	1,017.49 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	1,025.90 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	47.65 lbs.			X			S
Water	Aerosol in KTF Airspace	299.92 lbs.	X					S
Nitrogen	Aerosol in KTF Airspace	370.00 lbs.			X			S
Lead	Aerosol in KTF Airspace	47.65 lbs.						K

CHEMICAL HAZARD SCREENING WORKSHEET

Facility: Kauai Test Facility   Hazard Source: Terrier Motor (Exhaust By-Products)

Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	<10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	87.11 lbs.						K
Carbon Monoxide	Aerosol in KTF Airspace	484.34 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	338.67 lbs.			X			S
Dihydrogen	Aerosol in KTF Airspace	20.98 lbs.			X			S
Water	Aerosol in KTF Airspace	115.29 lbs.	X					S
Nitrogen	Aerosol in KTF Airspace	154.70 lbs.			X			S
Lead	Aerosol in KTF Airspace	20.25 lbs.						K

CHEMICAL HAZARD SCREENING WORKSHEET

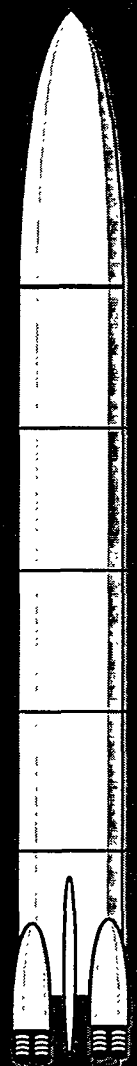
'acility: Kauai Test Facility

Hazard Source: Tomahawk Motor (Exhaust By-Products)

Hazard			Screening Criteria					
Hazard Source	Location	Quantity of Material	Standard Industrial Hazard	≤10 Pounds	Non-Toxic	Non-Dispersible	Additional Screening Criteria	Keep or Screen
Aluminum Oxide	Aerosol in KTF Airspace	124.81 lbs.						K
Chlorine	Aerosol in KTF Airspace	1.01 lbs.		X				S
Carbon Monoxide	Aerosol in KTF Airspace	107.28 lbs.						K
Carbon Dioxide	Aerosol in KTF Airspace	4.73 lbs.		X				S
Hydrogen	Aerosol in KTF Airspace	0.09 lbs.		X				S
Dihydrogen	Aerosol in KTF Airspace	11.56 lbs.			X			S
Water	Aerosol in KTF Airspace	16.15 lbs.	X					S
Hydrogen Chloride	Aerosol in KTF Airspace	87.00 lbs.						K
Nitrogen	Aerosol in KTF Airspace	34.37 lbs.			X			S

Appendix B

K A U A I T E S T F A C I L I T Y



May, 1995

Plume Dispersion Modeling of KTF Owned Hazards

Hypergolic Fuel Spill Scenarios

Unsymmetrical Dimethylhydrazine (UDMH)

- **Release Designations (U-1 through U-6)**

Nitrogen Tetroxide (NTO)

- **Release Designations (N-1 through N-6)**

Kauai Test Facility

NASA's Assumptions Applied to ALOHA

Assumptions Applied to ALOHA Concerning Spills of Hypergolic Fuel

In Section 5.0 of this Hazard Assessment the accidental spill of hypergolic fuel was postulated. The computer model ALOHA was utilized for the calculation of plume dispersion. The met conditions employed in these calculations were referenced from the NASA document titled: The ODES Evacuation Requirements Plan For Liquid Hypergolic Propellant Spills, WSTF-KTF-EVAC-92-01. This NASA document provided dispersion modeling utilizing a Dupont model called Trace II. The dispersion calculations found in the NASA document could not be utilized for this Hazard Assessment Document for the following reasons.

- It allowed the material to evaporate out of a 3/4 inch hole, in the top of an upright vessel, at a rate dependent on its own vapor pressure at the defined temperature. This incident, although the most credible scenario does not provide the level of conservatism required by the EMG. Therefore, fuel was assumed to be released directly into the environment instantly (one minute duration).

- ALOHA has been chosen by Sandia National Laboratories for the modeling of chemical releases at all SNL facilities.

- Three wind speeds were employed in the dispersion process.

  1) 1 meter per second (required in the EMG)
  2) 10 mph (identified in the NASA document relating to "low end" average wind speeds with relation to the prevailing trade winds).
  3) 20 mph (identified in the NASA document relating to "high end" average wind speeds with relation to the prevailing trade winds).

The final condition identified in the NASA document and utilized in the ALOHA computations was an ambient temperature of 85 degrees F. It should be noted that the lowest recorded temperature on Kauai is 61 degrees F.

Hypergolic Fuel Spill Scenarios

Unsymmetrical Dimethylhydrazine (UDMH)

Release Designation U - 1

Scenario: Release of 1 pint of UDMH at an ambient temperature of 85 degrees F, at ground level under "worst case" met conditions (F Stability with a wind speed of 1 meter per second).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 1.8 ppm (meters)	ESHE 4.1 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-4	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
B-5			543				
B-6				401			
B-7	1,580 (ppm)				Arrives in 30 seconds Departs at 2 minutes		
B-8		8.93 (ppm)				Arrives in 3 minutes Departs at 8 minutes	

Kauai Test Facility

Text Summary

2849167941

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

CHEMICAL INFORMATION:
Chemical Name: DIMETHYLHYDRAZINE
Molecular Weight: 60.10 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 50.00 ppm
Note: Potential or confirmed human carcinogen.
Footprint Level of Concern: 1.8 ppm
Boiling Point: 63.89° C
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: .9375 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 7.09 grams/sec
Total Amount Released: 425 grams

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 543 meters
Max Threat Zone for IDLH: 158 meters

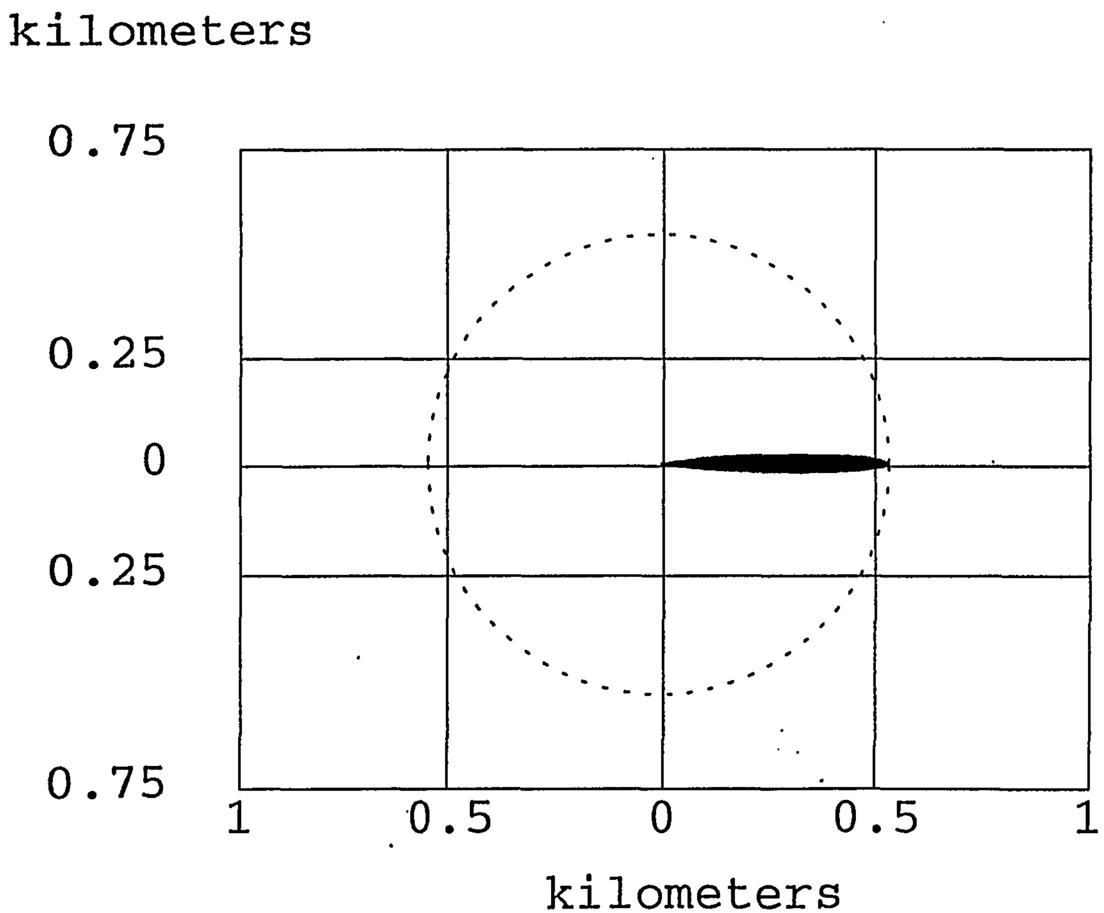
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.0204 ppm
Indoor: 0.0202 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2849167940

Chemical Name: DIMETHYLHYDRAZINE
Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 543 meters
Max Threat Zone for IDLH: 158 meters

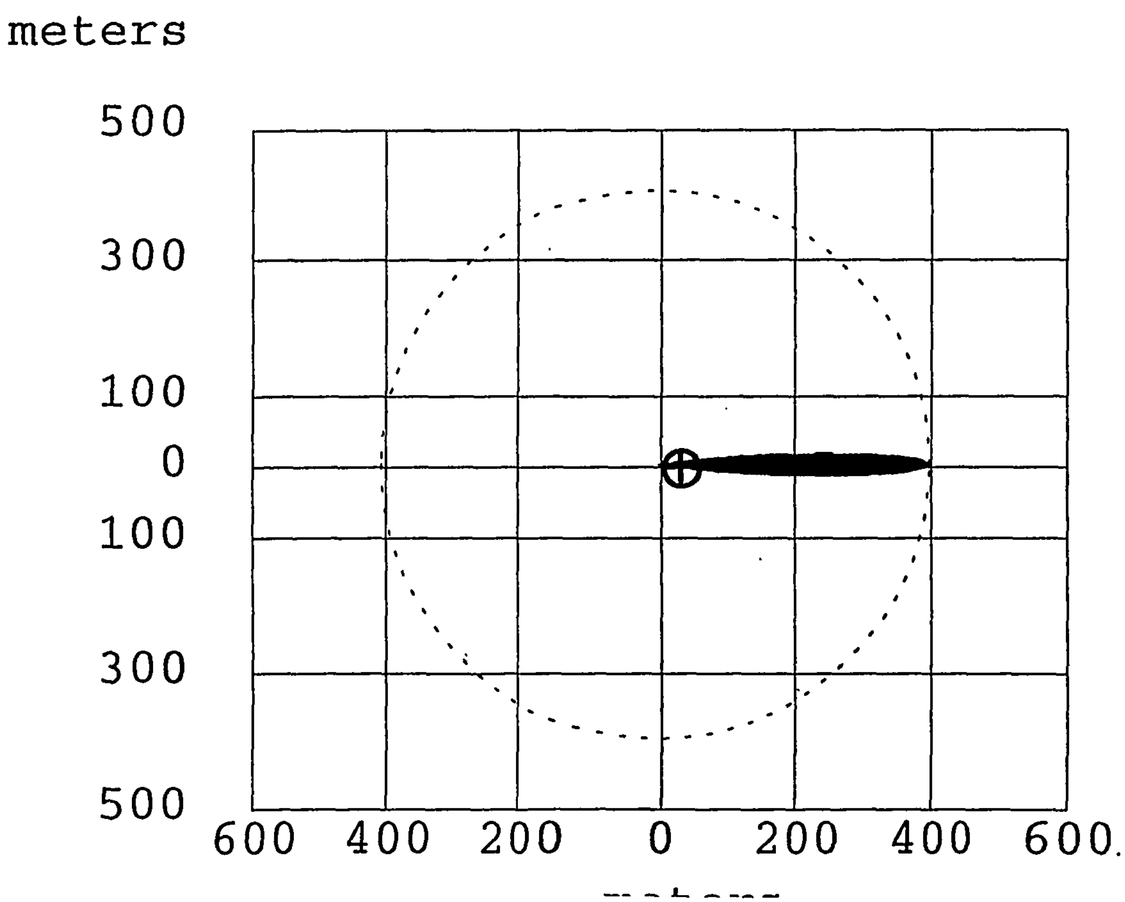


Footprint Window

2849168067

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

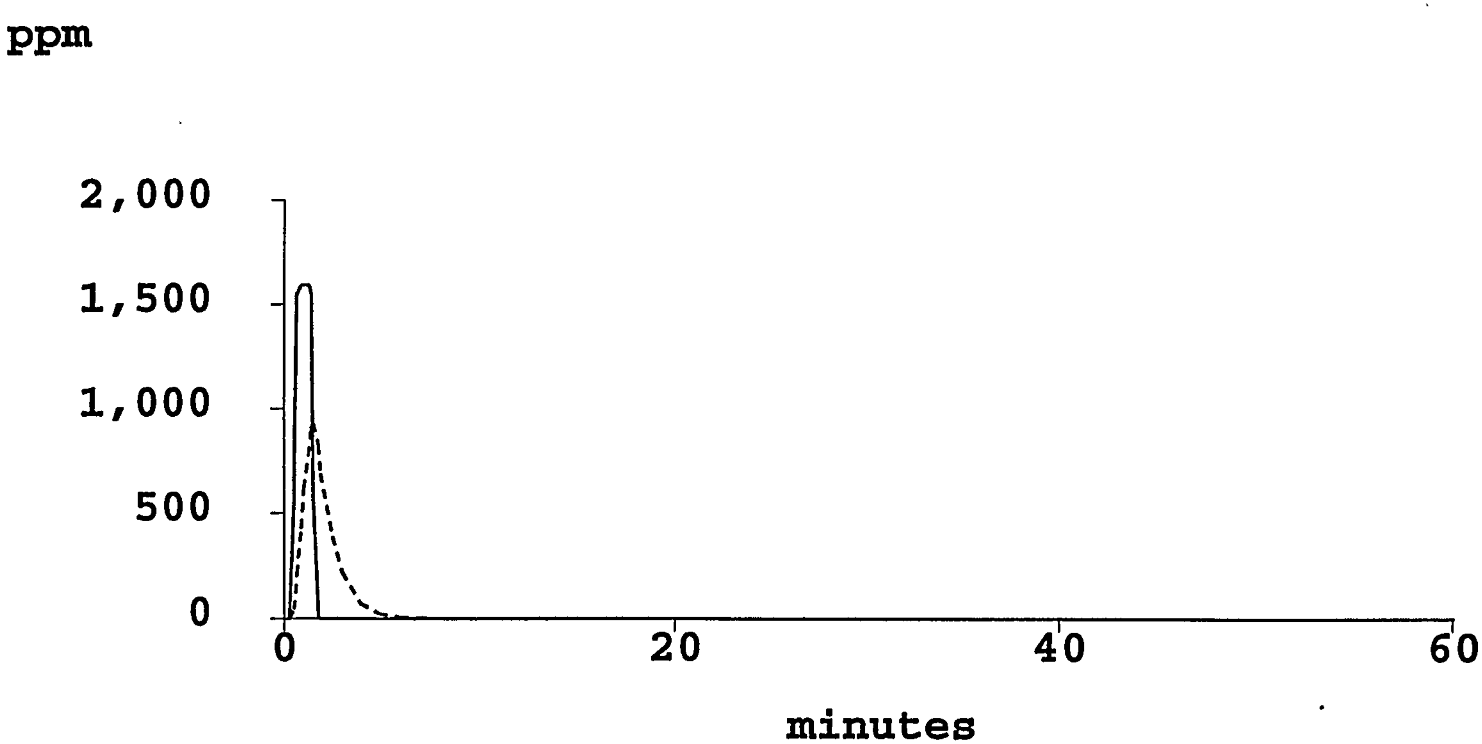
FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 4.15 ppm
  Max Threat Zone for LOC: 401 meters
  Max Threat Zone for IDLH: 158 meters



Concentration Window 2870430903

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

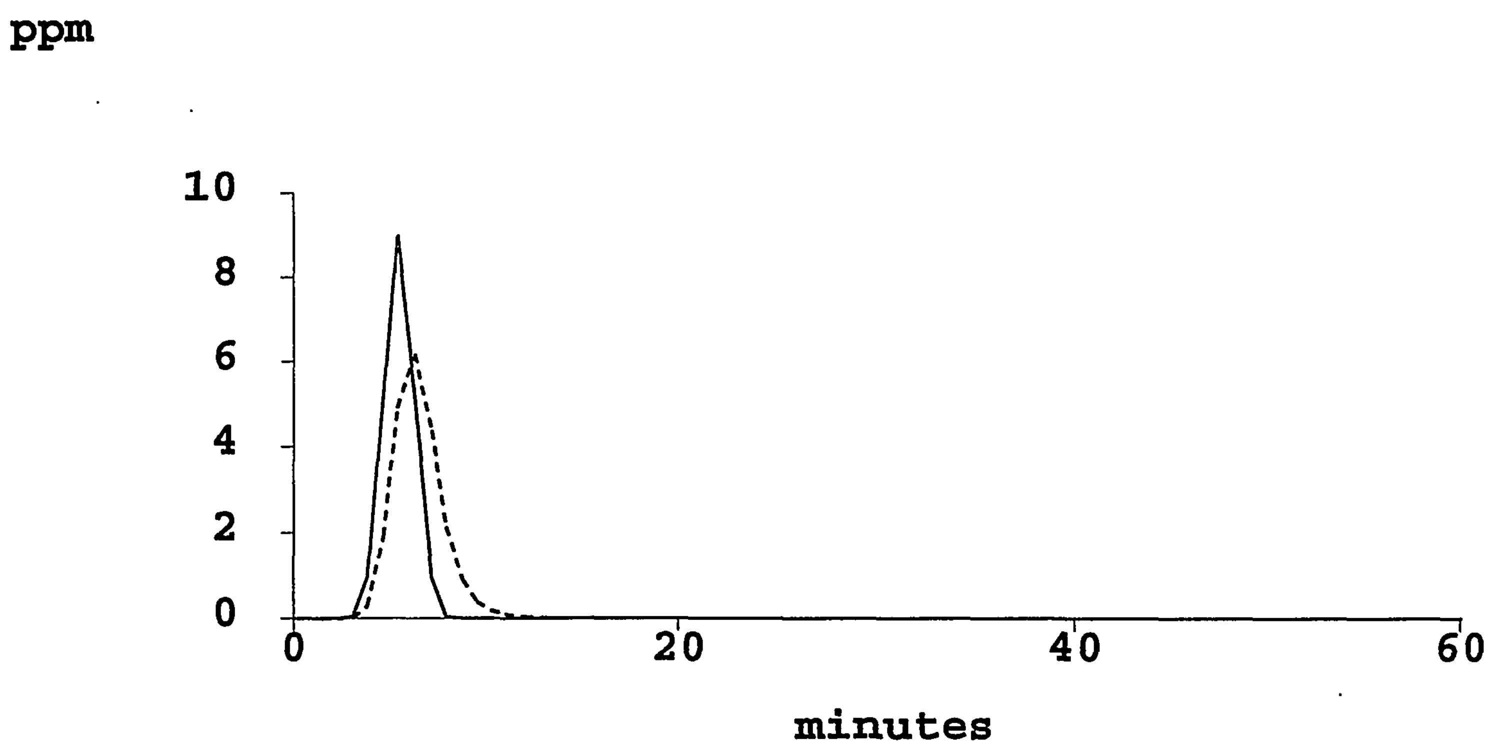
TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 30 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 1,580 ppm
    Indoor: 924 ppm
  Note: Indoor graph is shown with a dotted line.



Concentration Window 2870430915

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 300 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 8.93 ppm
    Indoor: 6.13 ppm
  Note: Indoor graph is shown with a dotted line.



Unsymmetrical Dimethylhydrazine (UDMH)

Release Designation U - 2

Scenario: Release of 1 pint of UDMH at an ambient temperature of 85 degrees F, at ground level under "low end" average met conditions (C Stability with a wind speed of 10 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 1.8 ppm (meters)	ESHE 4.1 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-10	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
B-11			116				
B-12				76			
B-13	25.6 (ppm)				Arrives in 6 seconds Departs at 1 minutes		
B-14		0.266 (ppm)				Arrives in 45 seconds Departs at 2.3 minutes	

Kauai Test Facility

Text Summary 2849168614

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

CHEMICAL INFORMATION:
Chemical Name: DIMETHYLHYDRAZINE
Molecular Weight: 60.10 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 50.00 ppm
Note: Potential or confirmed human carcinogen.
Footprint Level of Concern: 1.8 ppm
Boiling Point: 63.89° C
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 10 mph from 0° true No Inversion Height
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: .9375 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 7.09 grams/sec
Total Amount Released: 425 grams

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 116 meters
Max Threat Zone for IDLH: 22 meters

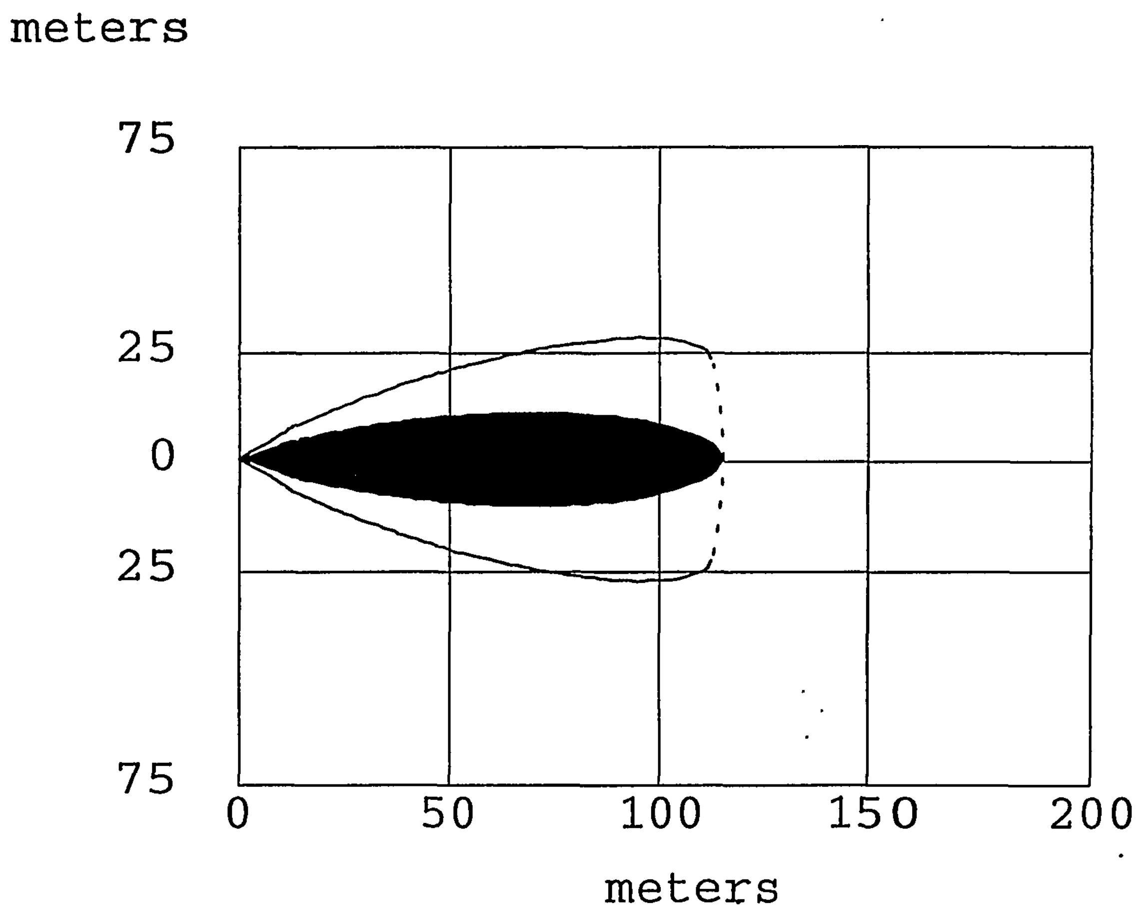
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 26.4 ppm
Indoor: 15.6 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2849168613

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 1.8 ppm
  Max Threat Zone for LOC: 116 meters
  Max Threat Zone for IDLH: 22 meters



Footprint Window

2849168575

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 10 mph from 0° true

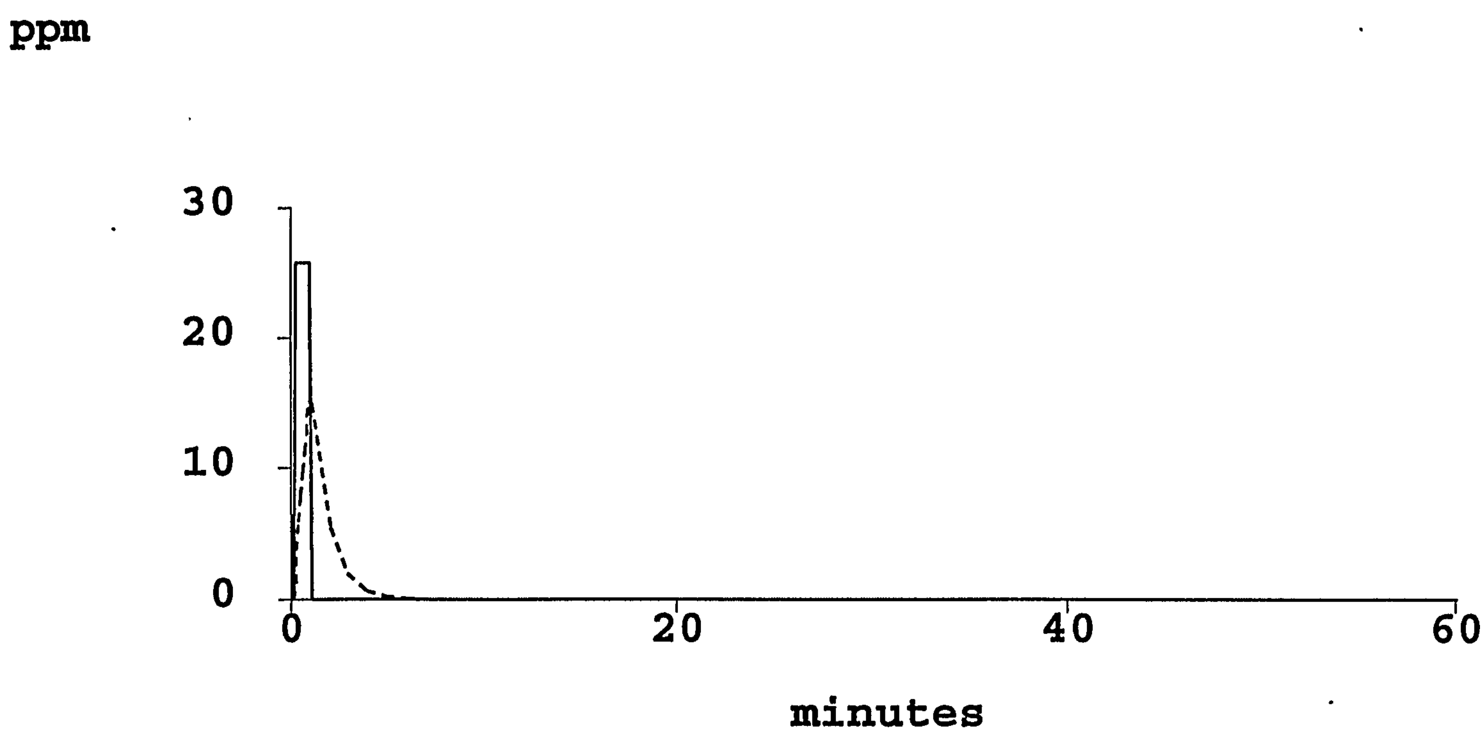
FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 4.15 ppm
  Max Threat Zone for LOC: 76 meters
  Max Threat Zone for IDLH: 22 meters
  Note: Footprint was not drawn because
    effects of near-field patchiness make plume
    presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 4.15 ppm
Max Threat Zone for LOC: 76 meters
Max Threat Zone for IDLH: 22 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Concentration Window 2870431210

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

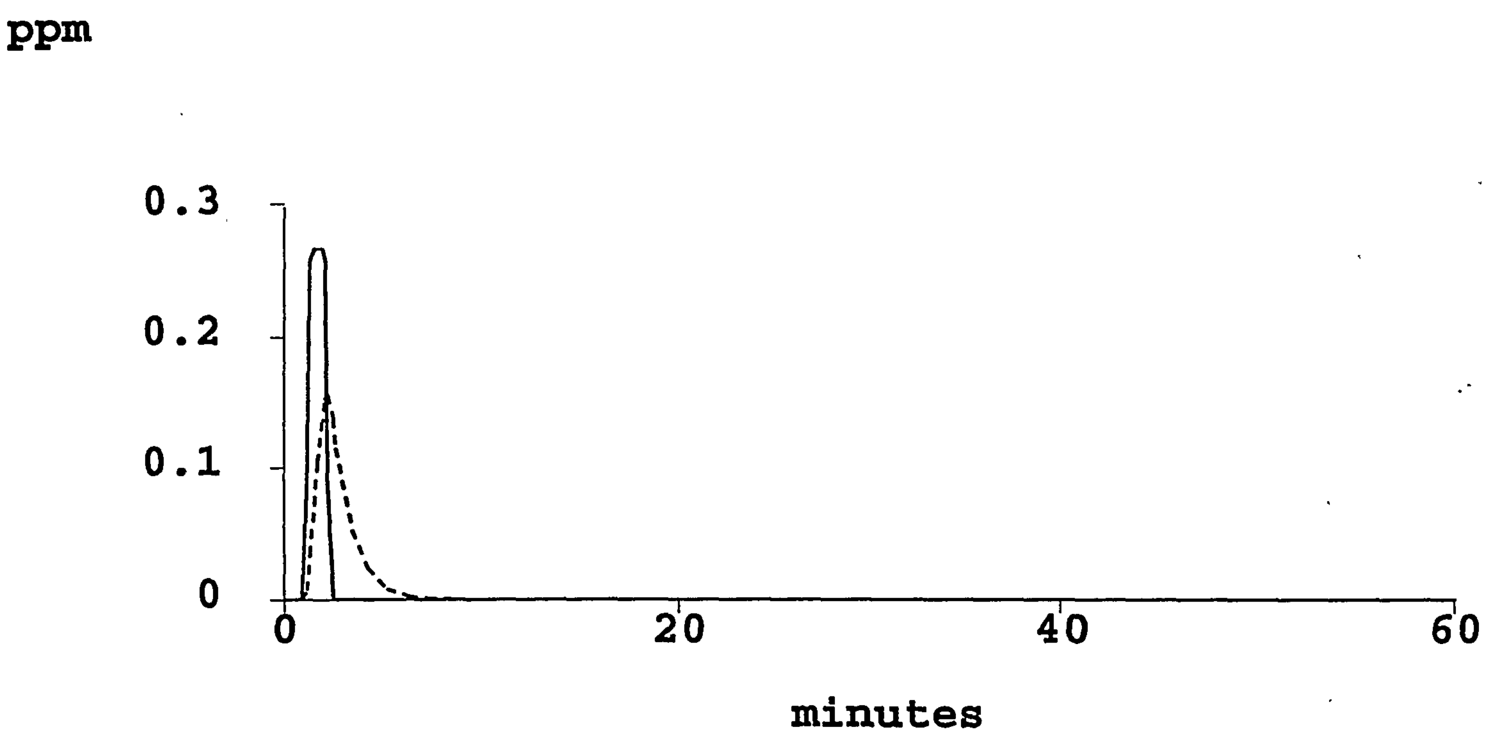
TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 30 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 25.6 ppm
    Indoor: 15.1 ppm
  Note: Indoor graph is shown with a dotted line.



Concentration Window 2870431188

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 300 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 0.266 ppm
     Indoor: 0.155 ppm
  Note: Indoor graph is shown with a dotted line.



Unsymmetrical Dimethylhydrazine (UDMH)

Release Designation U - 3

Scenario: Release of 1 pint of UDMH at an ambient temperature of 85 degrees F, at ground level under "high end" average met conditions (C Stability with a wind speed of 20 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 1.8 ppm (meters)	ESHE 4.1 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-16	INPUT PARAMETERS AND TEXT SUMMARY						**SITE AREA EMERGENCY**
B-17			**81**				
B-18				**53**			
B-19	**12.8 (ppm)**				**Arrives in 3 seconds Departs at 1 minutes**		
B-20		**0.133 (ppm)**				**Arrives in 23 seconds Departs at 1.6 minutes**	

Kauai Test Facility

Text Summary 2849168911

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

CHEMICAL INFORMATION:
Chemical Name: DIMETHYLHYDRAZINE
Molecular Weight: 60.10 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 50.00 ppm
Note: Potential or confirmed human carcinogen.
Footprint Level of Concern: 1.8 ppm
Boiling Point: 63.89° C
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 20 mph from 0° true No Inversion Height
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: .9375 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 7.09 grams/sec
Total Amount Released: 425 grams

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 81 meters
Max Threat Zone for IDLH: 16 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: 3.0 kilometers
Off Centerline: 0 meters
Note: Conc/Dose pictures not drawn because
there is no significant concentration/dose at the point selected.

Footprint Window 2849168910

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 1.8 ppm
  Max Threat Zone for LOC: 81 meters
  Max Threat Zone for IDLH: 16 meters
  Note: Footprint was not drawn because
    effects of near-field patchiness make plume
    presentation unreliable for short distances.

Dispersion Module: Gaussian

User specified LOC: 1.8 ppm

Max Threat Zone for LOC: 81 meters

Max Threat Zone for IDLH: 16 meters

Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Footprint Window 2849168706

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 4.15 ppm
  Max Threat Zone for LOC: 53 meters
  Max Threat Zone for IDLH: 16 meters
  Note: Footprint was not drawn because
    effects of near-field patchiness make plume
    presentation unreliable for short distances.

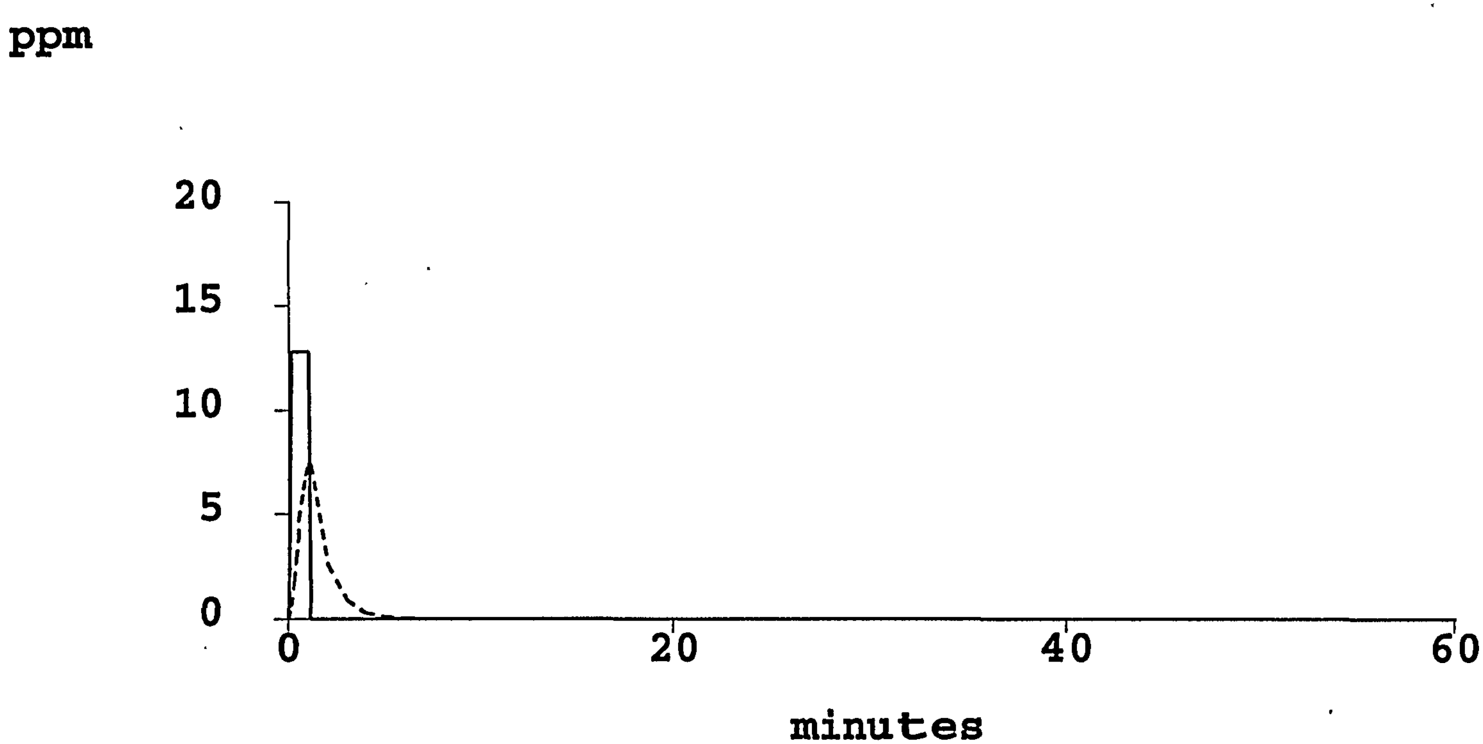
D 10

Dispersion Module: Gaussian
User specified LOC: 4.15 ppm
Max Threat Zone for LOC: 53 meters
Max Threat Zone for IDLH: 16 meters
Note: Footprint was not drawn because
  effects of near-field patchiness make plume
  presentation unreliable for short distances.

Concentration Window 2870431405

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

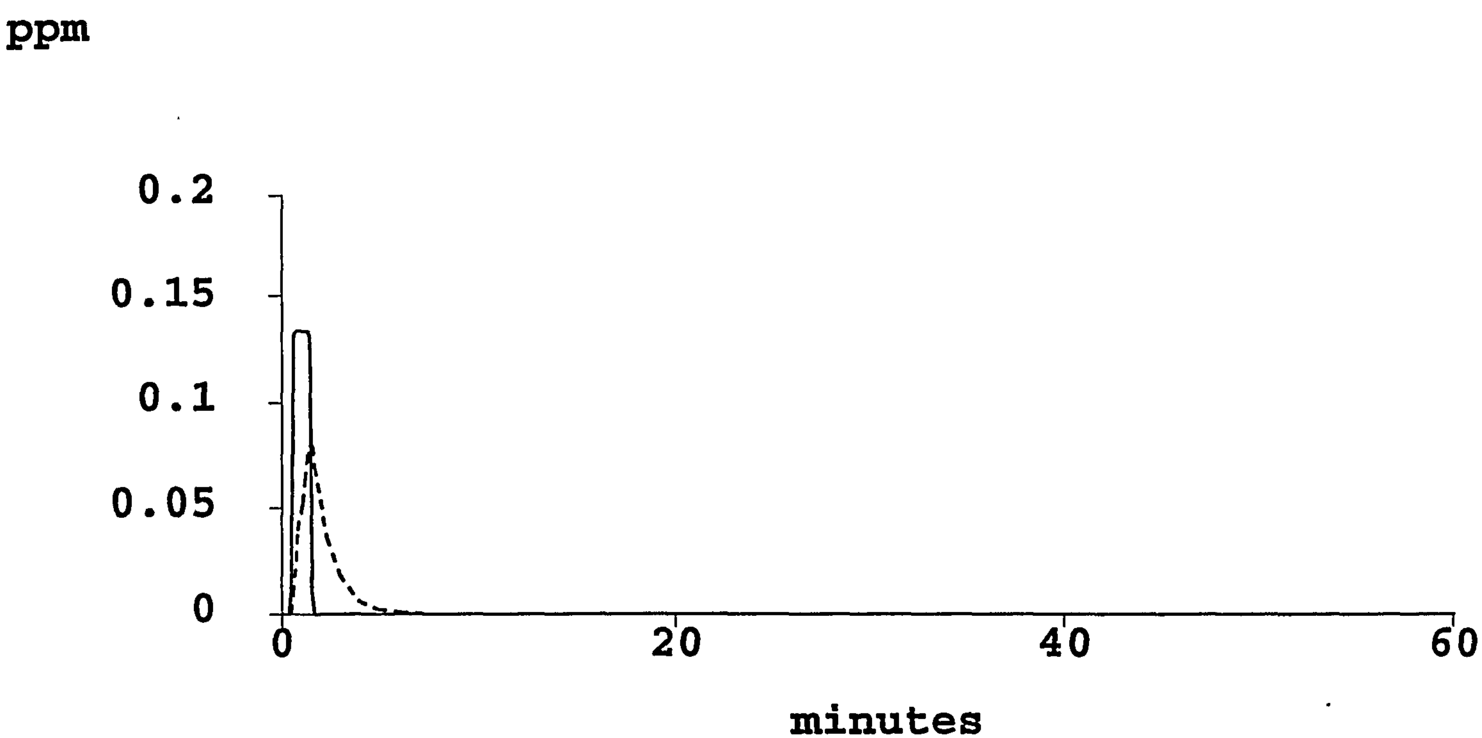
TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 30 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 12.8 ppm
    Indoor: 7.44 ppm
  Note: Indoor graph is shown with a dotted line.



Concentration Window 2870431415

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 300 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 0.133 ppm
    Indoor: 0.0795 ppm
  Note: Indoor graph is shown with a dotted line.



Unsymmetrical Dimethylhydrazine (UDMH)

Release Designation U - 4

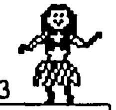
Scenario: Release of 55 gallons of UDMH at an ambient temperature of 85 degrees F, at ground level under "worst case" met conditions (F Stability with a wind speed of 1meter per second).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 1.8 ppm (meters)	ESHE 4.1 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-22	INPUT PARAMETERS AND TEXT SUMMARY						GENERAL EMERGENCY
B-23			6,200				
B-24				4,200			
B-25	697,000 (ppm)				Arrives in 30 seconds Departs at 1.6 minutes		
B-26		3,390 (ppm)				Arrives in 3 minutes Departs at 9.5 minutes	

Kauai Test Facility

Text Summary



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

CHEMICAL INFORMATION:
Chemical Name: DIMETHYLHYDRAZINE
Molecular Weight: 60.10 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 50.00 ppm
Note: Potential or confirmed human carcinogen.
Footprint Level of Concern: 1.8 ppm
Boiling Point: 63.89° C
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 412.5 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 3.12 kilograms/sec
Total Amount Released: 187 kilograms

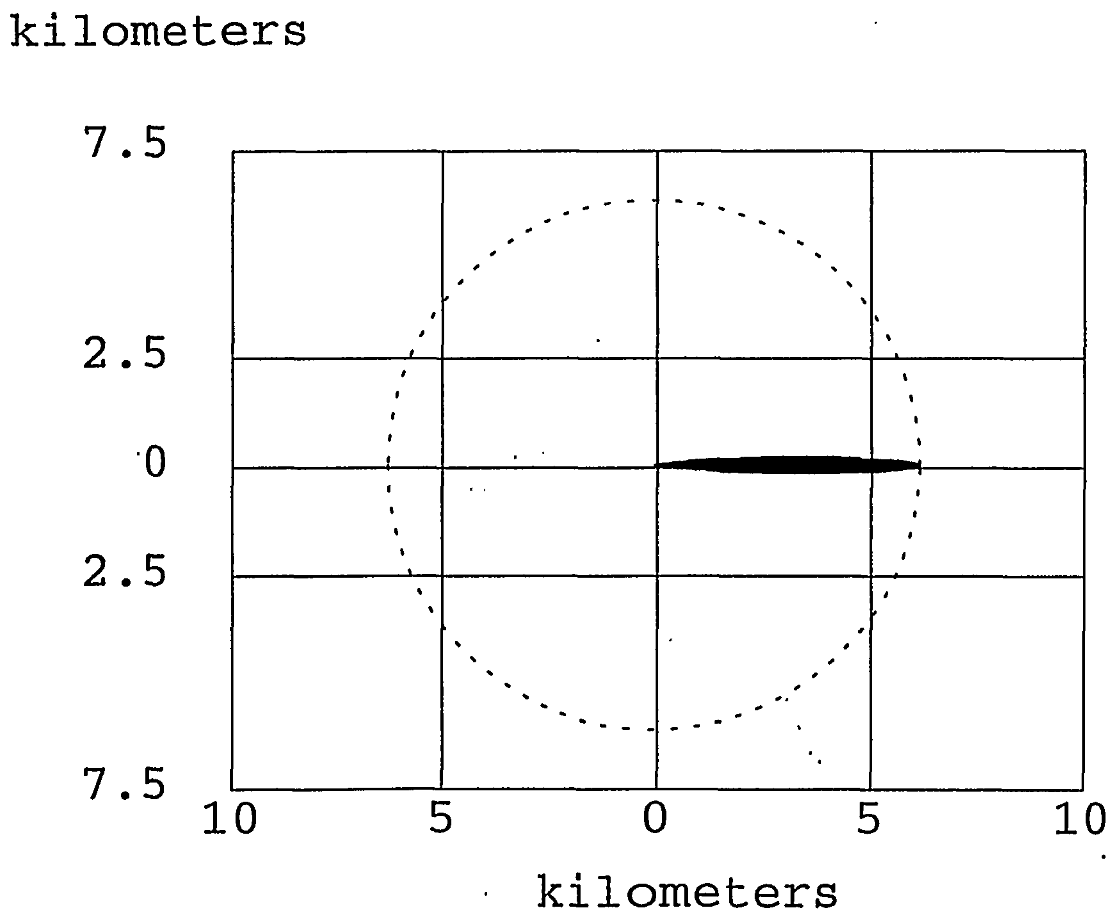
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 6.2 kilometers
Max Threat Zone for IDLH: 1.5 kilometers

Footprint Window

2849169312

Chemical Name: DIMETHYLHYDRAZINE
Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

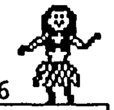
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 6.2 kilometers
Max Threat Zone for IDLH: 1.5 kilometers



R-23

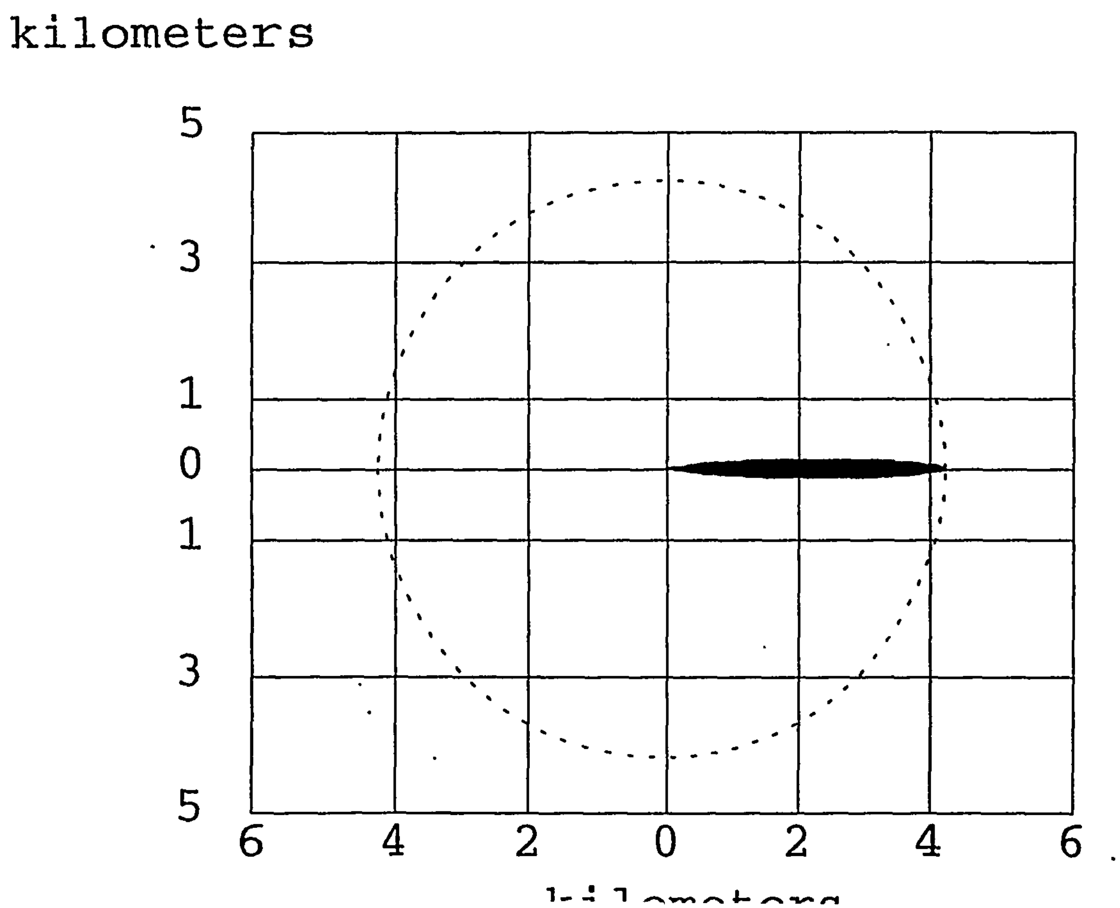
Footprint Window

2849169486



Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

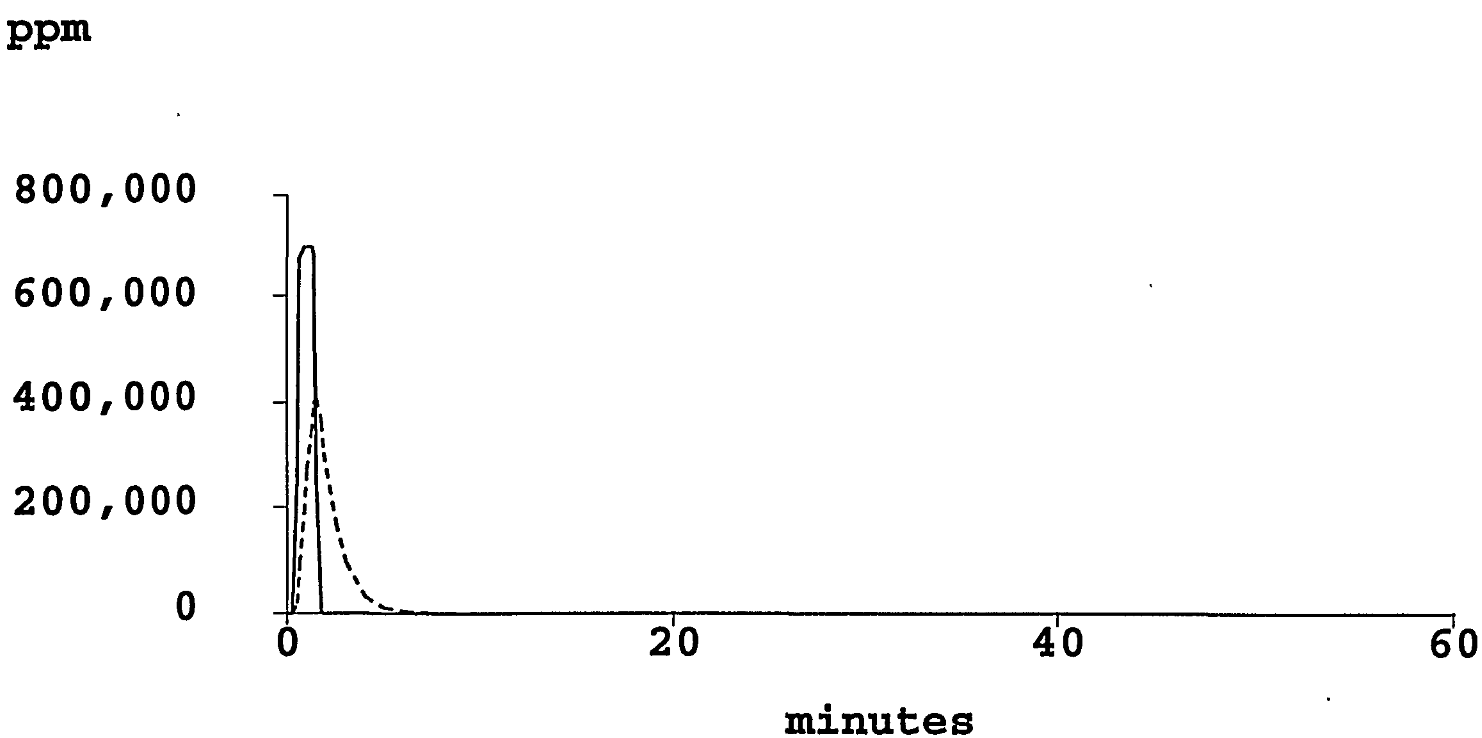
FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 4.15 ppm
  Max Threat Zone for LOC: 4.2 kilometers
  Max Threat Zone for IDLH: 1.5 kilometers



Concentration Window 2870429837

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

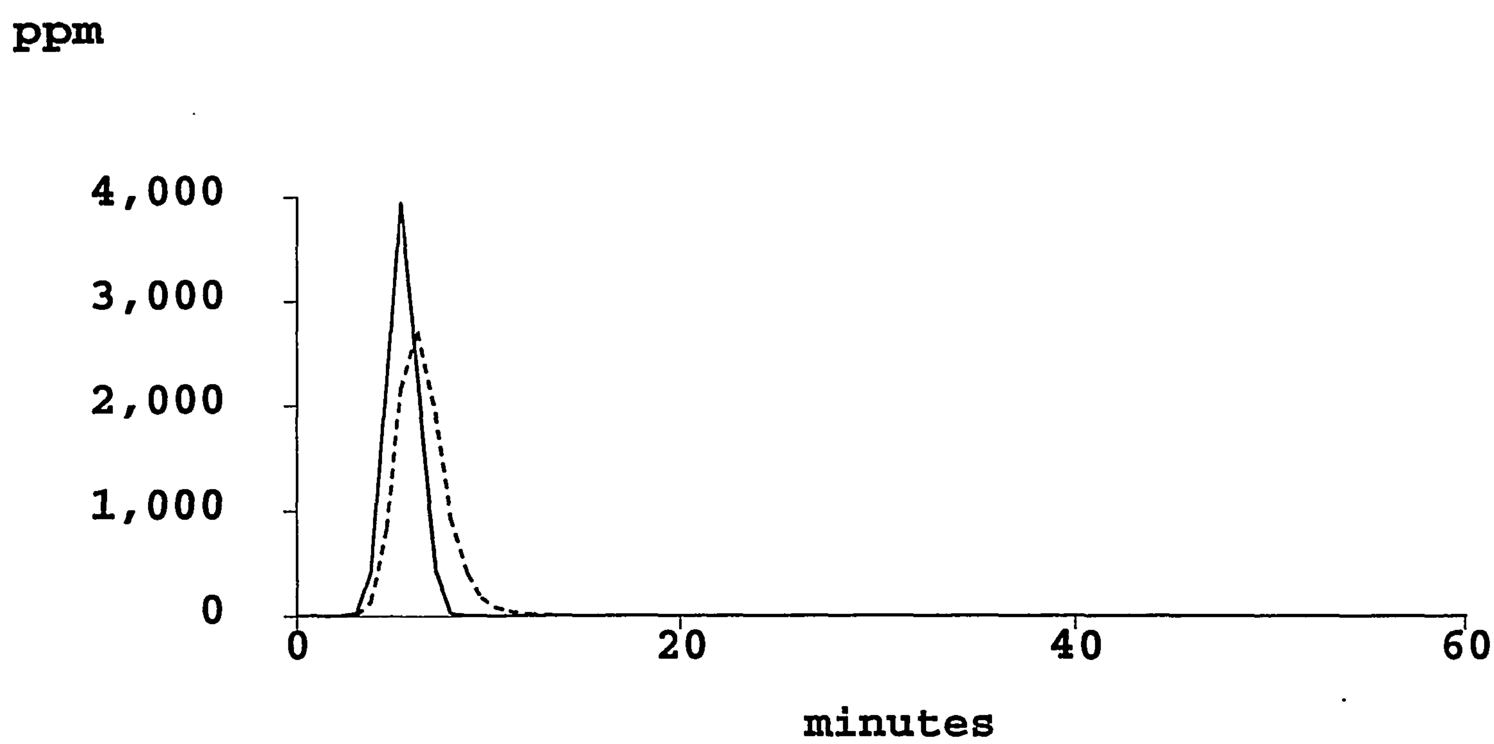
TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 30 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 697,000 ppm
    Indoor: 407,000 ppm
  Note: Indoor graph is shown with a dotted line.



Concentration Window 2870429753

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 300 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 3,930 ppm
    Indoor: 2,700 ppm
  Note: Indoor graph is shown with a dotted line.



Unsymmetrical Dimethylhydrazine (UDMH)

Release Designation U - 5

Scenario: Release of 55 gallons of UDMH at an ambient temperature of 85 degrees F, at ground level under "low end" average met conditions (C Stability with a wind speed of 10 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 1.8 ppm (meters)	ESHE 4.1 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-28	INPUT PARAMETERS AND TEXT SUMMARY						GENERAL EMERGENCY
B-29			1,900				
B-30				1,400			
B-31	11,300 (ppm)				Arrives in 6 seconds Departs at 1 minute		
B-32		117 (ppm)				Arrives in 1 minutes Departs at 2.3 minutes	

Kauai Test Facility

Text Summary

2849169749 

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

CHEMICAL INFORMATION:
Chemical Name: DIMETHYLHYDRAZINE
Molecular Weight: 60.10 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 50.00 ppm
Note: Potential or confirmed human carcinogen.
Footprint Level of Concern: 1.8 ppm
Boiling Point: 63.89° C
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 10 mph from 0° true No Inversion Height
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 412.5 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 3.12 kilograms/sec
Total Amount Released: 187 kilograms

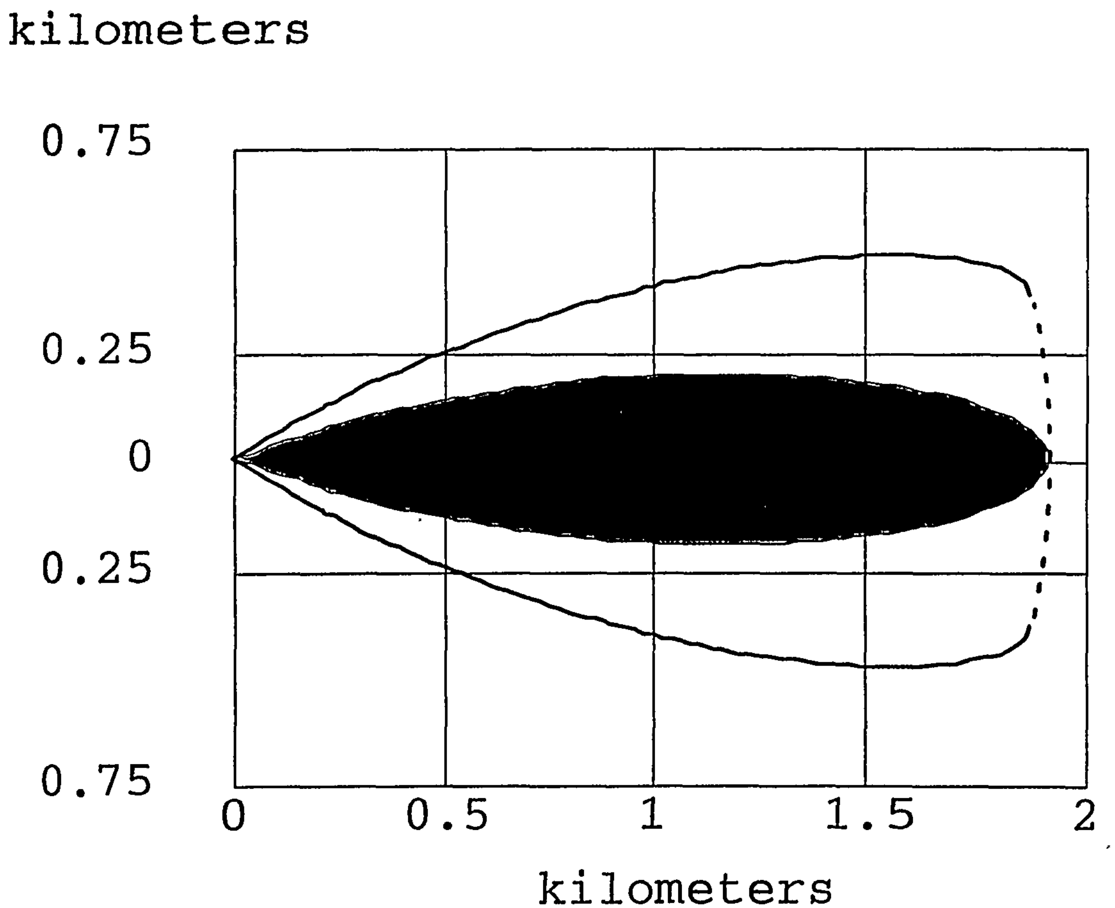
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 1.9 kilometers
Max Threat Zone for IDLH: 473 meters

Footprint Window

2849169748

Chemical Name: DIMETHYLHYDRAZINE
Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 10 mph from 0° true

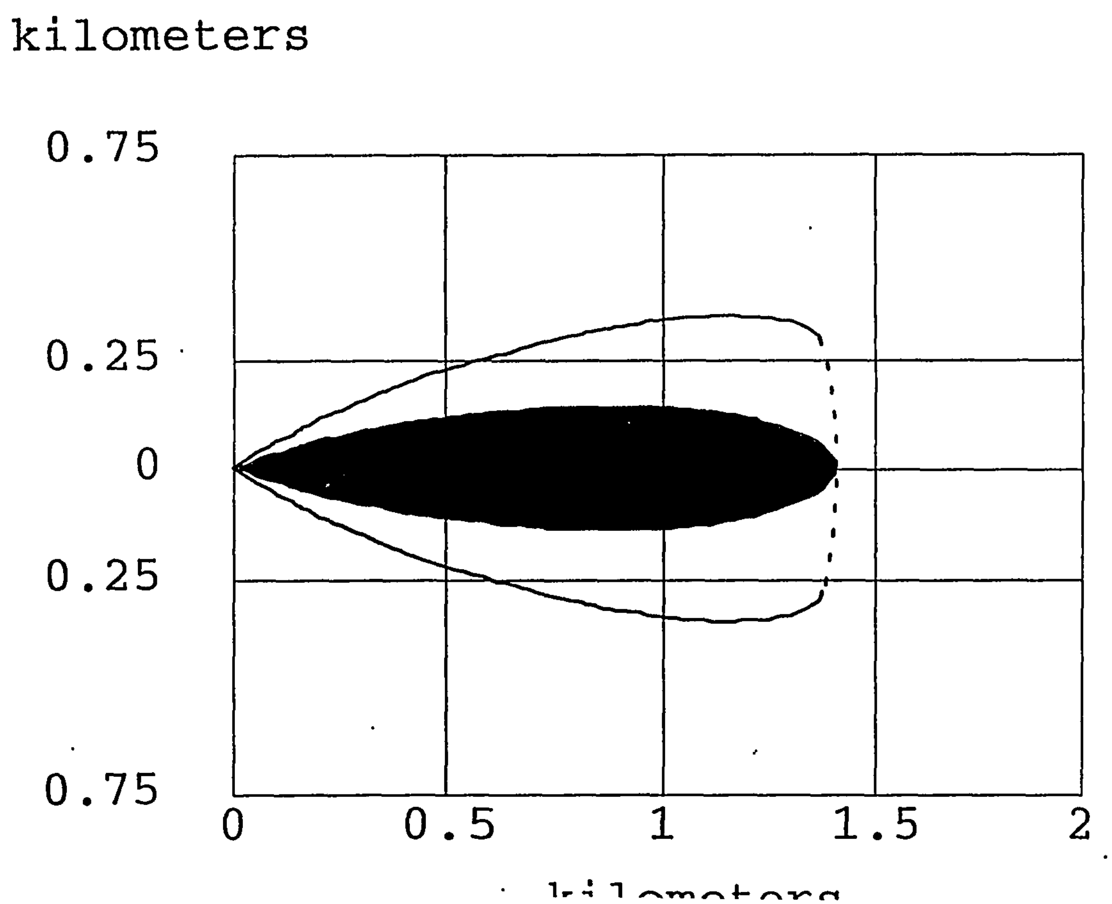
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 1.9 kilometers
Max Threat Zone for IDLH: 473 meters



Footprint Window

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 10 mph from 0° true

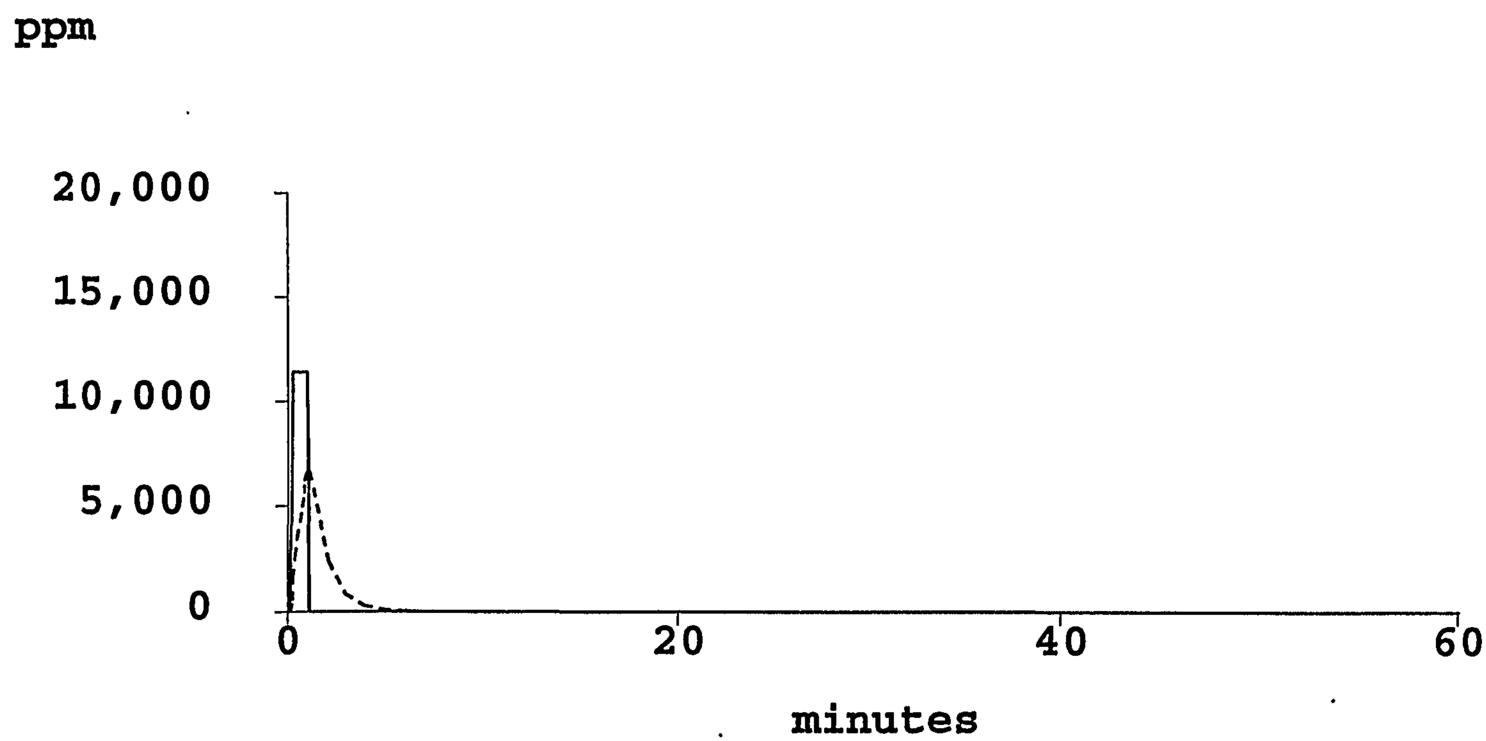
FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 4.15 ppm
  Max Threat Zone for LOC: 1.4 kilometers
  Max Threat Zone for IDLH: 473 meters



Concentration Window 2870431599

Chemical Name: DIMETHYLHYDRAZINE
Note: Potential or confirmed human carcinogen.
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: 11,300 ppm
Indoor: 6,640 ppm
Note: Indoor graph is shown with a dotted line.

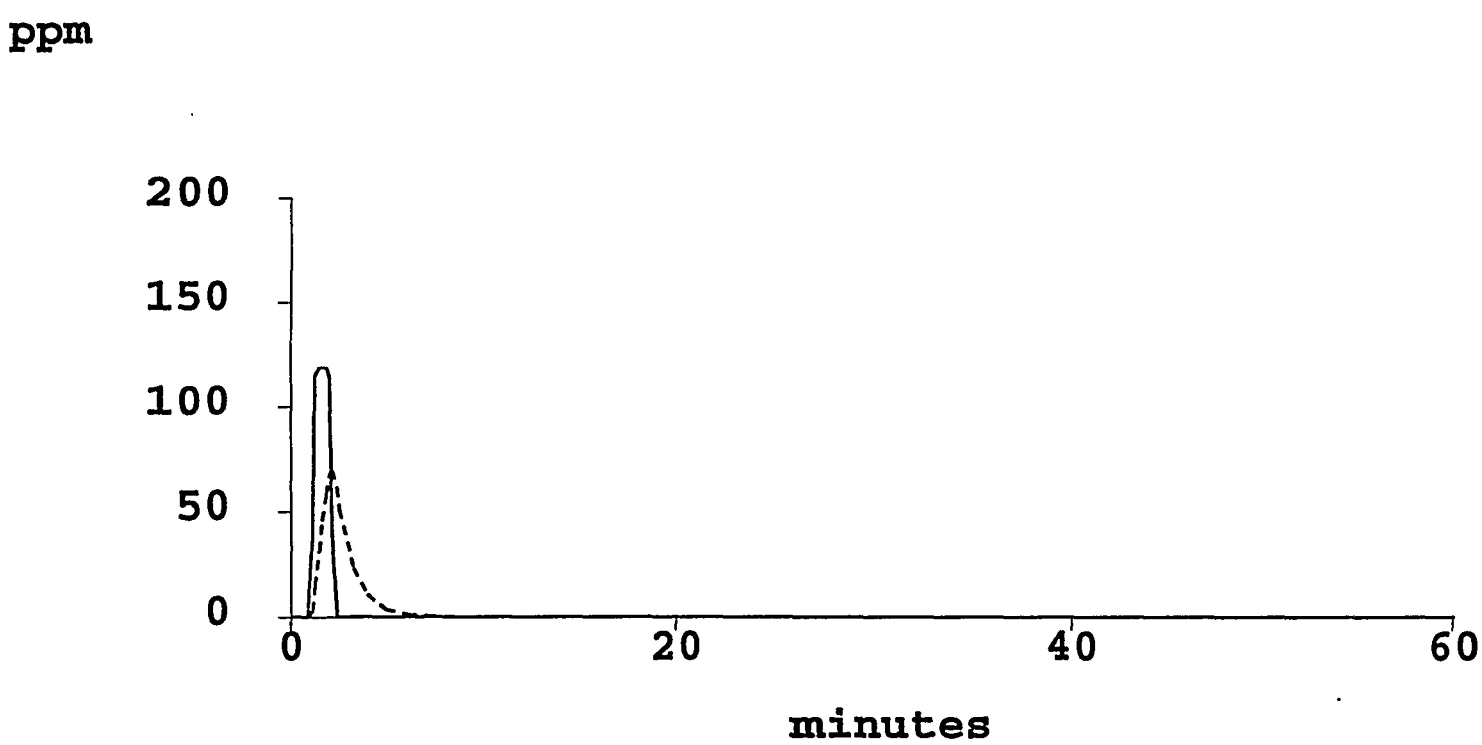


R-31

Concentration Window 2870431587

Chemical Name: DIMETHYLHYDRAZINE
Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 117 ppm
Indoor: 68.3 ppm
Note: Indoor graph is shown with a dotted line.



R-32

Unsymmetrical Dimethylhydrazine (UDMH)

Release Designation U - 6

Scenario: Release of 55 gallons of UDMH at an ambient temperature of 85 degrees F, at ground level under "high end" average met conditions (C Stability with a wind speed of 20 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 1.8 ppm (meters)	ESHE 4.1 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-34	INPUT PARAMETERS AND TEXT SUMMARY						GENERAL EMERGENCY
B-35			1,800				
B-36				1,200			
B-37	5,640 (ppm)				Arrives in 3 seconds Departs at 1 minute		
B-38		58.6 (ppm)				Arrives in 1 minutes Departs at 2 minutes	

Kauai Test Facility

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

CHEMICAL INFORMATION:
Chemical Name: DIMETHYLHYDRAZINE
Molecular Weight: 60.10 kg/kmol
TLV-TWA: 0.50 ppm   IDLH: 50.00 ppm
Note: Potential or confirmed human carcinogen.
Footprint Level of Concern: 1.8 ppm
Boiling Point: 63.89° C
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 20 mph from 0° true   No Inversion Height
Stability Class: C   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 3 tenths

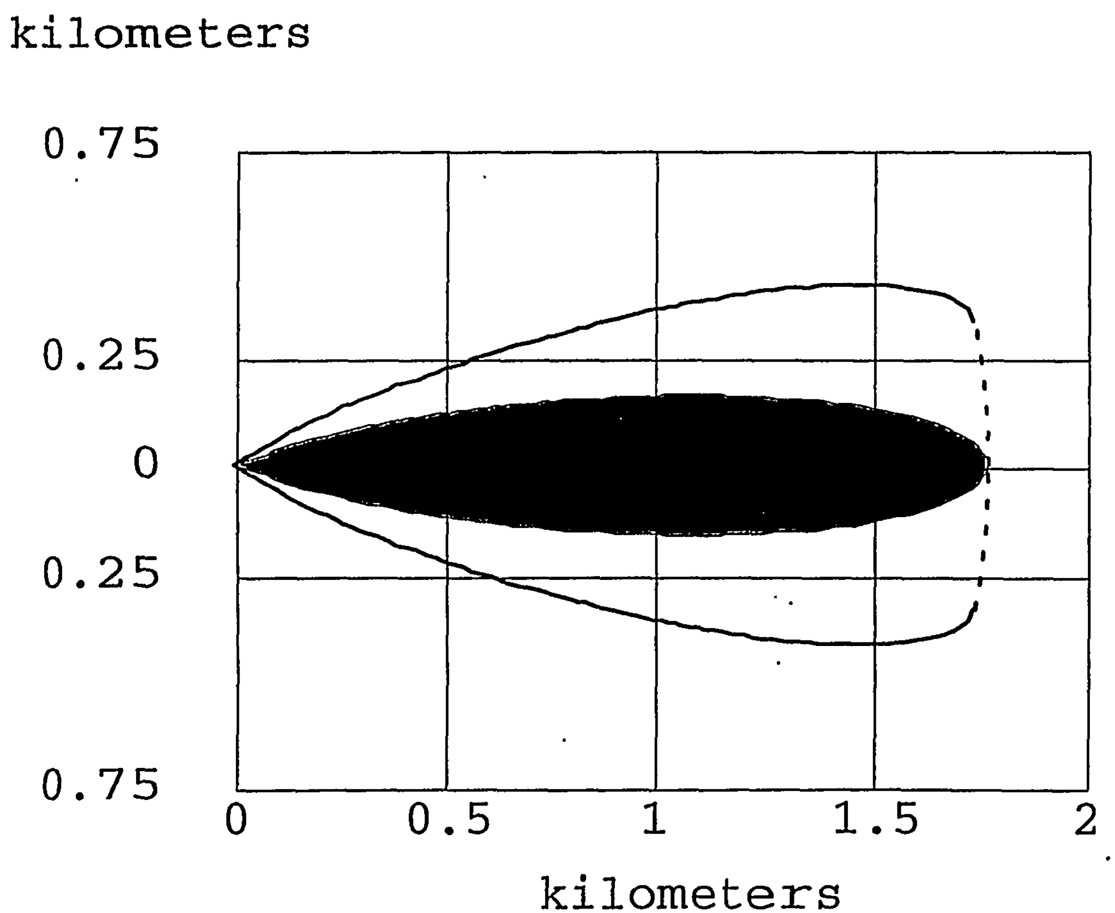
SOURCE STRENGTH INFORMATION:
Direct Source: 412.5 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 3.12 kilograms/sec
Total Amount Released: 187 kilograms

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 1.8 kilometers
Max Threat Zone for IDLH: 331 meters

Footprint Window 2849170097

Chemical Name: DIMETHYLHYDRAZINE
Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 1.8 ppm
Max Threat Zone for LOC: 1.8 kilometers
Max Threat Zone for IDLH: 331 meters

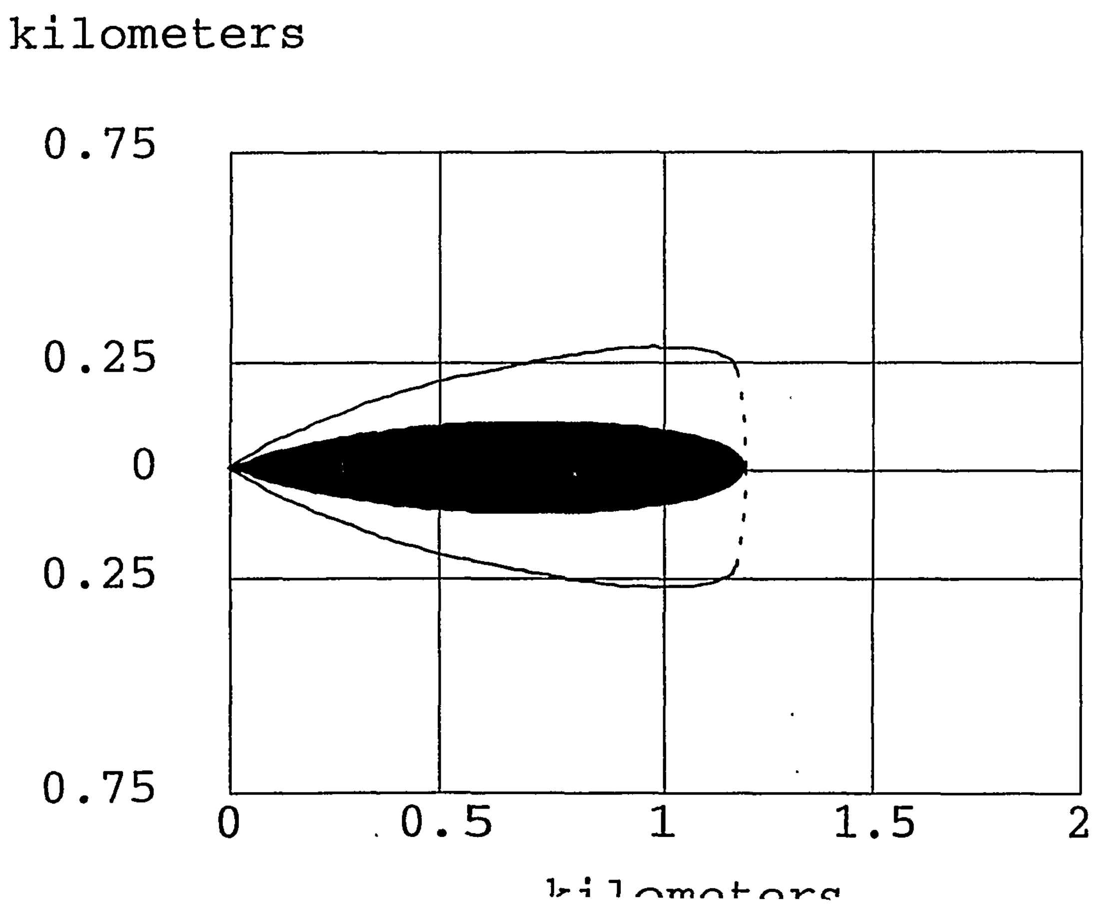


Footprint Window

2849170173

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Wind: 20 mph from 0° true

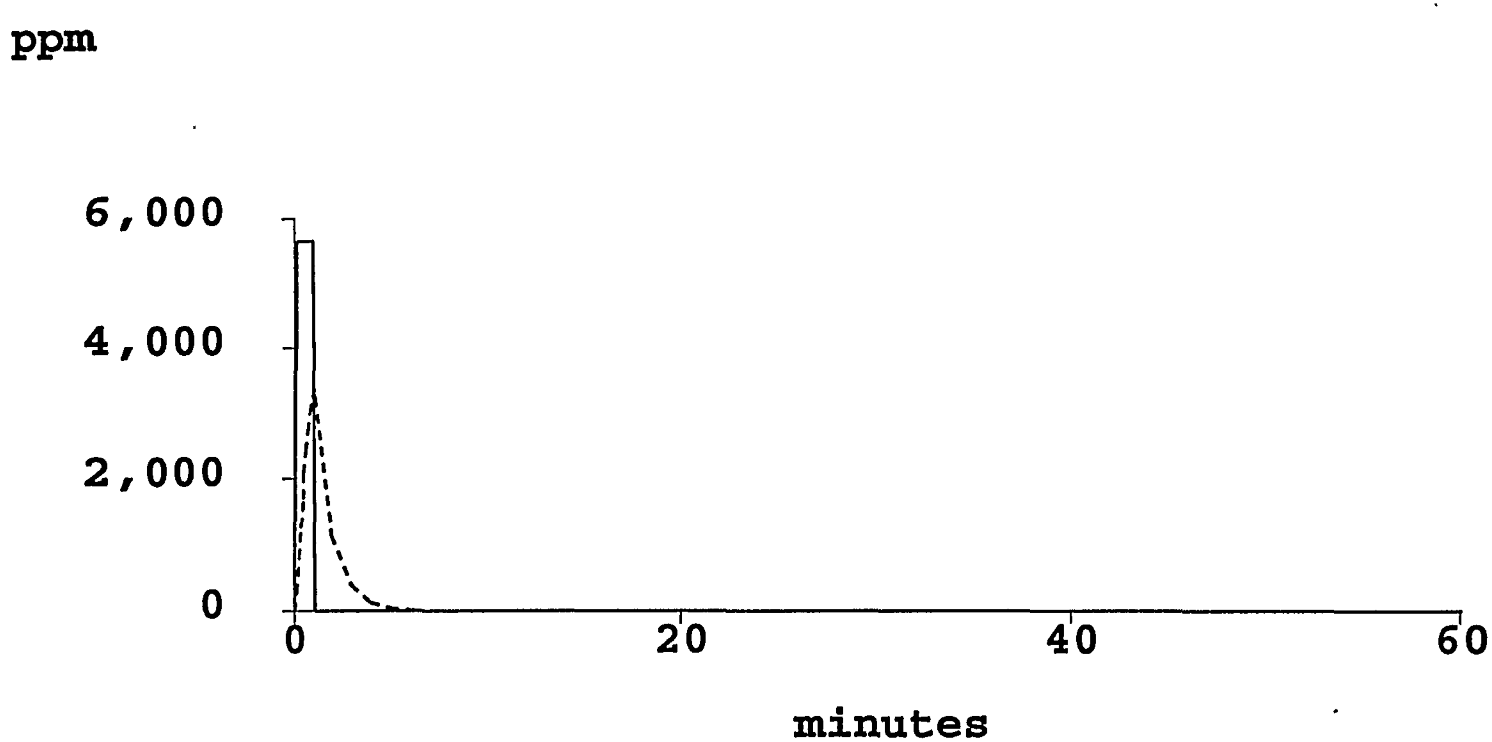
FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 4.15 ppm
  Max Threat Zone for LOC: 1.2 kilometers
  Max Threat Zone for IDLH: 331 meters



Concentration Window 2870431858

Chemical Name: DIMETHYLHYDRAZINE
Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

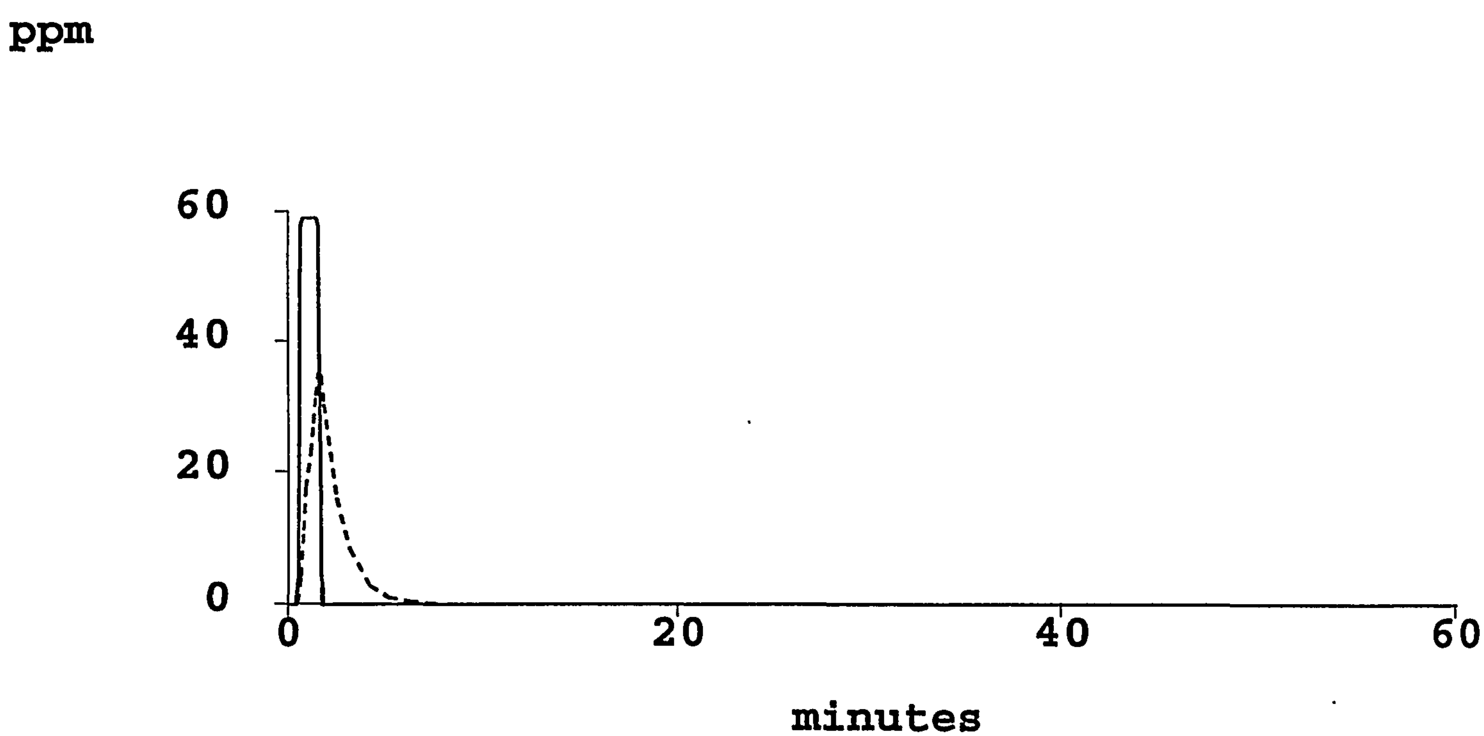
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 5,640 ppm
Indoor: 3,270 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2870431869

Chemical Name: DIMETHYLHYDRAZINE
  Note: Potential or confirmed human carcinogen.
Model Run: Gaussian
Building Air Exchanges Per Hour: 60 (User specified)

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 300 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 58.6 ppm
     Indoor: 35 ppm
  Note: Indoor graph is shown with a dotted line.



Nitrogen Tetroxide (NTO)

Release Designation N - 1

Scenario: Release of 1 pint of NTO at an ambient temperature of 85 degrees F, at ground level under "worst case" met conditions (F Stability with a wind speed of 1 meter per second).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 30 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-40	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
B-41			255				
B-42				196			
B-43	1,660 (ppm)				Arrives in 30 seconds Departs at 2 minute		
B-44		9.33 (ppm)				Arrives in 3 minutes Departs at 8 minutes	

Kauai Test Facility

Text Summary

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

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE
Molecular Weight: 92.01 kg/kmol
TLV-TWA: -unavail-   IDLH: -unavail-
Footprint Level of Concern: 15 ppm
Boiling Point: -unavail-
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
No Inversion Height
Stability Class: F   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 1.5 pounds   Source Height: 0
Release Duration: 1 minute
Release Rate: 11.3 grams/sec
Total Amount Released: 680 grams

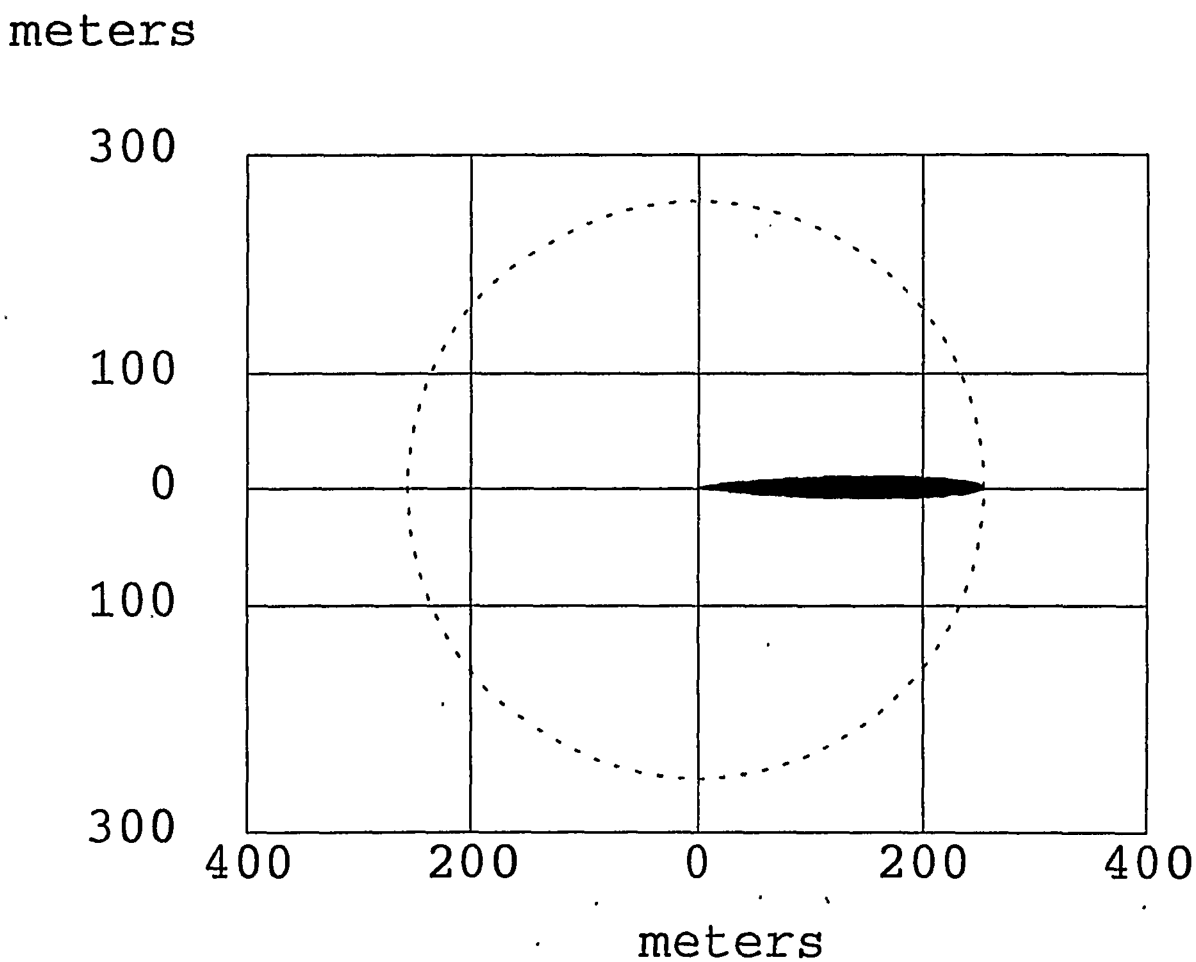
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 255 meters

Footprint Window

2849171076

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

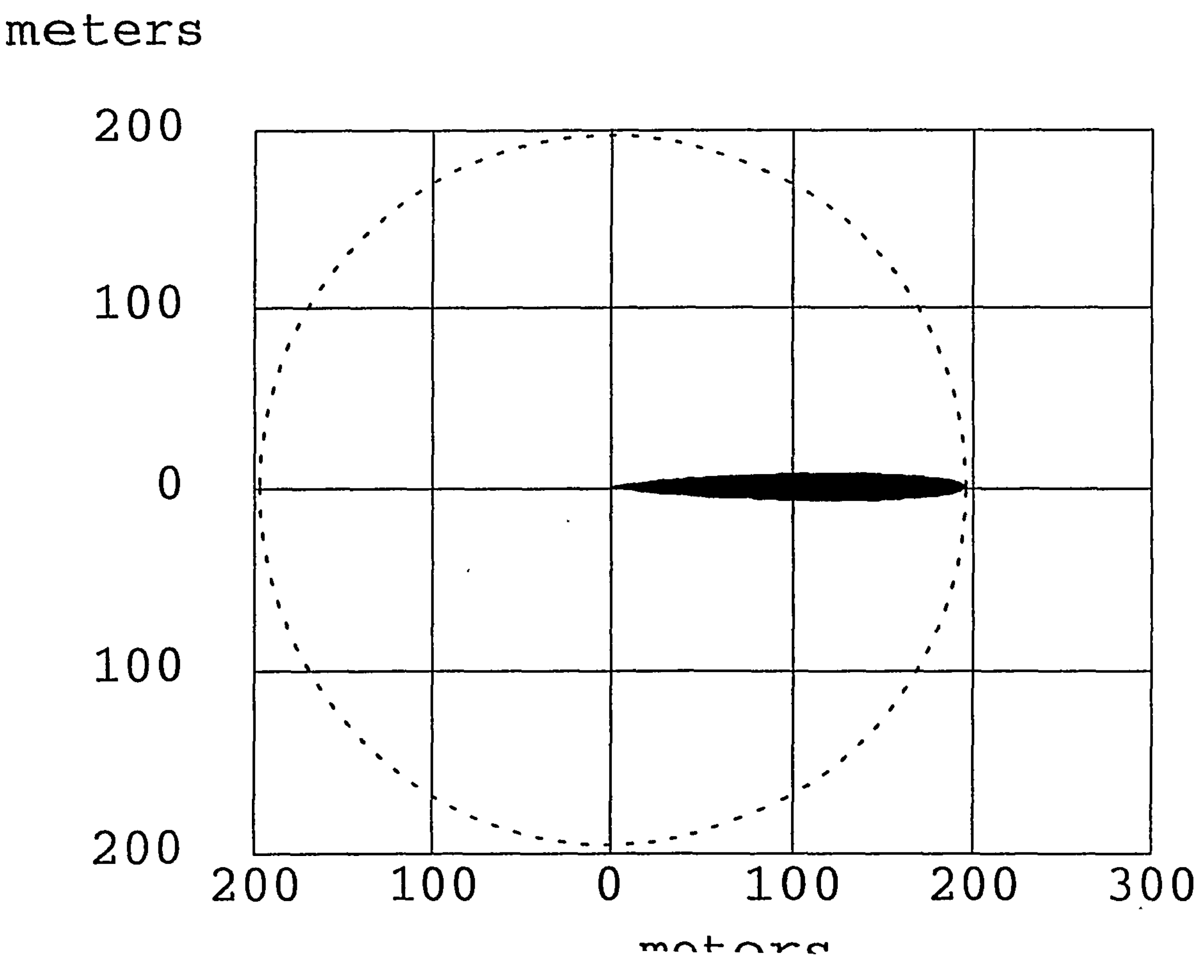
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 255 meters



Footprint Window

2849171163

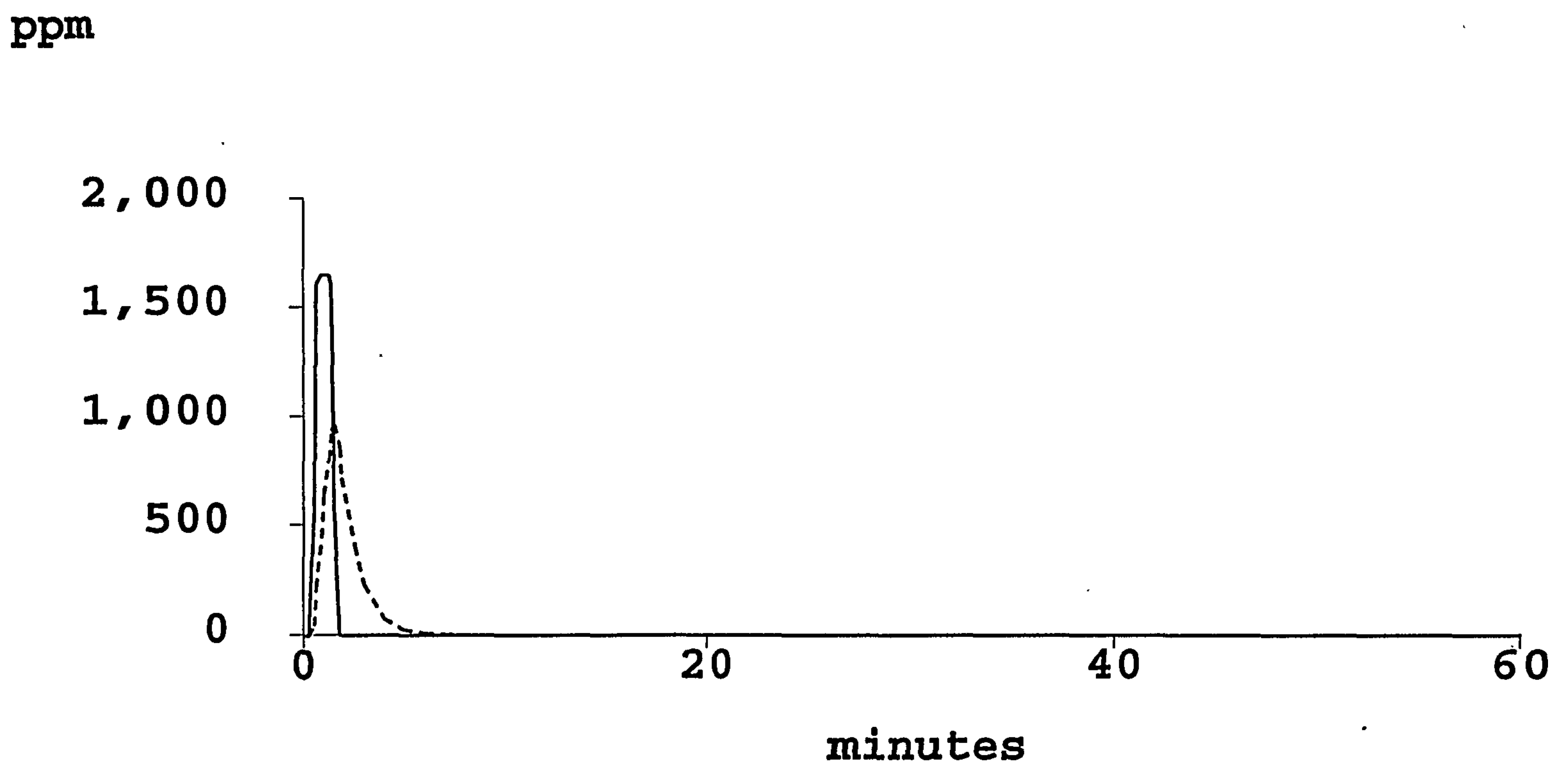
```
Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 1 meters/sec from 0° true


FOOTPRINT INFORMATION:   (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 30 ppm
  Max Threat Zone for LOC:  196 meters
```



Concentration Window 2870432239

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

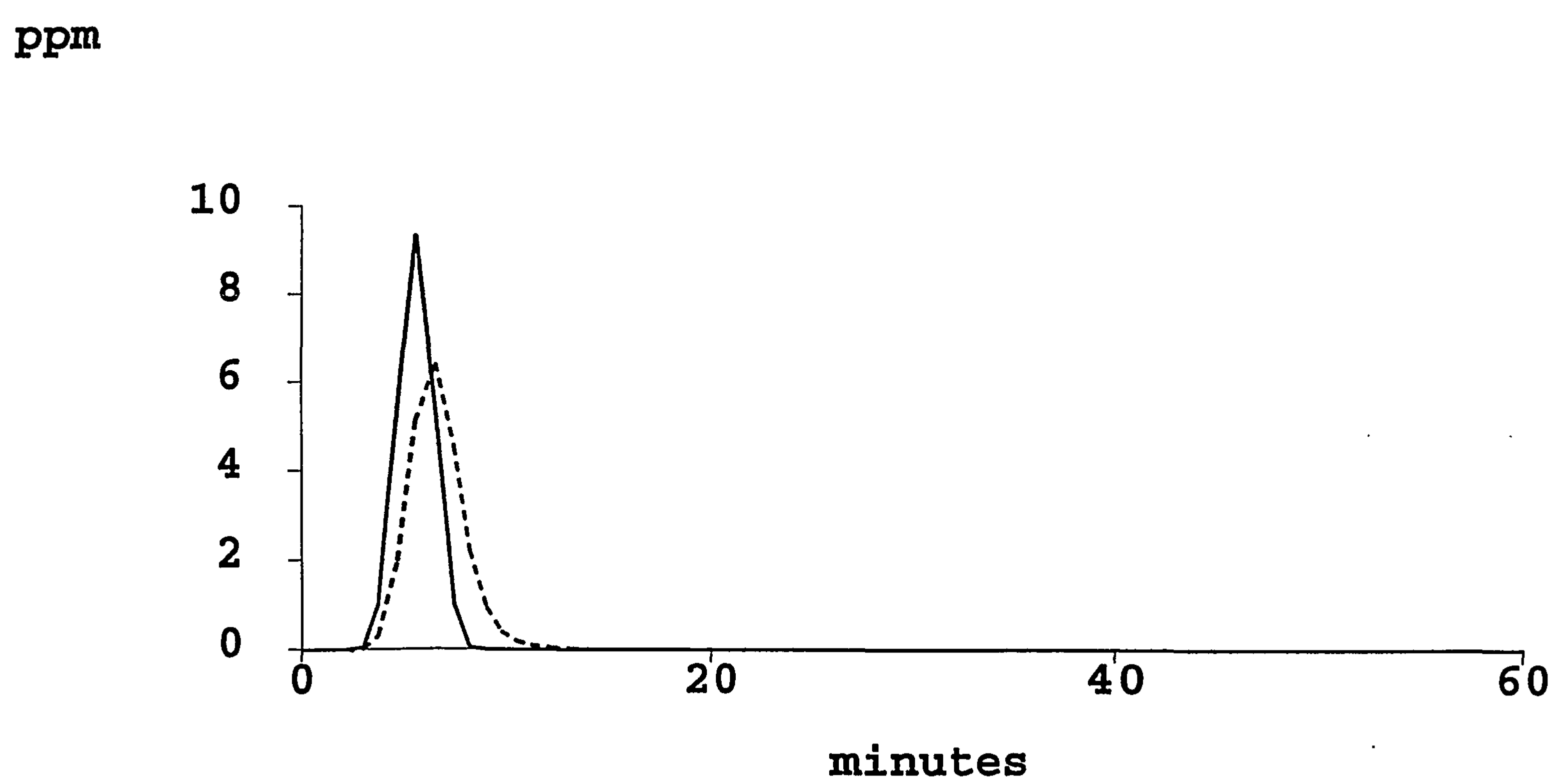
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1,660 ppm
Indoor: 966 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2870432248

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 9.33 ppm
Indoor: 6.4 ppm
Note: Indoor graph is shown with a dotted line.



Nitrogen Tetroxide (NTO)

Release Designation N - 2

Scenario: Release of 1 pint of NTO at an ambient temperature of 85 degrees F, at ground level under "low end" average met conditions (C Stability with a wind speed of 10 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 30 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-46	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
B-47			41				
B-48				29			
B-49	26.8 (ppm)				Arrives in 6 seconds Departs at 1 minute		
B-50		0.279 (ppm)				Arrives in 45 seconds Departs at 2.3 minutes	

Kauai Test Facility

Text Summary 2849172003

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

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE
Molecular Weight: 92.01 kg/kmol
TLV-TWA: -unavail- IDLH: -unavail-
Footprint Level of Concern: 15 ppm
Boiling Point: -unavail-
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 10 mph from 0° true No Inversion Height
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 1.5 pounds Source Height: 0
Release Duration: 1 minute
Release Rate: 11.3 grams/sec
Total Amount Released: 680 grams

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 41 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Footprint Window

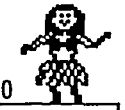
2849172003 

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 41 meters
Note: Footprint was not drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 41 meters
Note: Footprint was not drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

Footprint Window



Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 29 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

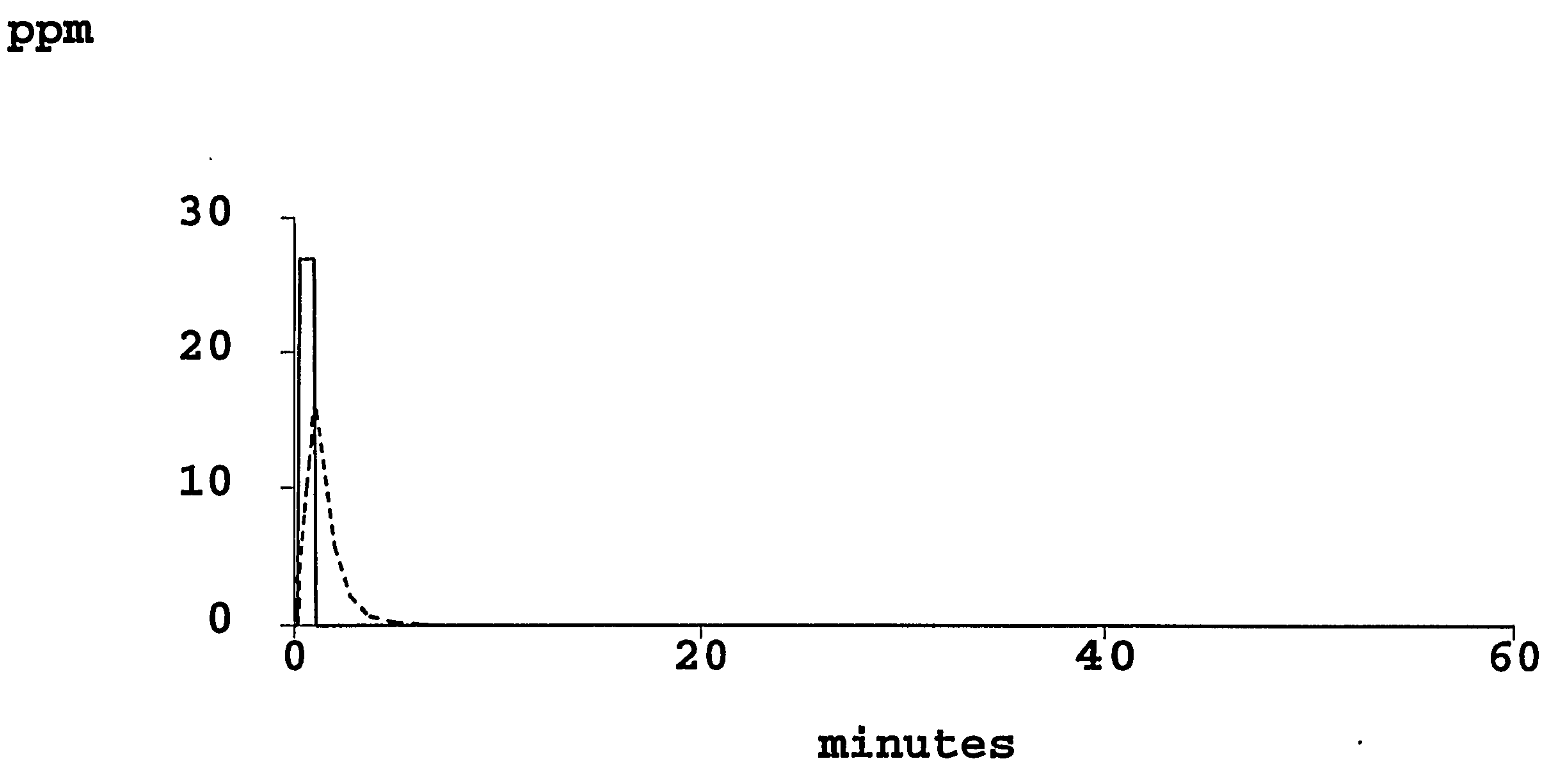
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 29 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Concentration Window

2870432438

Chemical Name: NITROGEN TETROXIDE
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: 26.8 ppm
     Indoor: 15.8 ppm
  Note: Indoor graph is shown with a dotted line.

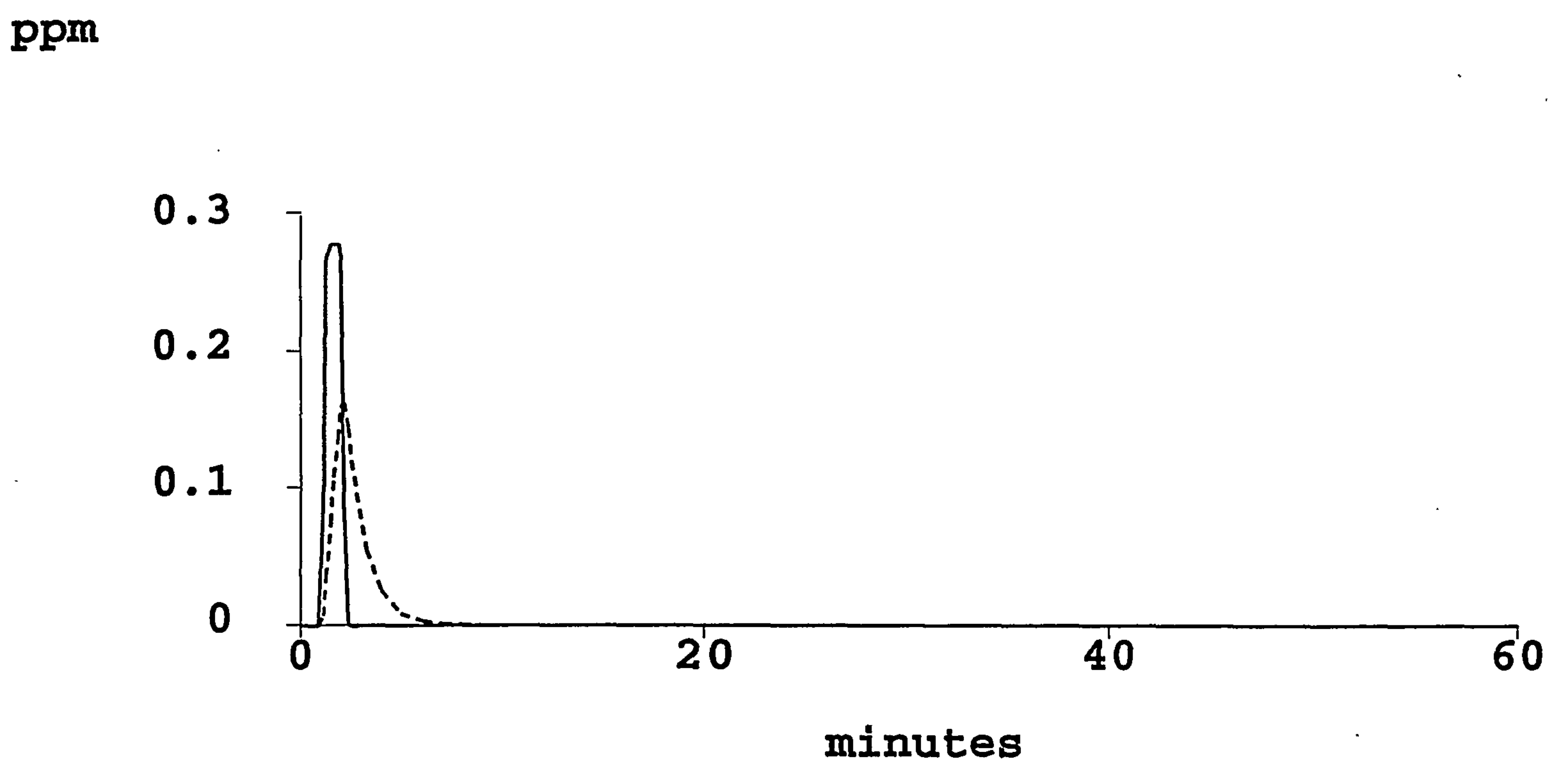


Concentration Window

2870432427

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.279 ppm
Indoor: 0.162 ppm
Note: Indoor graph is shown with a dotted line.



Nitrogen Tetroxide (NTO)

Release Designation N - 3

Scenario: Release of 1 pint of NTO at an ambient temperature of 85 degrees F, at ground level under "high end" average met conditions (C Stability with a wind speed of 20 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 30 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-52	INPUT PARAMETERS AND TEXT SUMMARY						ALERT
B-53			29				
B-54				20			
B-55	13.4 (ppm)				Arrives in 3 seconds Departs at 1 minute		
B-56		0.139 (ppm)				Arrives in 23 seconds Departs at 1.6 minutes	

Kauai Test Facility

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

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE
Molecular Weight: 92.01 kg/kmol
TLV-TWA: -unavail-   IDLH: -unavail-
Footprint Level of Concern: 15 ppm
Boiling Point: -unavail-
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 20 mph from 0° true   No Inversion Height
Stability Class: C   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 1.5 pounds   Source Height: 0
Release Duration: 1 minute
Release Rate: 11.3 grams/sec
Total Amount Released: 680 grams

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 29 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Footprint Window 2849172190

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 29 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 29 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Footprint Window

2849172248

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 20 mph from 0° true

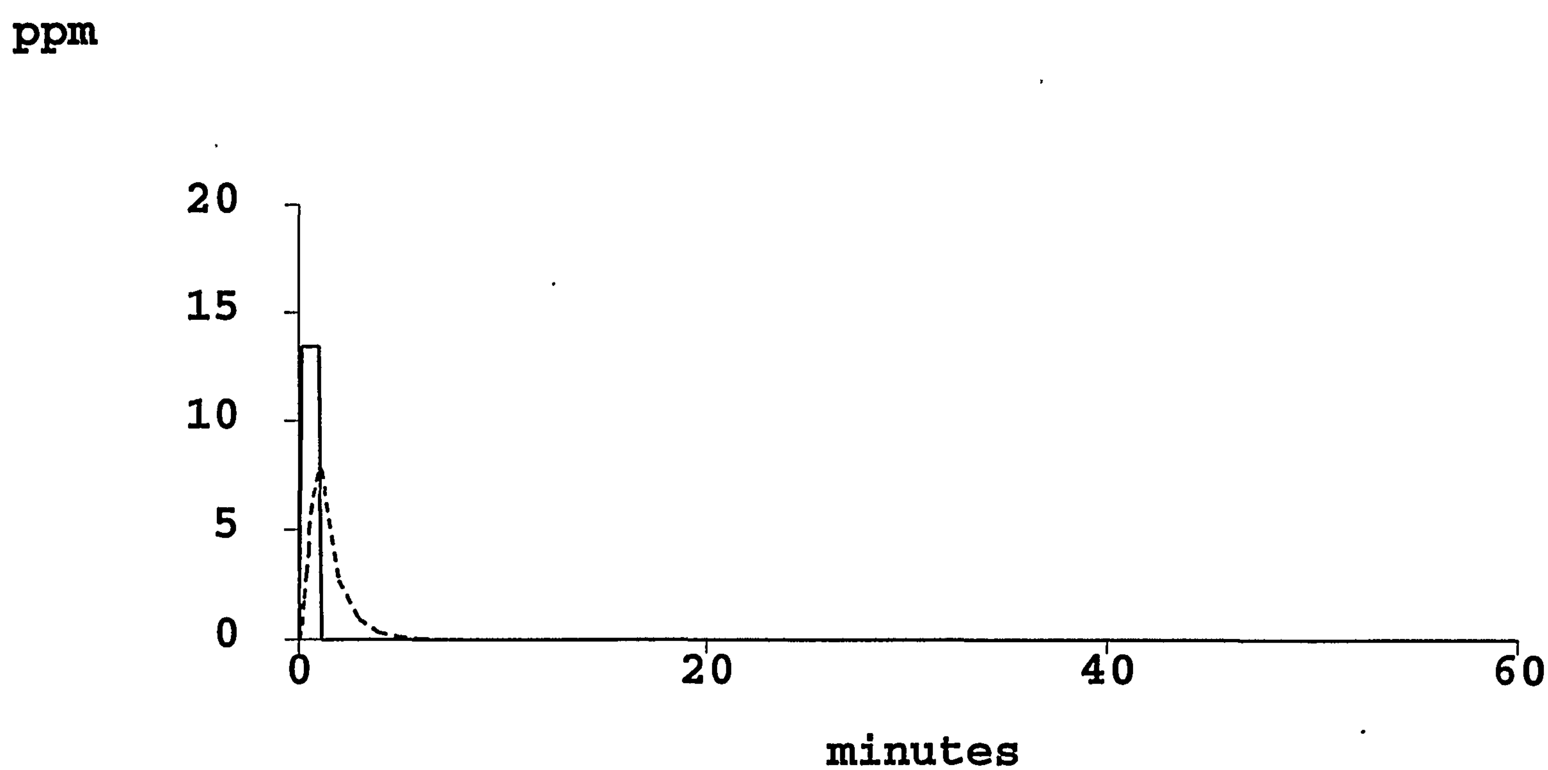
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 20 meters
Note: Footprint was not drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 20 meters
Note: Footprint was not drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

Concentration Window 2870432563

Chemical Name: NITROGEN TETROXIDE
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: 13.4 ppm
    Indoor: 7.78 ppm
  Note: Indoor graph is shown with a dotted line.

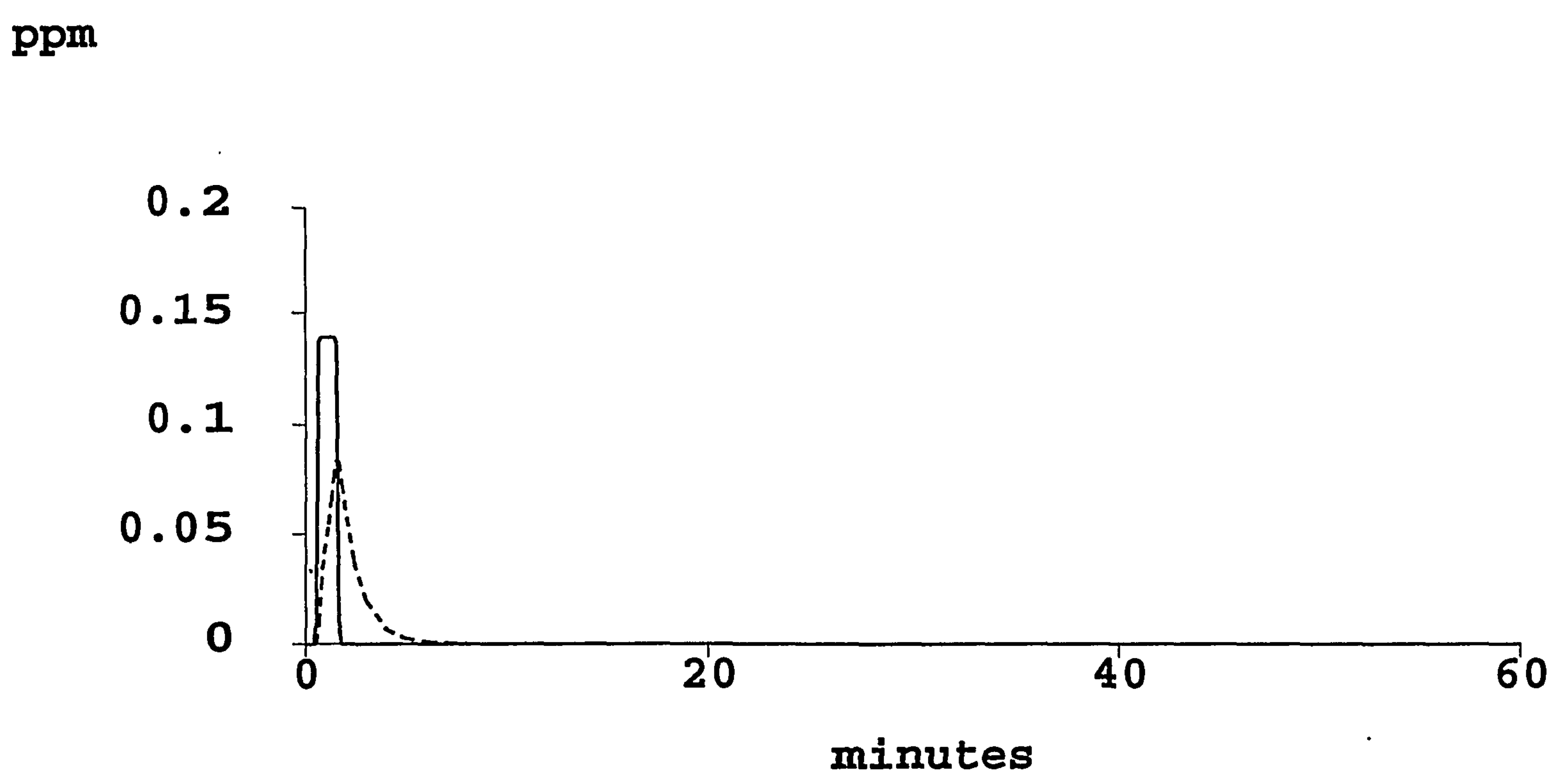


Concentration Window

2870432572

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.139 ppm
Indoor: 0.0831 ppm
Note: Indoor graph is shown with a dotted line.



Nitrogen Tetroxide (NTO)

Release Designation N - 4

Scenario: Release of 55 gallons of NTO at an ambient temperature of 85 degrees F, at ground level under "worst case" met conditions (F Stability with a wind speed of 1 meter per second).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 30 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-58	**INPUT PARAMETERS AND TEXT SUMMARY**						**GENERAL EMERGENCY**
B-59			**2,500**				
B-60				**1,900**			
B-61	**735,000 (ppm)**				**Arrives in 30 seconds Departs at 1.6 minutes**		
B-62		**4,140 (ppm)**				**Arrives in 3 minutes Departs at 9.5 minutes**	

Kauai Test Facility

Text Summary

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

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE
Molecular Weight: 92.01 kg/kmol
TLV-TWA: -unavail-   IDLH: -unavail-
Footprint Level of Concern: 15 ppm
Boiling Point: -unavail-
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
No Inversion Height
Stability Class: F   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 665.5 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 5.03 kilograms/sec
Total Amount Released: 302 kilograms

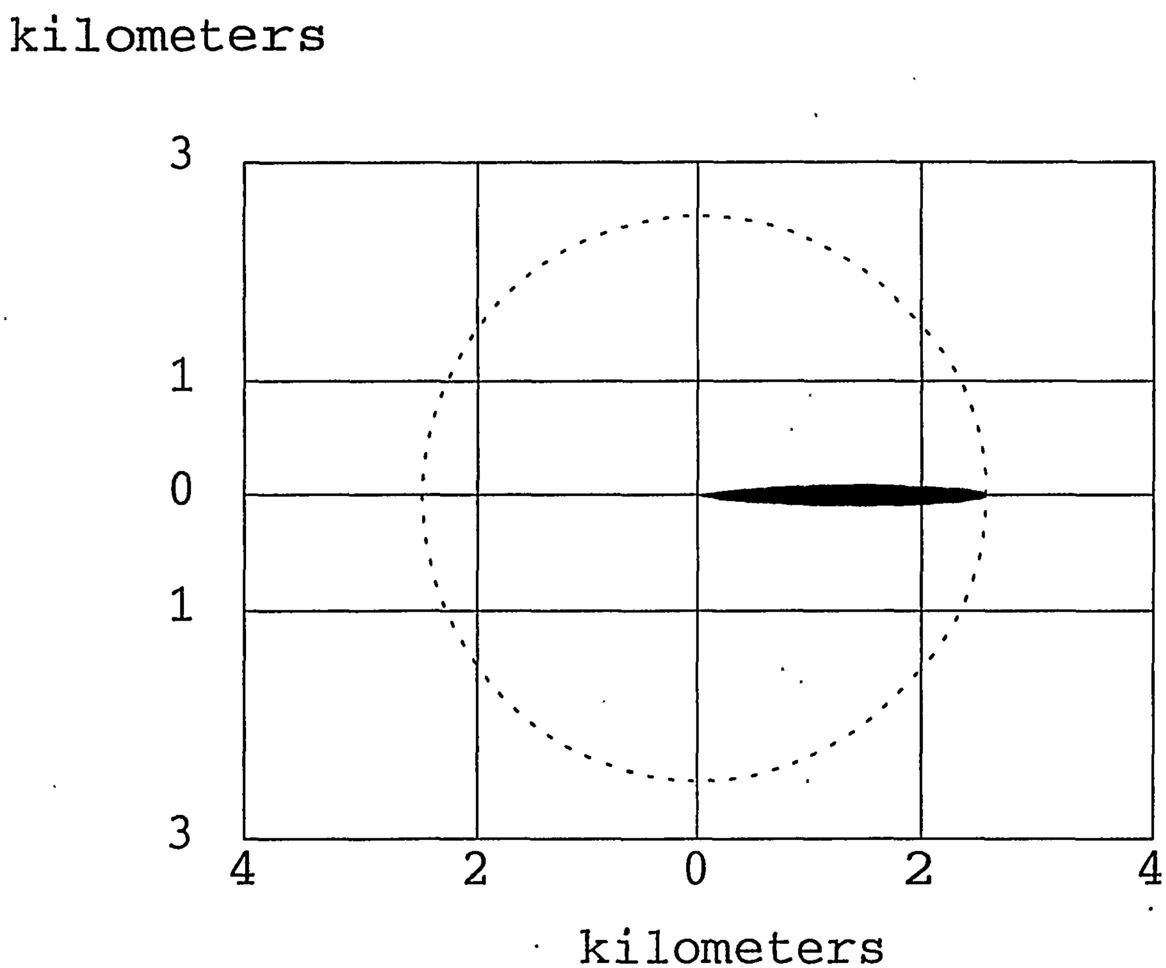
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 2.5 kilometers

Footprint Window

2849172409

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 2.5 kilometers

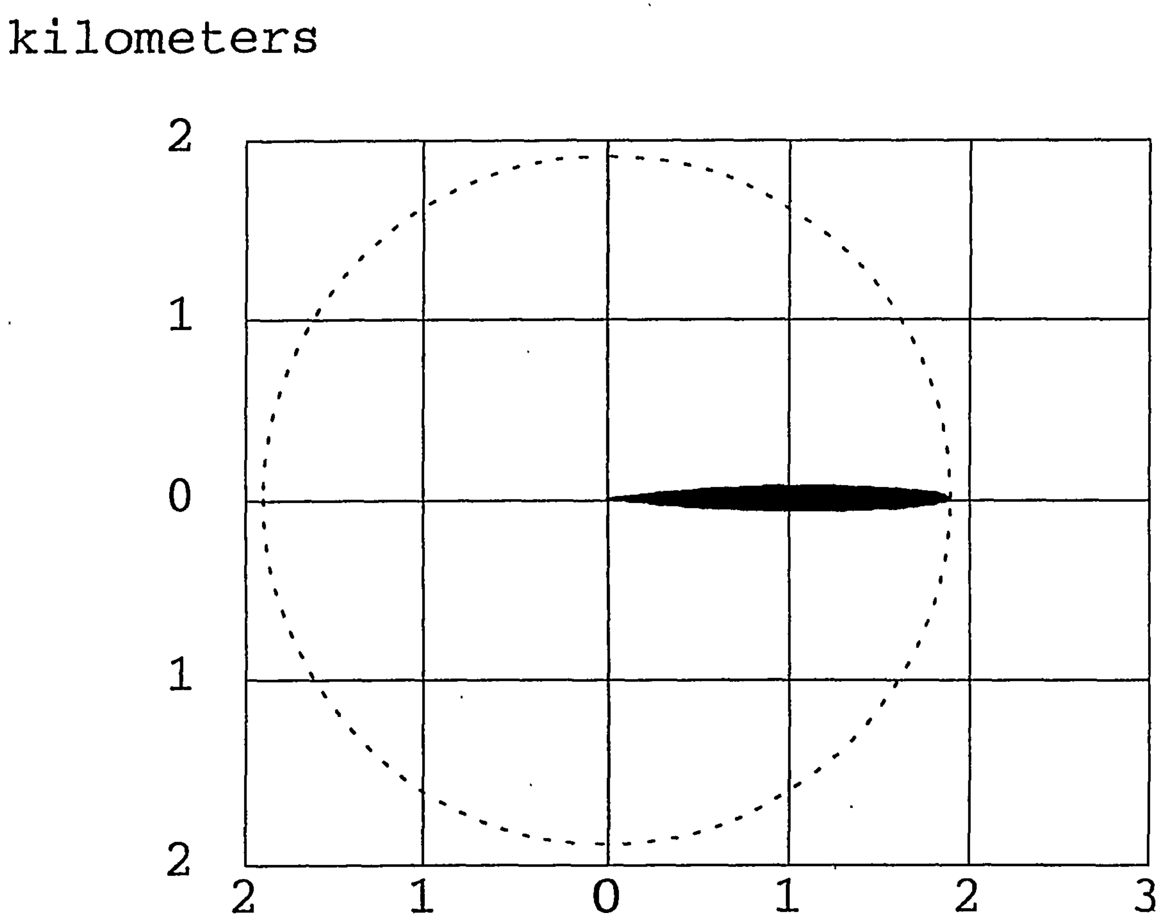


Footprint Window

2849172484

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

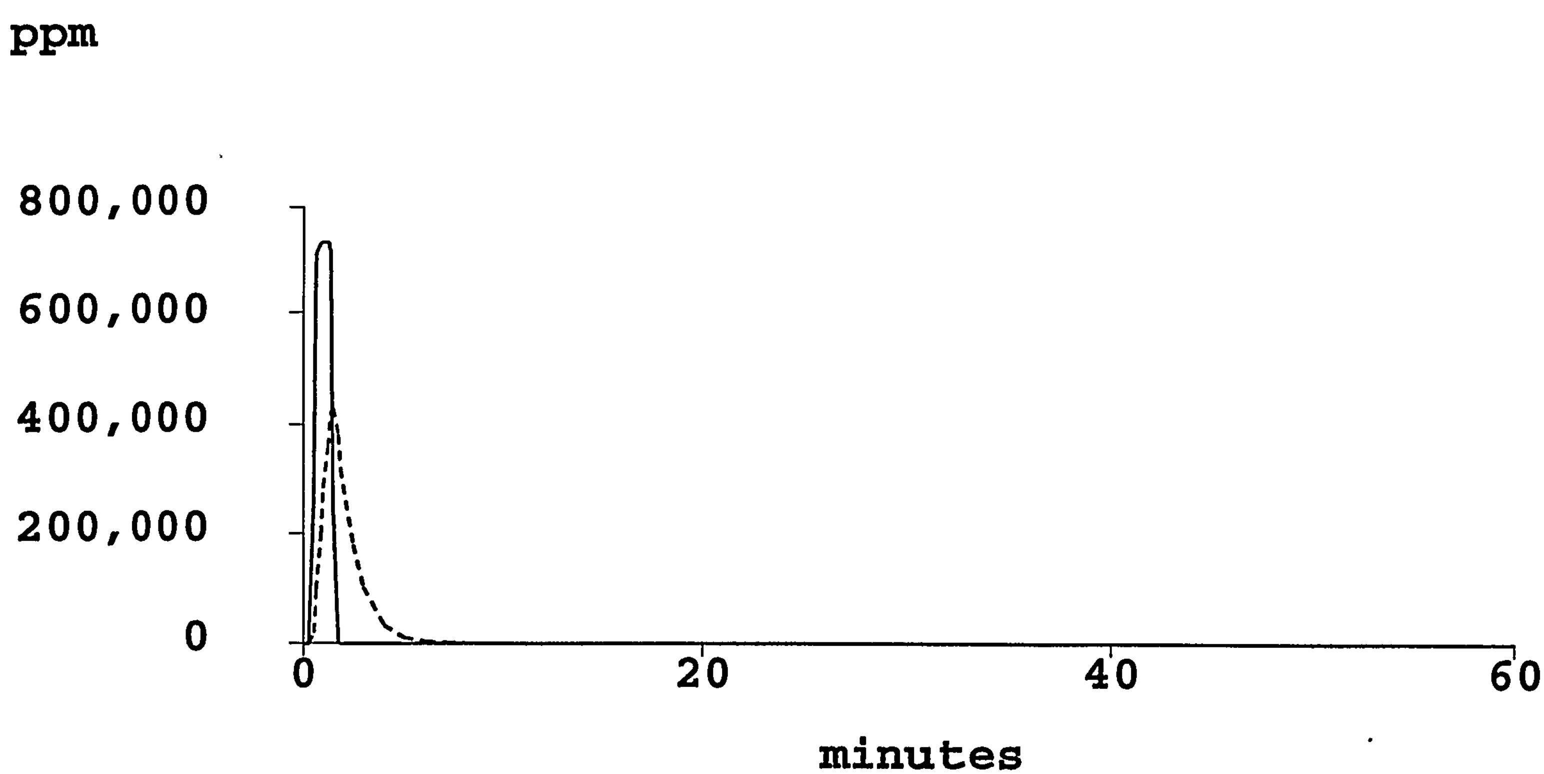
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 1.9 kilometers



Concentration Window

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

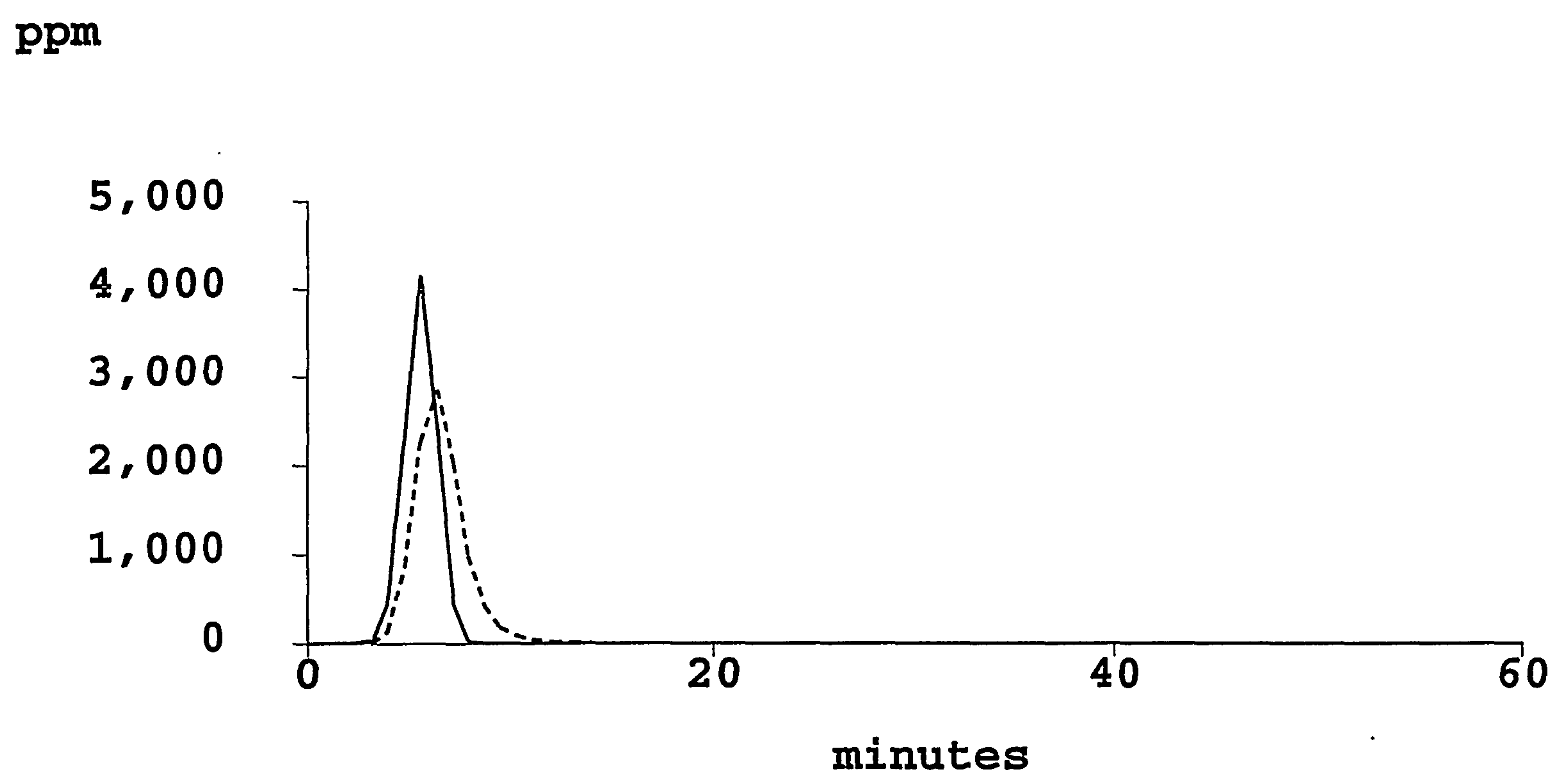
TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 30 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 735,000 ppm
     Indoor: 429,000 ppm
  Note: Indoor graph is shown with a dotted line.



Concentration Window

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 4,140 ppm
Indoor: 2,840 ppm
Note: Indoor graph is shown with a dotted line.



Nitrogen Tetroxide (NTO)

Release Designation N - 5

Scenario: Release of 55 gallons of NTO at an ambient temperature of 85 degrees F, at ground level under "low end" average met conditions (C Stability with a wind speed of 10 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 30 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-64	INPUT PARAMETERS AND TEXT SUMMARY						GENERAL EMERGENCY
B-65			871				
B-66				630			
B-67	11,900 (ppm)				Arrives in 6 seconds Departs at 1 minutes		
B-68		124 (ppm)				Arrives in 1 minutes Departs at 2.3 minutes	

Kauai Test Facility

Text Summary

2849172681

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

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE
Molecular Weight: 92.01 kg/kmol
TLV-TWA: -unavail-   IDLH: -unavail-
Footprint Level of Concern: 15 ppm
Boiling Point: -unavail-
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 10 mph from 0° true   No Inversion Height
Stability Class: C   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 665.5 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 5.03 kilograms/sec
Total Amount Released: 302 kilograms

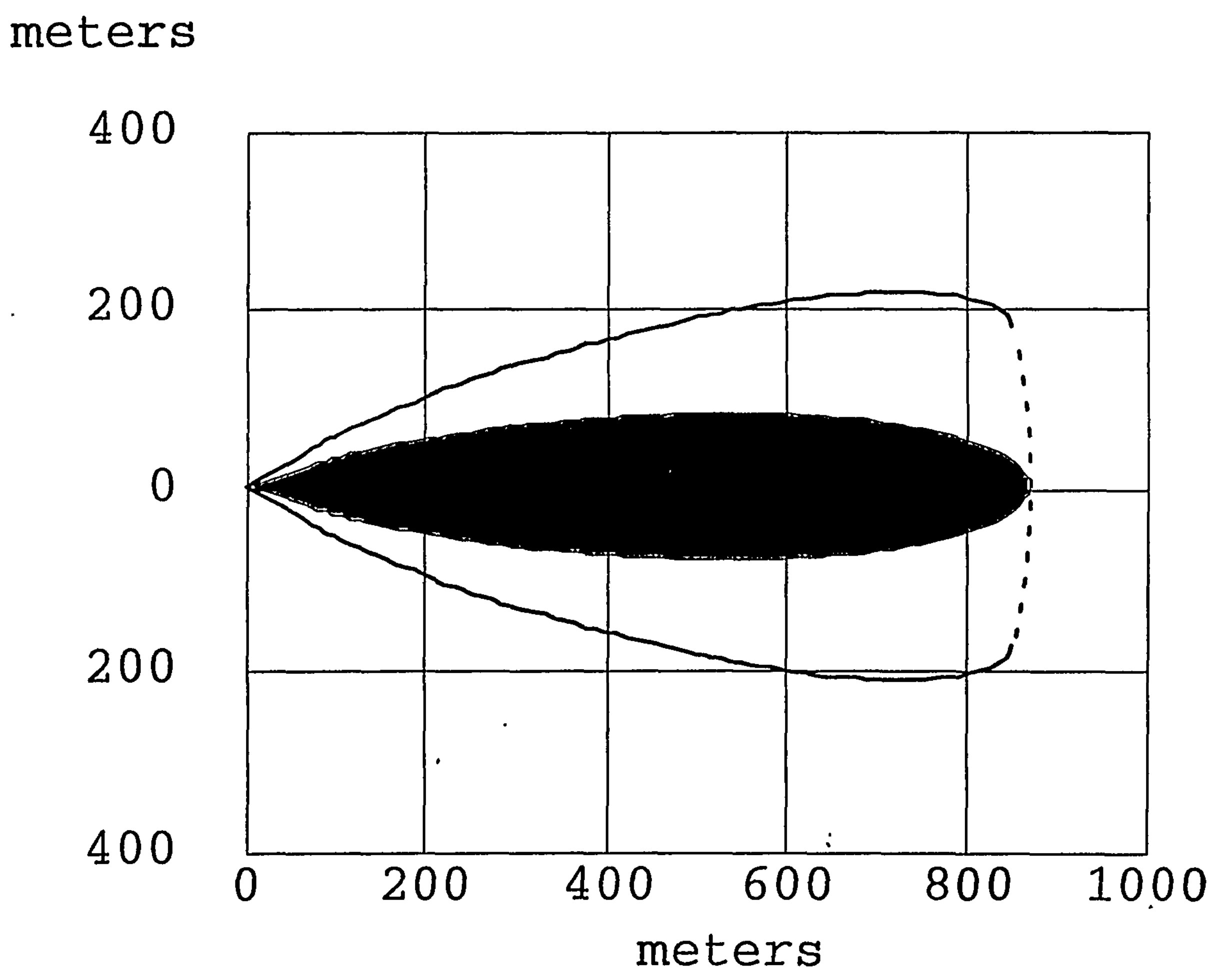
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 871 meters

Footprint Window

2849172680

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 10 mph from 0° true

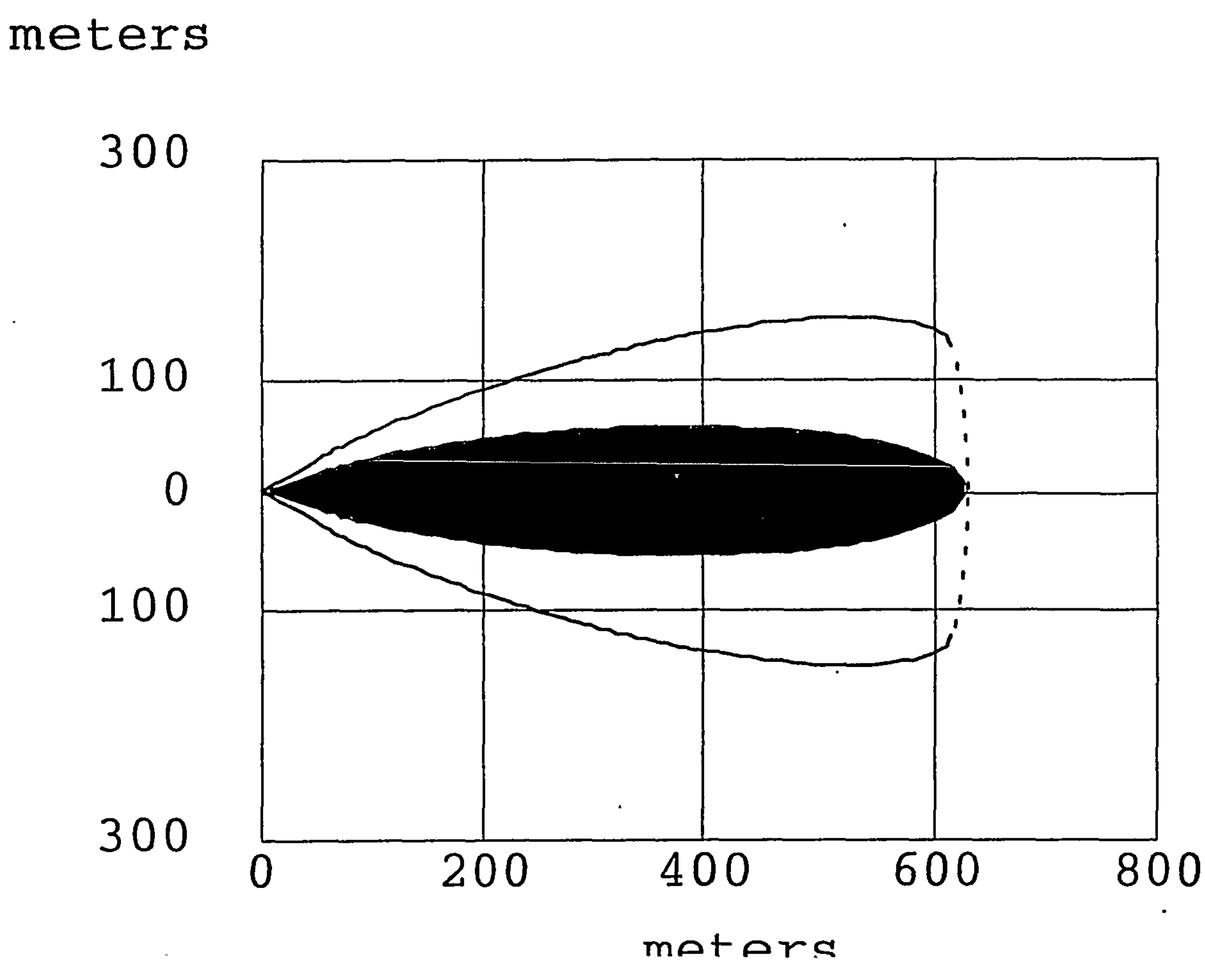
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 871 meters



Footprint Window 2849172622

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 630 meters

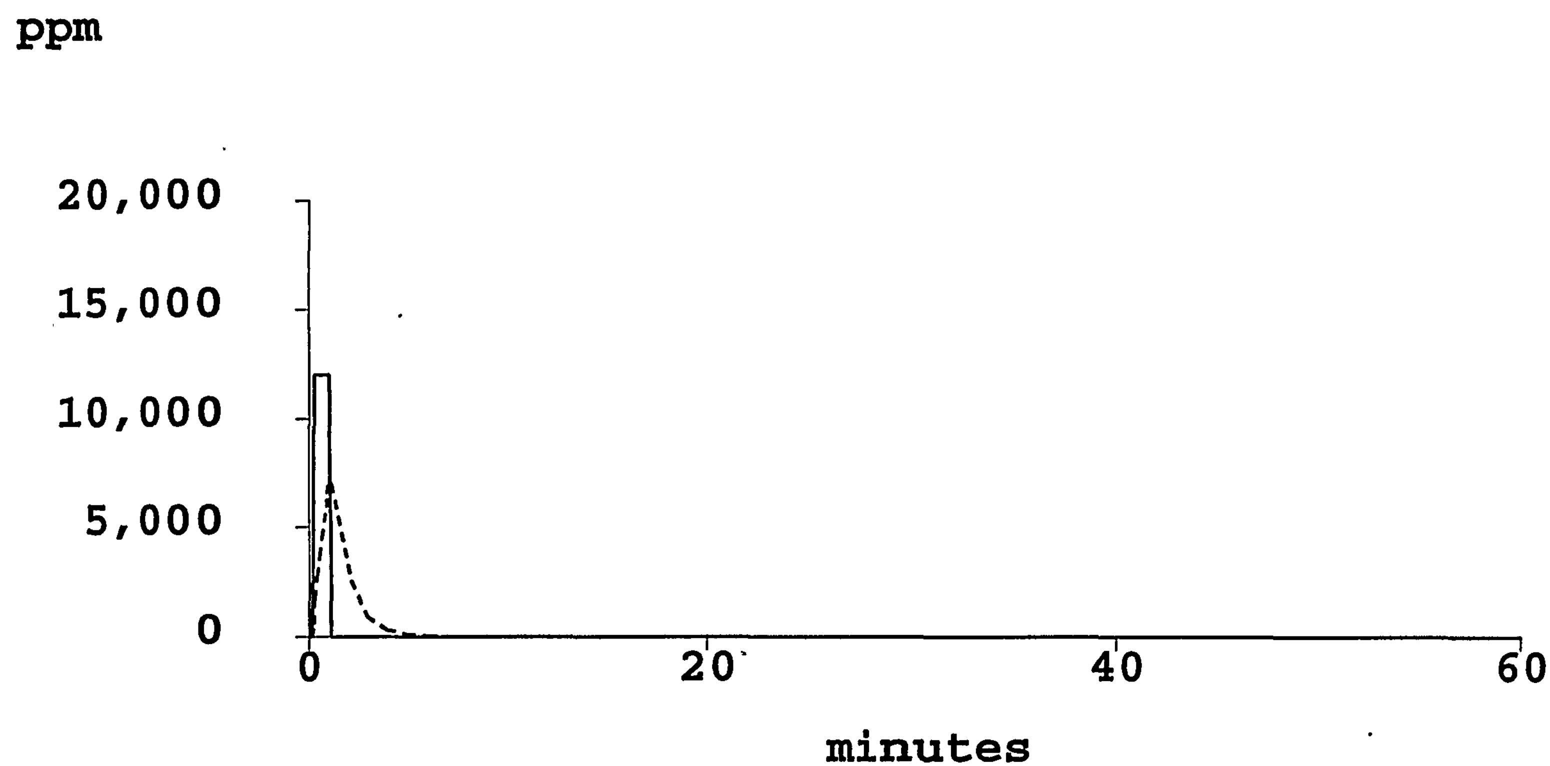


Concentration Window

2870432939

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

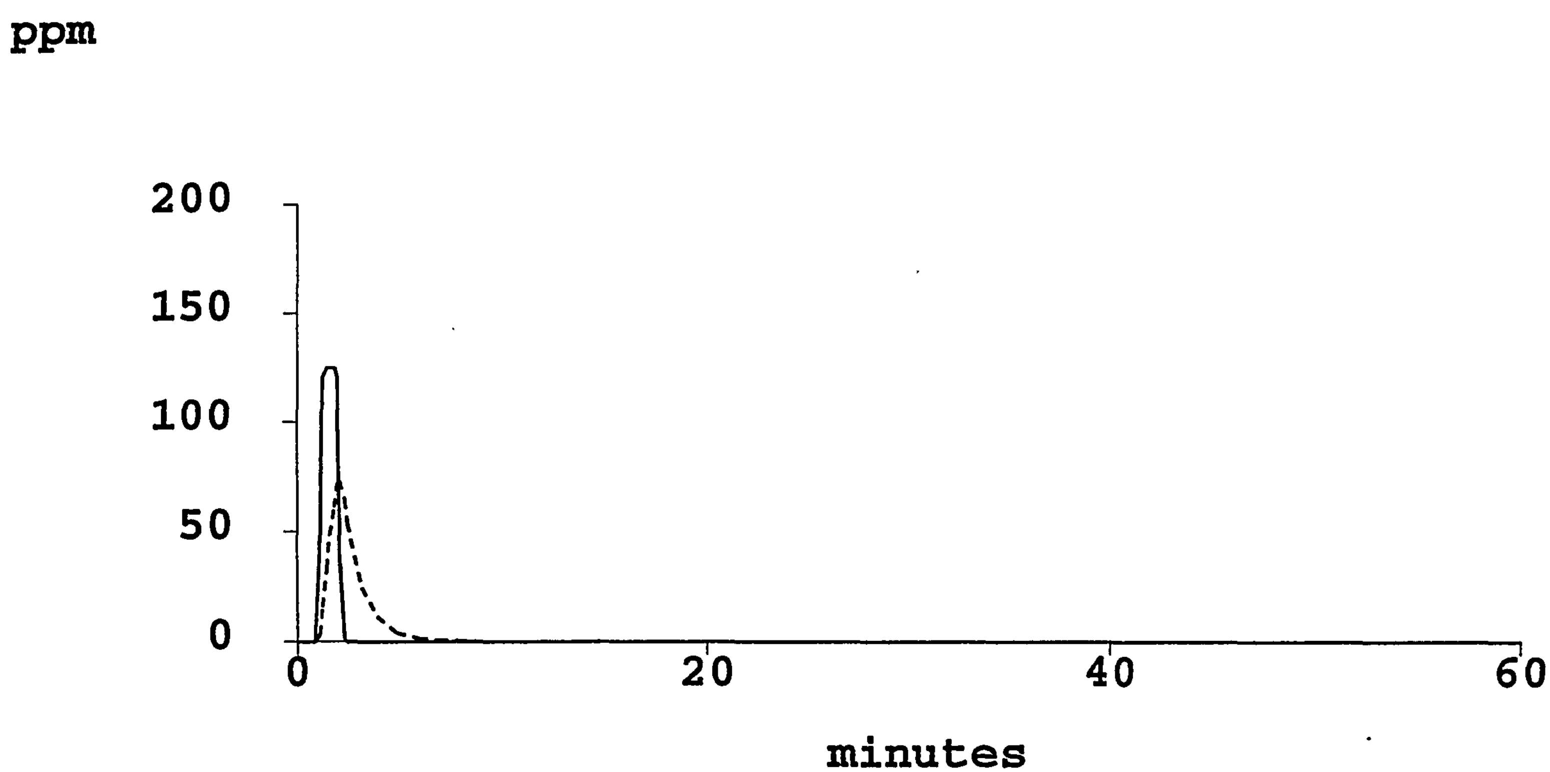
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 11,900 ppm
Indoor: 7,000 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2870432948

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 124 ppm
Indoor: 71.9 ppm
Note: Indoor graph is shown with a dotted line.



Nitrogen Tetroxide (NTO)

Release Designation N - 6

Scenario: Release of 55 gallons of NTO at an ambient temperature of 85 degrees F, at ground level under "high end" average met conditions (C Stability with a wind speed of 20 mph).

Liquid Hypergolic Propellant Spill Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 30 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
B-70	INPUT PARAMETERS AND TEXT SUMMARY						GENERAL EMERGENCY
B-71			633				
B-72				442			
B-73	5,940(ppm)				Arrives in 3 seconds Departs at 1 minutes		
B-74		61.8 (ppm)				Arrives in 1 minutes Departs at 2 minutes	

Kauai Test Facility

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

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE
Molecular Weight: 92.01 kg/kmol
TLV-TWA: -unavail- IDLH: -unavail-
Footprint Level of Concern: 15 ppm
Boiling Point: -unavail-
Note: Not enough chemical data to use Heavy Gas option

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 20 mph from 0° true No Inversion Height
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 665.5 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 5.03 kilograms/sec
Total Amount Released: 302 kilograms

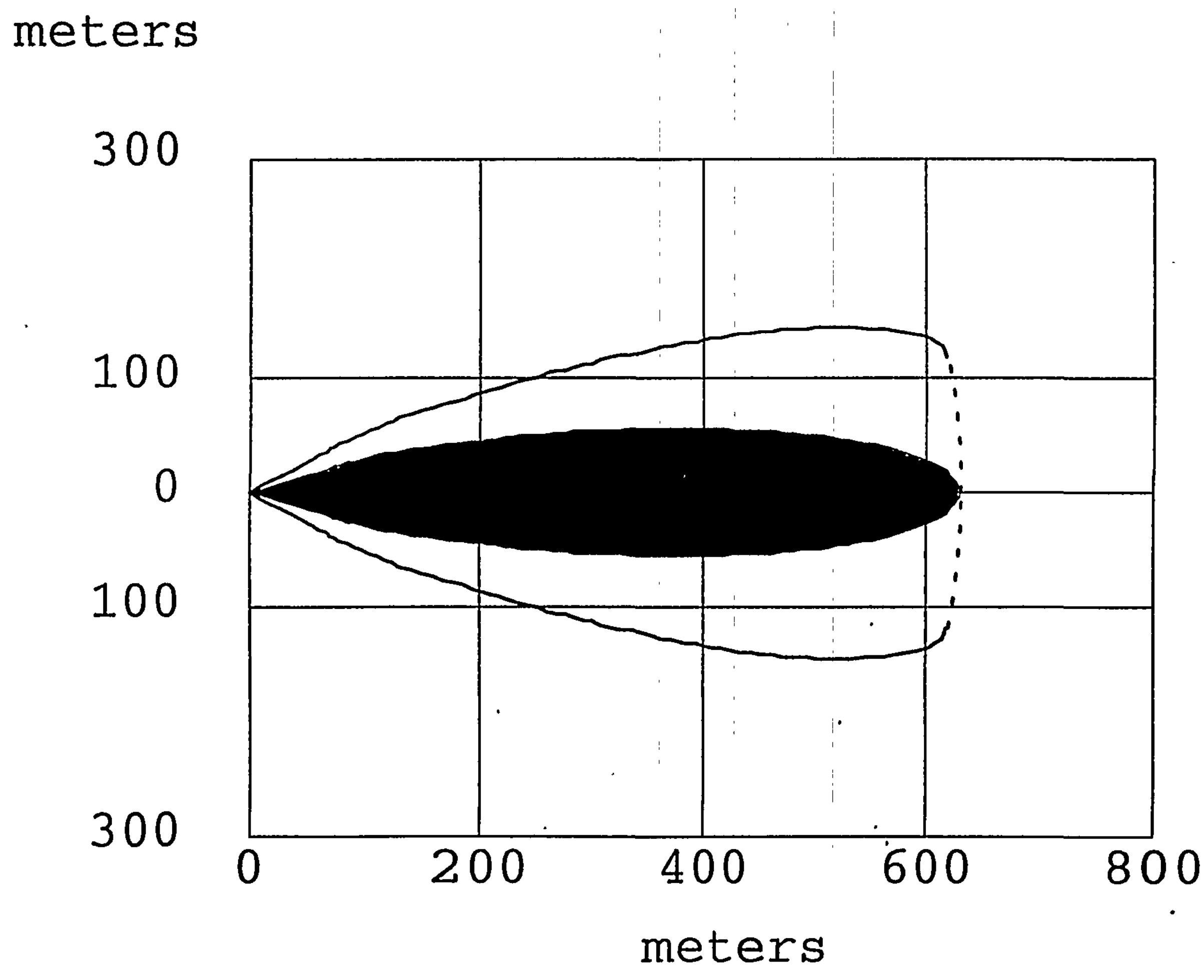
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 633 meters

Footprint Window

2849173144

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 20 mph from 0° true

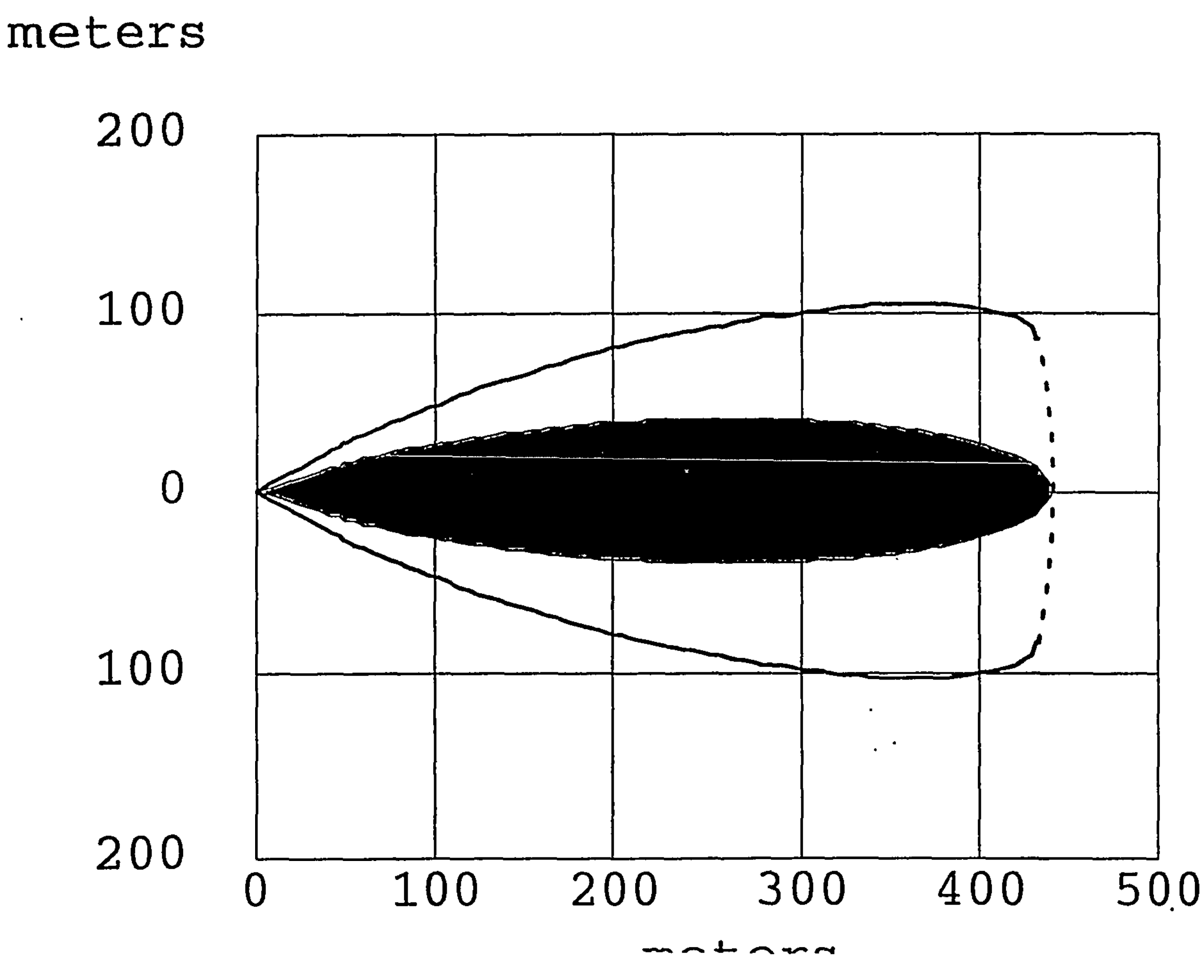
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 15 ppm
Max Threat Zone for LOC: 633 meters



Footprint Window 2849173201

Chemical Name: NITROGEN TETROXIDE
Model Run: Gaussian
Wind: 20 mph from 0° true

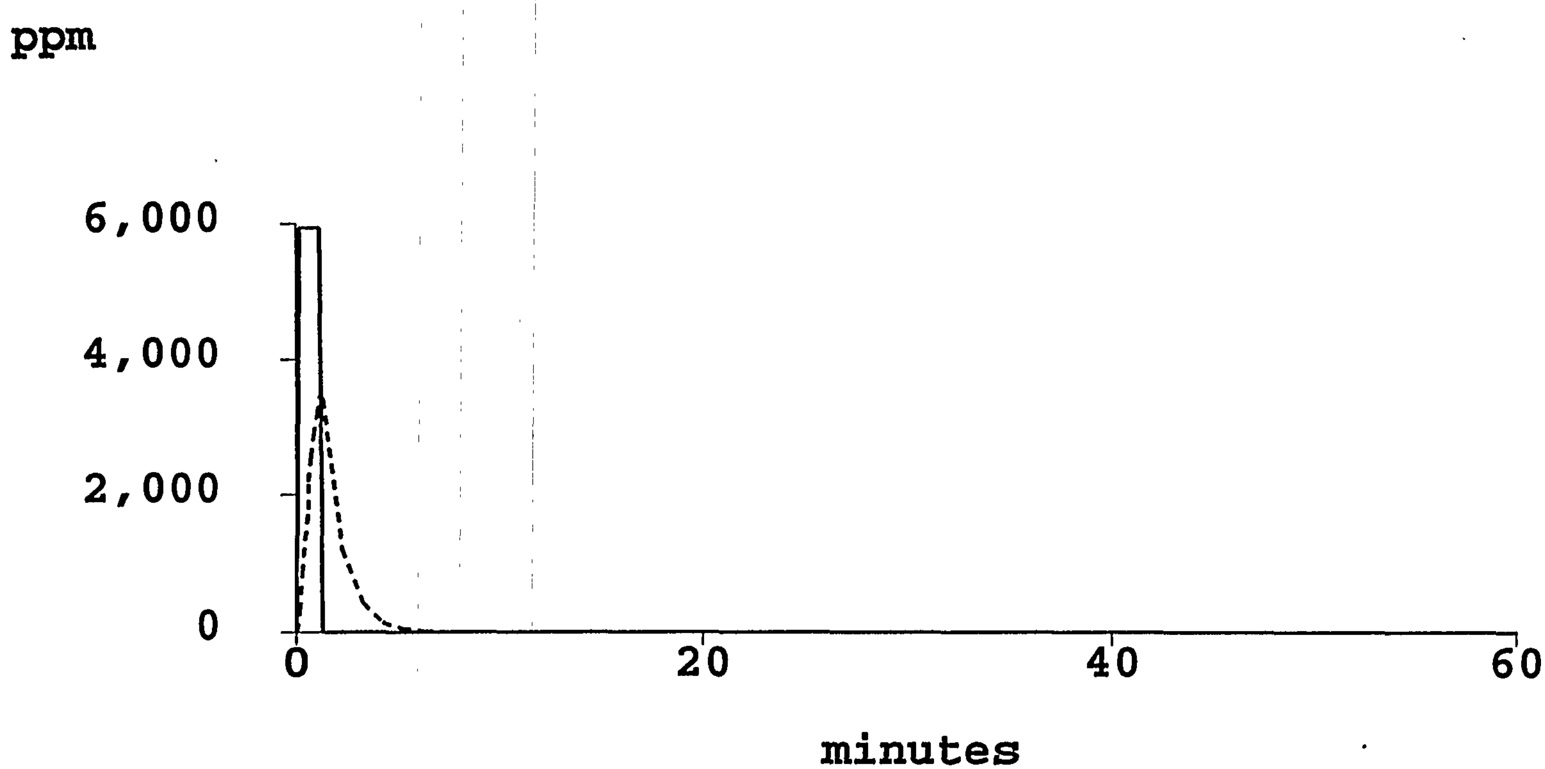
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 442 meters



Concentration Window 2870432795

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

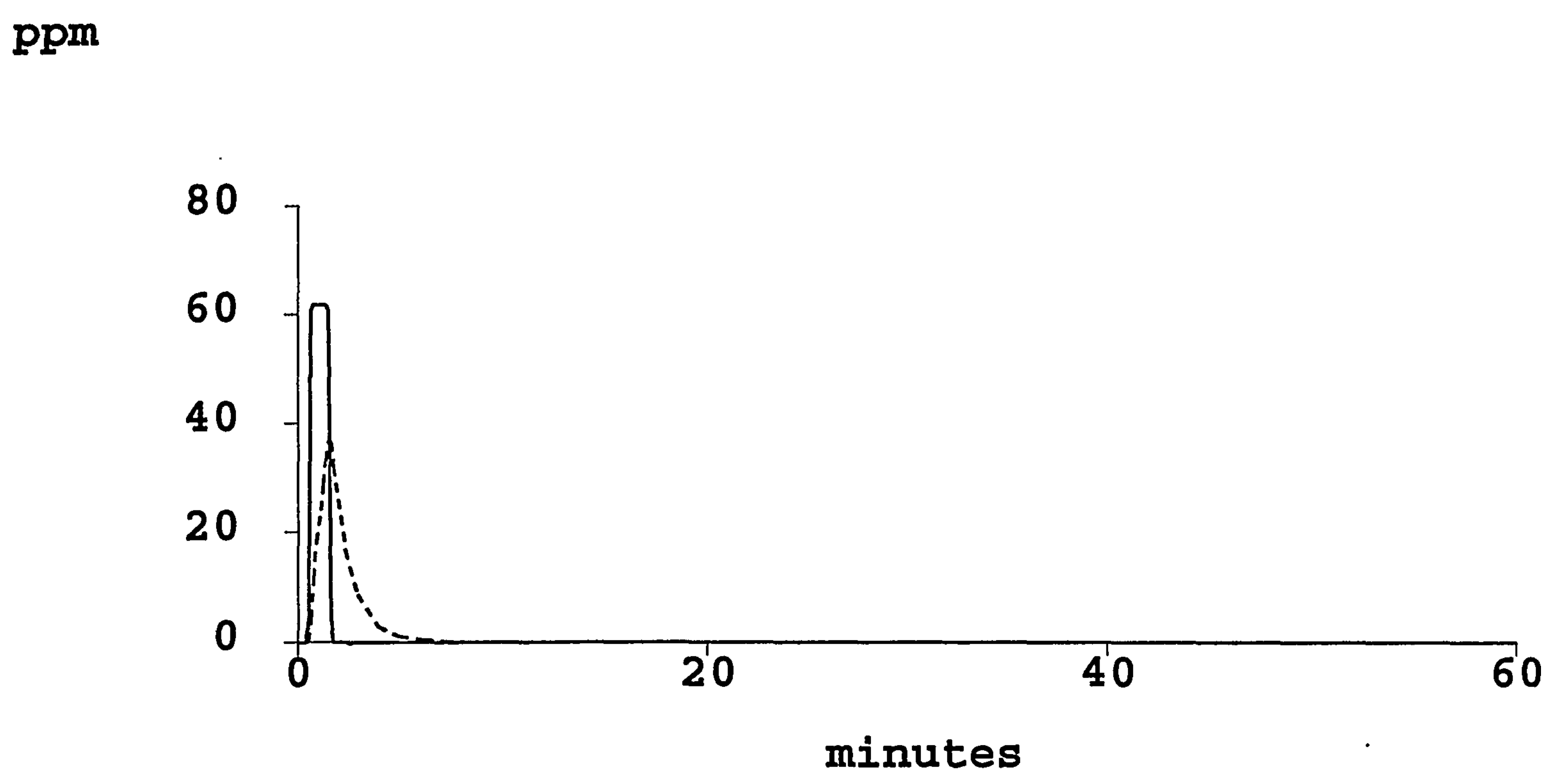
TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 30 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 5,940 ppm
     Indoor: 3,450 ppm
  Note: Indoor graph is shown with a dotted line.



Concentration Window

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 61.8 ppm
Indoor: 36.9 ppm
Note: Indoor graph is shown with a dotted line.



Exhaustive Byproduct Scenarios

DIFOUT's Assumptions Applied to ALOHA

Assumptions Applied to ALOHA Concerning Exhaust Byproducts Resulting from Detonations and/or Deflagrations

In Section 5.0 of this Hazard Assessment the accidental detonation of each individual motor system (24 total) previously used at the KTF, though improbable, was analyzed. The primary hazard resulting from the premature detonation and/or deflagration of any motor is hazardous byproducts produced as a result of the combustion of the solid propellant. These 24 motor systems produced a total of 21 chemicals in the combustion process in either gaseous or aerosol form. Of the 21 chemical byproducts, only 6 were found to be hazardous via the Hazard Screening Worksheets. Maximum quantities of those 6 hazardous chemicals were produced by analyzing the detonation of five separate motor systems (STARS, NIKE, Terrier, Talos, and Recruit).

The Gaussian dispersion model (ALOHA) was utilized to study and predict the dispersal of toxic materials released during solid propellant detonation and/or combustion and the associated consequences. However, ALOHA employs a point source theory of release. Therefore, to accurately portray an event involving the detonation and/or deflagration of solid propellant, input values (quantities of material available) were calculated utilizing information derived from the calculational model DIFOUT. This aided in identifying the distribution of byproducts within a fireball as a result of an explosion. Once this data was formulated it was released at four different release heights each with different wind speeds. Therefore, the following provides detailed information on the assumptions and evaluation of the dispersion of the combustion products for a ground detonation of the previously mentioned motor systems.

<u>Note</u>: DIFOUT was originally created in 1969 from a earlier model called DIFFAL. DIFOUT was produced on a large mainframe computer system. Recently, it was converted to PC. However, much of the documentation needed to run the DIFOUT code is not available. Therefore, the following documentation will provide the DIFOUT theory and assumptions applied to ALOHA, thus, allowing reviewers the opportunity to duplicate this study with a minimal amount of time and resources.

In Section 6.0 we define the maximum potential consequences associated with these postulated scenarios. The following evaluation is intended to ensure that SNL and the KTF are conservative in efforts to provide emergency response to employees, the general public and the environment. This study will also provide confirmation that this information, as well as previously developed studies of the KTF, are conservative. If additional data is required concerning DIFOUT theory and assumptions applied to the following evaluation, detailed information may be found in R.E. Luna, H.W. Church, DIFOUT: <u>A Model for Computation of Aerosol Transport and Diffusion in the Atmosphere</u>, SNL Research Report, SC-RR-68-555, January 1969; and A.L. Dudley, S.A. Sonnleitner, SPECTRA Research Institute, <u>Dispersal of KTF Combustion Products</u>, Revision 5, May 1991.

Exhaust Byproduct Scenarios

The gas and particulate effluent quantities produced in the combustion process are substantial. If they were released from a single source point (such as a spill) instead of combustion products entrained partially in a buoyant plume that rises rapidly, the consequences of their release could be significant. This thermal process both dilutes the gases within the plume envelope and lifts them high above the ground. Once lofted, dilution in the atmosphere further reduces the potential toxic and corrosive consequences of the gases at the surface.

The products of the propellants combustion are either gaseous or aerosols. Uncertainties exist as to which of several potential materials are produced, because during the first few microseconds after ignition of a very small volume of propellant, certain products are more common than later on during the cycle. The volume of hazardous byproducts utilized in the following study were referenced in the July 1992 KTF Environmental Assessment. These hazardous byproducts, the maximum inventory involving any single event at the KTF, are characterized in Section 4.3 of this hazard assessment.

DIFOUT's Diffusive Dispersal

Atmospheric motion is generally turbulent and flows are irregular and random. When dealing with turbulent flows, the fluid flow equations (the diffusion equation, the momentum equation, the continuity equation, the thermodynamic equation, and the equation of state) are partial differential equations whose dependant variables are random functions. The random variables cannot be predicted precisely; consequently, the equations cannot be solved exactly. However, the statistical properties of the meteorological variables can be estimated using equations.

Diffusion of part of a fluid depends primarily on turbulent motion, which mixes the constituent with the fluid, and on the mean velocity differences in the fluid. These differences increase the separation of constituents and therefore the size of the effective eddies of the turbulent motion.

The mean-square displacement of marked fluid particles can be shown to be the second moment of the particle displacement probability distribution. If the probability distribution is Gaussian, the second moment of the particle displacement is sufficient to describe the concentration distribution. If the Fourier components of a particle velocity are independent random variables, the probability distribution is Gaussian.

No satisfactory theoretical determination exists for deciding when the components may be regarded as independent in order to justify the use of the Gaussian distribution of the particle probability function. However, experimental data indicate that the Gaussian model provides a first approximation to the concentration distribution, if the constituents are generally well-mixed throughout the flow (i.e., the various components of the mixture do not behave as distinct flows with a marked surface of interaction between constituents).

For well-mixed gases a Gaussian flow model should approximate the concentrations, assuming a reasonable representation of the source volume and release rate. For such flows, the theory employed in elevated-tilting plume Gaussian models for transport and diffusion is appropriate. A cloud from either a continuous or instantaneous elevated source descends at a characteristic terminal velocity and is simultaneously transported by the mean wind transport vector and spread out by the fluctuations normal to the mean wind direction. At locations where the constituents of interest reach the ground, air concentration and deposition rate are calculated.

DIFOUT's Source Cloud Envelope and Mass Distribution

The shapes of the propellant explosion cloud and the distribution of mass within this cloud must be approximated. The approximation becomes the source of both toxic gas and particulate to be used as initial conditions for the diffusion calculations. Traditional models establishing prospective detonation cloud envelopes and mass distributions have shown limited success.

When propellant explodes, the toxic gases and particulate are initially confined to the region of the buoyant fireball, since that is where they are either formed or released. The spatial extent of their mass distributions does not include the volume containing the ground dirt cloud. Consequently, the visible, near surface cloud has a volume larger than that containing the decomposition products. However, if a near point source is assumed, then a substantially more buoyant fireball may be predicted than may occur. Point sources can predict cloud heights at equilibrium which are excessively high and, consequently, can enclose unrealistically large volumes and can place too much mass (whether gaseous or particulate) at higher altitudes in the cloud. If the fireball volume is not adequately estimated, the ground exposures may be improperly reduced by the dilution of the initial distribution. If the quantity of combustible material is relatively small and the observer is distant compared with the size of the envelope calculated, the differences between a specific event's cloud and the modeled clouds are of little consequence even when possibly in error. However, for the propellant in STARS, the quantity of combustibles and the distant observer criteria are only marginally met.

The only comparable (although larger) scale, diffuse source, ammonium perchlorate detonation which could be promoted as an experimental analog to a STARS accident explosion is the Pacific Engineering and Production Company incident in Henderson, NV on May 4, 1988. Aluminum, binders, and additives were not present in the stockpiled perchlorate which burned and detonated. A total of approximately 8 million pounds was consumed in several explosions and a lengthy burn. Using inventory records, before and after aerial photographs, weather reports, blast damage reports, etc., the sizes of distinct detonations were estimated. Stop-frames of a videotape of the incident were used to scale the explosion to height for the STARS accident cloud. The distinctions between the detonation and the burn clouds for both envelope shape and rise height were studied for comparison with the theoretical model clouds. This incident, scaled to STARS equivalent TNT yield and adjusted for gravitational equilibrium altitude was compared with scaled empirical cloud top heights before the source was selected. It also was used as a comparative event for the calculation of conical inclination of the theoretical model envelope.

Dispersion Calculation Assumptions derived from DIFOUT applied to ALOHA

A cloud top height of 386.4 feet was derived for STARS accident. DIFOUT allows for the dispersion of material throughout a maximum of 31 layers. Previous studies performed for the KTF using DIFOUT allowed for 15 layers of material for an incident involving a STARS Rocket. Each layer is 25.8 feet thick. The layer, though uniform in shape, contains various quantities of material based on the deposition within the thermal envelope. The percentage of hazardous byproducts within each of the 15 layers, the bottom and top height of each layer as well as each layer width, was derived at in previous studies of the KTF utilizing DIFOUT and is provide in Table B-1 below.

In addition, five layers of differing wind speeds exist in the DIFOUT model. The wind speed corresponding to the various layers, their bottom and top heights, are provided in Table B-2. A computer generated picture of the initial plume geometry (before wind induced tilting) is shown in Illustration B-1. The following assumptions were made when applying this information to the ALOHA computer program.

1)The bottom two layers were combined. The slowest wind speed of 3.7 m/s (8.14 mph) was applied with a *ground level* release height. This allowed for a larger amount of material to be released while employing the most conservative input value (met. conditions).

2)The second layer (actually layer 3) employed a release height of 76.2 feet (~23 m). This release height was employed because most of the material within this layer was located in the upper 1/2 of the layer. The wind speed was 7.0 m/s (~23 ft.) just like that identified by DIFOUT as average for the area.

3)The third layer (actually layer 4) employed a release height of 232 feet (~70 m). This again is because most of the material within this layer is located within the top 1/2 of the layer. The wind speed was 9.4 m/s (~31 m) just like that identified by DIFOUT as average for the area.

4)The fourth layer (actually layer 5) employed a release height of 328 feet (~99 m). This is due to loss of thermal energy causing most of the material within this layer to be located in the lower 1/3 of the remaining envelop. A wind speed of 12.1 m/s (~26.6 mph) was employed at this release height as identified in DIFOUT.

All other values such as temperature are the same as those employed in the modeling of spills.

Note:The modeling completed in the July 1992 Environmental Assessment using DIFOUT employed TWA values to establish the STARS Ground Hazard Area.

Modeling Conservatism

The first conservatism is the assumption that no turbulence within the thermal fireball occurs.

The second conservatism is the assumption that there is no initial overpressures and resurgence of returning air volumes.

The third conservatism is the assumption that there is no vertical wind sheering within the five wind speed layers.

The fourth conservatism is the assumption that no change of direction of wind occurs between the five different layers of wind speed.

Note:The previous assumptions negate additional dilution and mixing that would potentially be present in such instances.

The final conservative assumption is utilizing the detonation of a STARS motor system to represent all incidents at both KTF launch sites. This allows planning for the largest credible consequences identified at the KTF. Therefore, all other incidents and their associated consequences should fall within the projected impact areas. This allows for a greater flexibility in the KTF operations without necessitating a revision to this HAD.

TABLE B-1

Note: DIFOUTs 15 layers estimating dispersion of material throughout the thermal envelope.

Layer Height Bottom	Layer Height Top	Layer Cloud Width	Layer Percentage of Byproduct
0 feet	25.8 feet	114 feet	0.03%
25.8 feet	51.5 feet	114 feet	0.88%
51.5 feet	77.3 feet	106 feet	1.52%
77.3 feet	103.0 feet	86 feet	2.49%
103 feet	128.8 feet	83 feet	3.91%
128.8 feet	154.6 feet	72 feet	5.96%
154.6 feet	180.3 feet	72 feet	7.48%
180.3 feet	206.1 feet	82 feet	9.75%
206.1 feet	231.9 feet	93 feet	13.79%
231.9 feet	257.6 feet	121 feet	16.28%
257.6 feet	283.4 feet	134 feet	14.09%
283.4 feet	309.1 feet	126 feet	20.19%
309.1 feet	334.9 feet	122 feet	3.17%
334.9 feet	360.7 feet	114 feet	0.45%
360.7 feet	386.4 feet	109 feet	0.01%

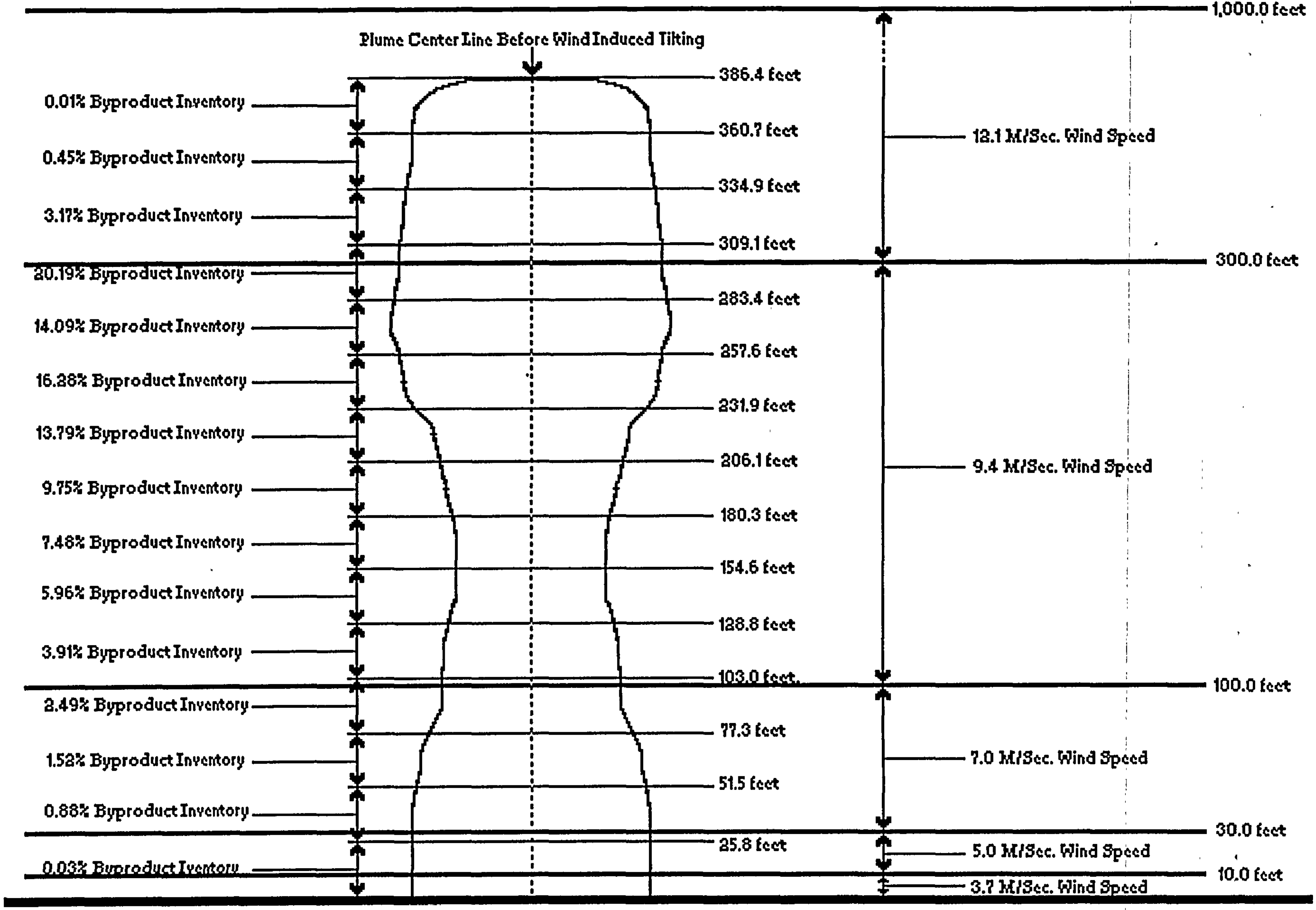
TABLE B-2

Note: DIFOUTs five layers allowing different wind speeds affecting the material within each layer.

Height	Wind Speed
0 - 10 feet	3.7 meters per second
10 - 30 feet	5.0 meters per second
30 - 100 feet	7.0 meters per second
100 - 300 feet	9.4 meters per second
300-999 feet	12.1 meters per second

Note: Wind speeds are horizontal with a vertical gradient in speed.

Illustration B-1



KTF "Main Compound" Byproduct Aluminum Oxide (Al_2O_3)

Release Designation B - 1

<u>Scenario</u>: Combustion of a STARS Rocket, comprised of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (the 3rd. Stg. motor). This results in 11,246 lb. of Aluminum Oxide divided by percentages into layers, as represented in Table B-1 on page B-80 and shown in Illustration B-1 on page B-81. This is jettisoned into the atmosphere under a Stability of F and wind speeds at corresponding elevations found in Table B-2 on page B-80.

Solid Propellant Exhaust Byproduct Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 35 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
ALUMINUM OXIDE IS A PARTICULATE. DUE TO MODELING CONSTRAINTS NO CONSEQUENCES ARE AVAILABLE. HOWEVER, IT IS ACCEPTED THAT THE CONSEQUENCES FOR A PARTICULATE WILL FALL WITHIN THOSE OF A GAS. THEREFORE, THE CONSEQUENCES IDENTIFIED IN RELEASE DESIGNATION B-3 (INVOLVING CARBON MONOXIDE GAS) AND RELEASE DESIGNATION B-6 (INVOLVING HYDROGEN CHLORIDE GAS) SHOULD EXCEED THOSE OF ANY PARTICULATE.							SITE AREA EMERGENCY

Kauai Test Facility

KTF "Main Compound" Byproduct Chlorine (Cl)

Release Designation B - 2

Scenario: Combustion of a STARS Rocket, comprised of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (the 3rd. Stg. motor). This results in 45 lb. of Chlorine divided by percentages into layers, as represented in Table B-1 on page 80 and shown in Illustration B-1 on page 81. This is jettisoned, as an aerosol, into the atmosphere, under a Stability of F with wind speeds at corresponding elevations found in Table B-2 on page 80.

Solid Propellant Exhaust Byproduct Consequences

Respective Consequences		Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
By Layer	Found On Page	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 3 ppm (meters)	ESHE 20 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
1	B-85	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
1	B-86			41				
1	B-87				16			
1	B-88	6.62				Arrives in 20 seconds Departs at 1.6 minutes		
1	B-89		0.07				Arrives in 2 minutes Departs at 5.2 minutes	
2	B-90	INPUT PARAMETERS AND TEXT SUMMARY						
2	B-91	"Not Exceeded"		N/A	N/A	N/A	N/A	
3	B-92	INPUT PARAMETERS AND TEXT SUMMARY						
3	B-93	"Not Exceeded"		N/A	N/A	N/A	N/A	
4	B-94	INPUT PARAMETERS AND TEXT SUMMARY						
4	B-95	"Not Exceeded"		N/A	N/A	N/A	N/A	

Kauai Test Facility

Text Summary

2844942460

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

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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: 3.7 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: .014 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 0.106 grams/sec
Total Amount Released: 6.35 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 41 meters
Max Threat Zone for IDLH: 13 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Footprint Window

2844942460

Chemical Name: CHLORINE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 41 meters
Max Threat Zone for IDLH: 13 meters
Note: Footprint was not drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 41 meters
Max Threat Zone for IDLH: 13 meters
Note: Footprint was not drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

Footprint Window 2849174132

```
Chemical Name: CHLORINE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true


FOOTPRINT INFORMATION:  (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 20 ppm
  Max Threat Zone for LOC:  16 meters
  Max Threat Zone for IDLH: 13 meters
  Note: Footprint was not drawn because
     effects of near-field patchiness make plume
     presentation unreliable for short distances.
```

Dispersion Module: Gaussian

User specified LOC: 20 ppm

Max Threat Zone for LOC: 16 meters

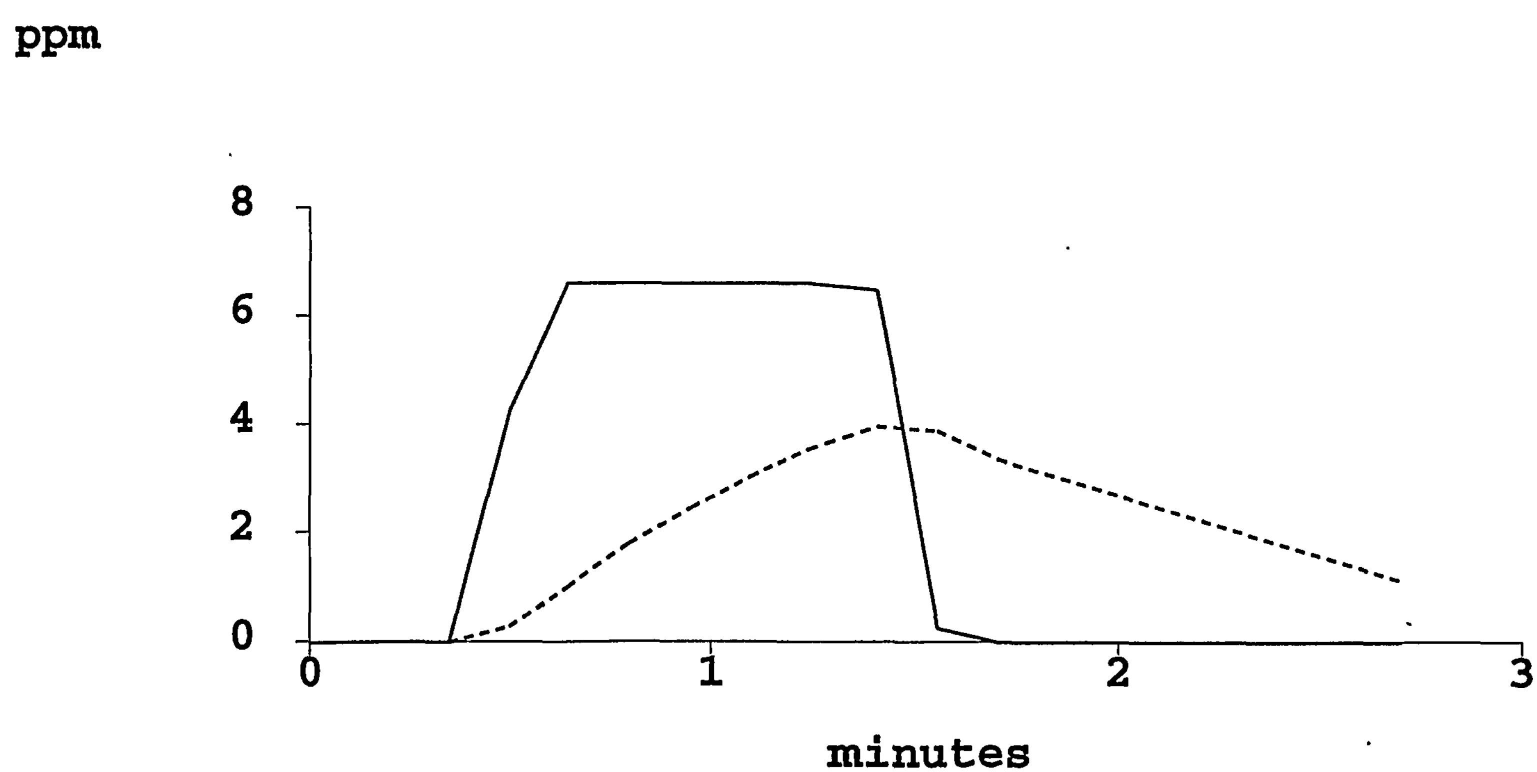
Max Threat Zone for IDLH: 13 meters

Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Concentration Window 2870433745

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

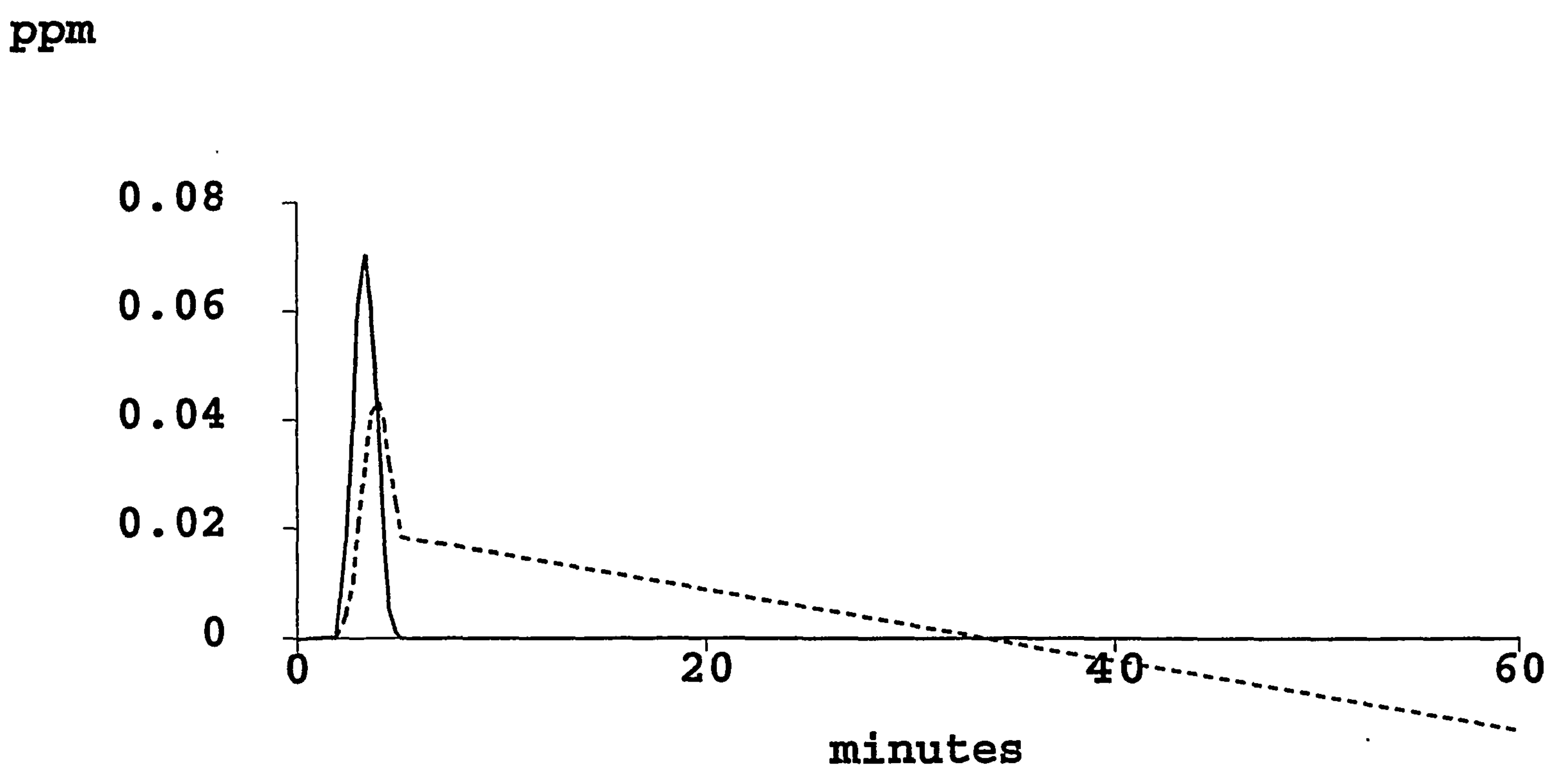
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 6.62 ppm
Indoor: 3.97 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2870433774

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.0704 ppm
Indoor: 0.0433 ppm
Note: Indoor graph is shown with a dotted line.



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

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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: 7 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 2.2 pounds Source Height: 76.2 feet
Release Duration: 1 minute
Release Rate: 16.6 grams/sec
Total Amount Released: 998 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window

2844942000 

Chemical Name: CHLORINE
Model Run: Gaussian
Wind: 7 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

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

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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: 9.4 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 41 pounds Source Height: 232 feet
Release Duration: 1 minute
Release Rate: 310 grams/sec
Total Amount Released: 18.6 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window

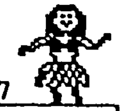
2844942158

Chemical Name: CHLORINE
Model Run: Gaussian
Wind: 9.4 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

Text Summary

2844942367 

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

CHEMICAL INFORMATION:
Chemical Name: CHLORINE   Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm   IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

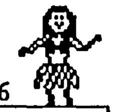
ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 12.1 meters/sec from 0° true
No Inversion Height
Stability Class: F   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 1.7 pounds   Source Height: 328 feet
Release Duration: 1 minute
Release Rate: 12.9 grams/sec
Total Amount Released: 771 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window

2844942366



Chemical Name: CHLORINE
Model Run: Gaussian
Wind: 12.1 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

KTF "Main Compound" Byproduct
Carbon Monoxide (CO)

Release Designation B - 3

<u>Scenario</u>: Combustion of a STARS Rocket, comprised of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (the 3rd. Stg. motor). This results in 8,358 lb. of Carbon Monoxide divided by percentages into layers, as represented in Table B-1 on page 80 and shown in Illustration B-1 on page 81. This is jettisoned, as an aerosol, into the atmosphere, under a Stability of F with wind speeds at corresponding elevations found in Table B-2 on page 80.

Solid Propellant Exhaust Byproduct Consequences

Respective Consequences		Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
By Layer	Found On Page	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 400 ppm (meters)	ESHE 1000 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
1	B-97	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
1	B-98			175				
1	B-99				114			
1	B-100	46,400				Arrives in 20 seconds Departs at 1.8 minutes		
1	B-101		262				Arrives in 3.2 minutes Departs at 9 minutes	
2	B-102	INPUT PARAMETERS AND TEXT SUMMARY						
2	B-103	"Not Exceeded"		N/A	N/A	N/A	N/A	
3	B-104	INPUT PARAMETERS AND TEXT SUMMARY						
3	B-105	"Not Exceeded"		N/A	N/A	N/A	N/A	
4	B-106	INPUT PARAMETERS AND TEXT SUMMARY						
4	B-107	"Not Exceeded"		N/A	N/A	N/A	N/A	

Kauai Test Facility

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

CHEMICAL INFORMATION:
Chemical Name: CARBON MONOXIDE
Molecular Weight: 28.01 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 1500.00 ppm
Footprint Level of Concern: 400 ppm
Boiling Point: -191.45° 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: 3.7 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 12.8 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 96.8 grams/sec
Total Amount Released: 5.81 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

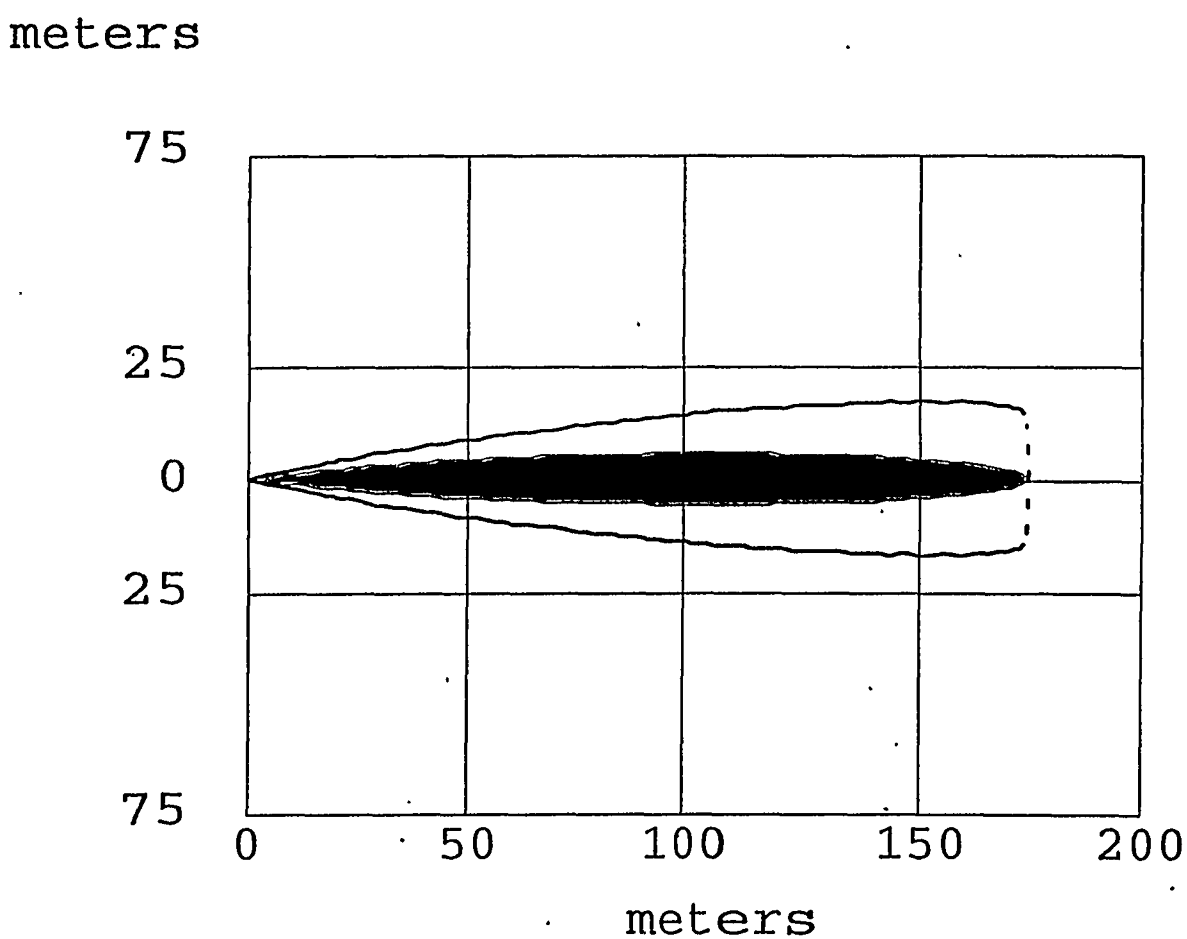
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: 175 meters
Max Threat Zone for IDLH: 89 meters

Footprint Window

2844942981

Chemical Name: CARBON MONOXIDE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true

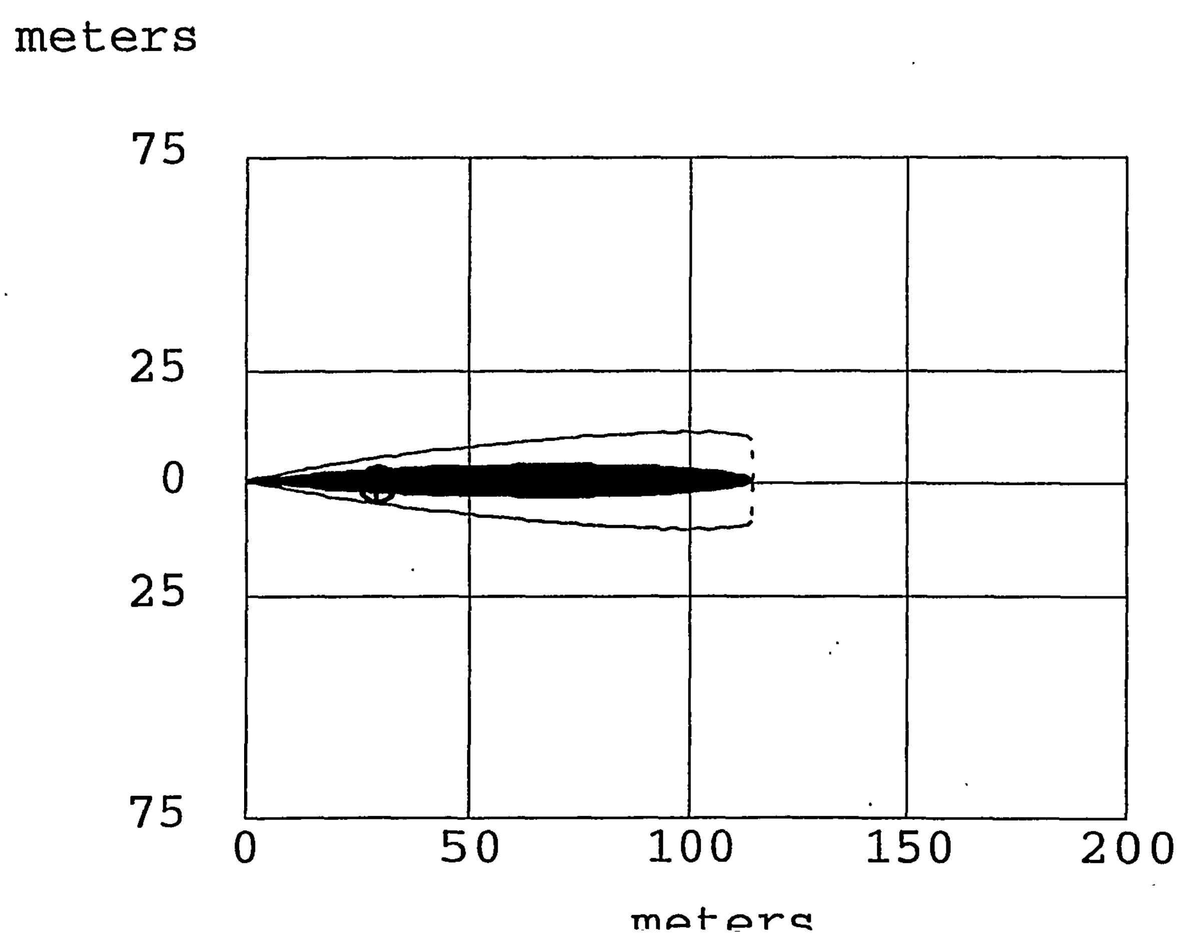
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: 175 meters
Max Threat Zone for IDLH: 89 meters



Footprint Window

Chemical Name: CARBON MONOXIDE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true

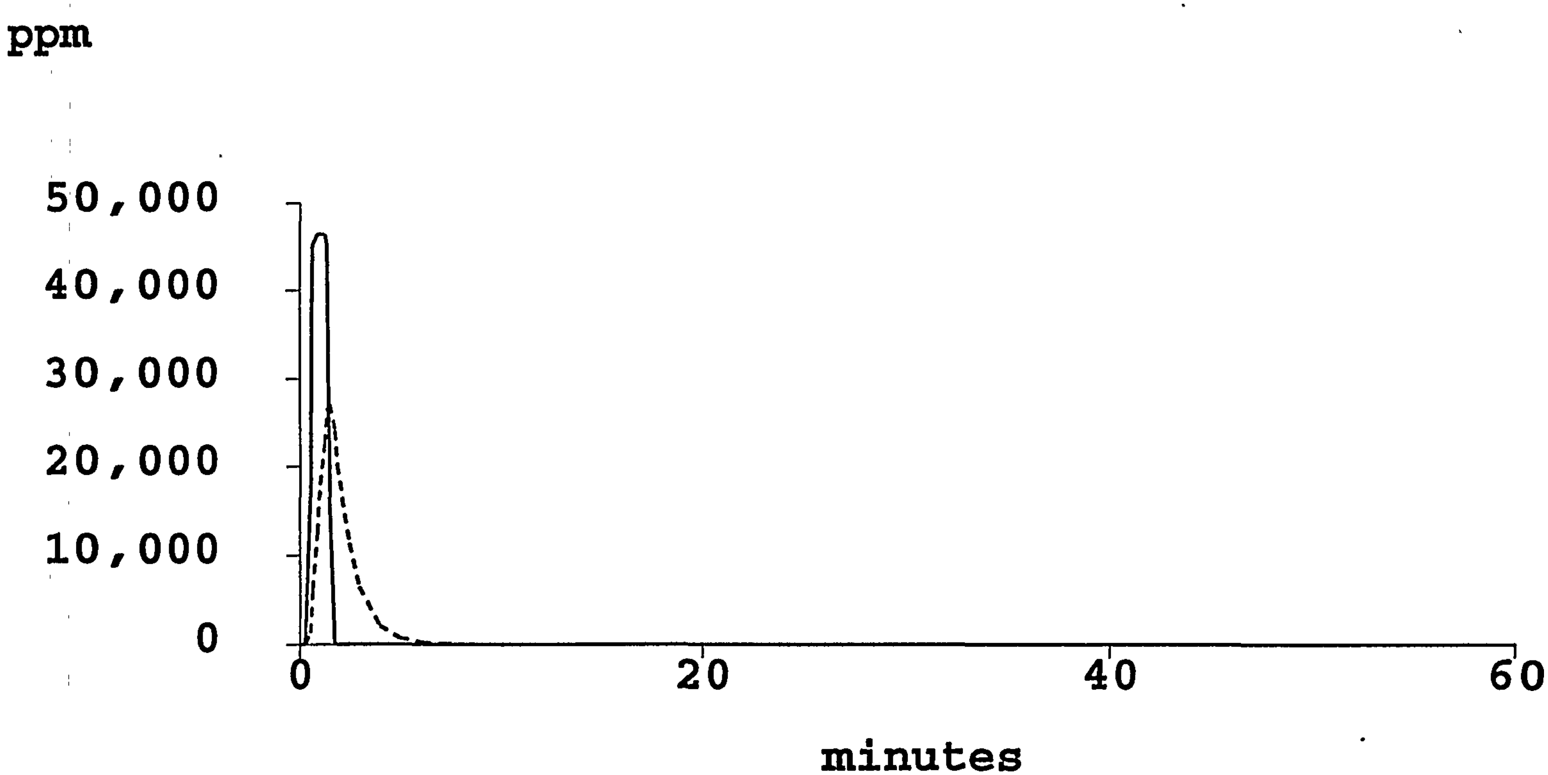
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 920 ppm
Max Threat Zone for LOC: 114 meters
Max Threat Zone for IDLH: 89 meters



Concentration Window 2870434007

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

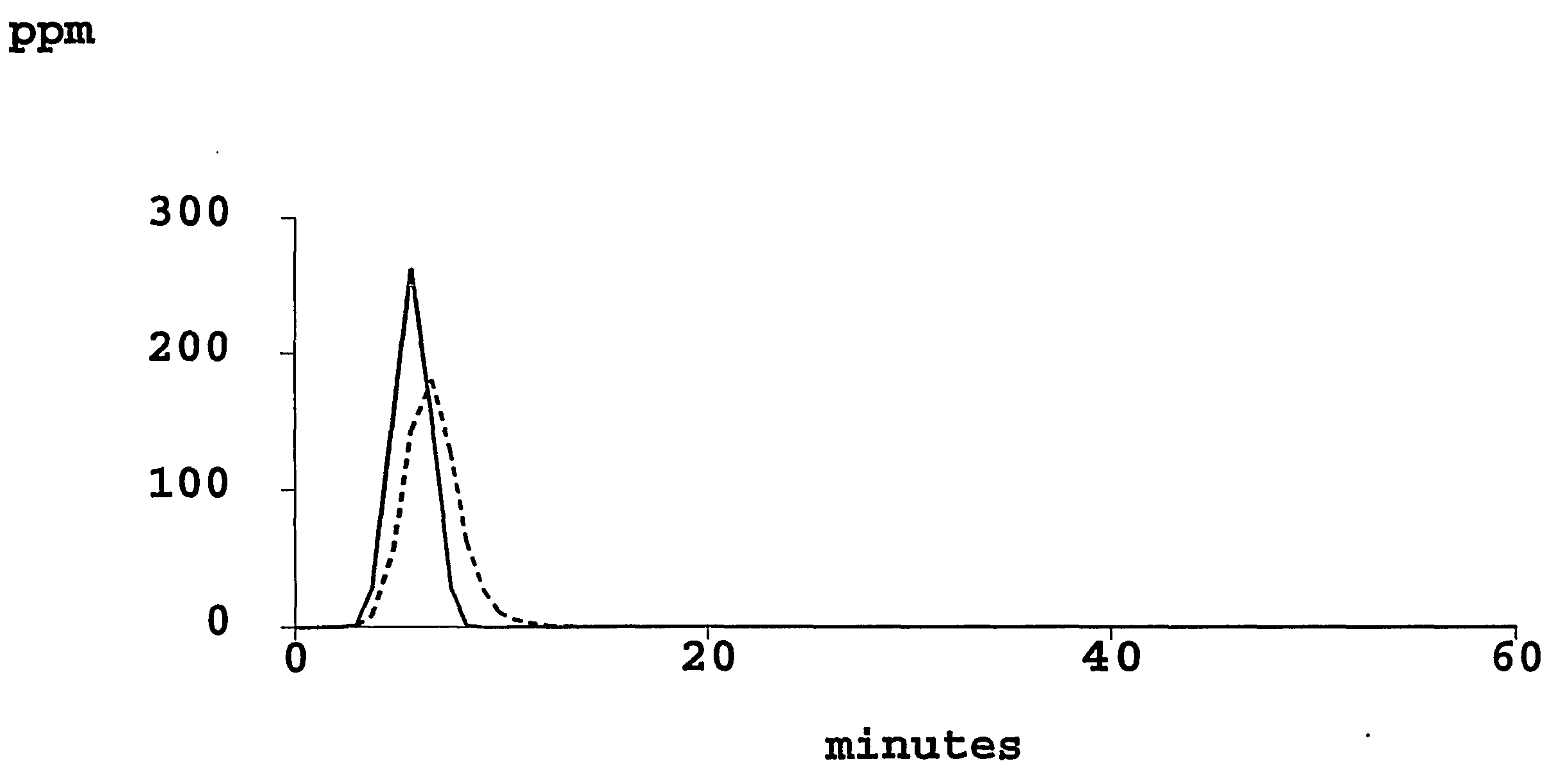
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 46,400 ppm
Indoor: 27,100 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2870433996

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 262 ppm
Indoor: 179 ppm
Note: Indoor graph is shown with a dotted line.



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

CHEMICAL INFORMATION:
Chemical Name: CARBON MONOXIDE
Molecular Weight: 28.01 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 1500.00 ppm
Footprint Level of Concern: 400 ppm
Boiling Point: -191.45° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

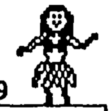
ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 7 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 375 pounds Source Height: 76.2 feet
Release Duration: 1 minute
Release Rate: 2.83 kilograms/sec
Total Amount Released: 170 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION: (GAUSS. SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 750 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 23.2 ppm
Indoor: 12.3 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2844943339 

Chemical Name: CARBON MONOXIDE
Model Run: Gaussian
Wind: 7 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

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

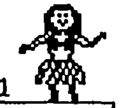
CHEMICAL INFORMATION:
Chemical Name: CARBON MONOXIDE
Molecular Weight: 28.01 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 1500.00 ppm
Footprint Level of Concern: 400 ppm
Boiling Point: -191.45° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 9.4 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 7073 pounds
Source Height: 232 feet
Release Duration: 1 minute
Release Rate: 53.5 kilograms/sec
Total Amount Released: 3,208 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 6.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 8.21 ppm
Indoor: 6.97 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2844943461 

Chemical Name: CARBON MONOXIDE
Model Run: Gaussian
Wind: 9.4 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

2844943605

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

CHEMICAL INFORMATION:
Chemical Name: CARBON MONOXIDE
Molecular Weight: 28.01 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 1500.00 ppm
Footprint Level of Concern: 400 ppm
Boiling Point: -191.45° 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: 12.1 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 865 pounds Source Height: 328 feet
Release Duration: 1 minute
Release Rate: 6.54 kilograms/sec
Total Amount Released: 392 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

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Footprint Window

2844943604

Chemical Name: CARBON MONOXIDE
Model Run: Gaussian
Wind: 12.1 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 400 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

KTF "Main Compound" Byproduct Hydrogen Sulfide (H_2S)

Release Designation B - 4

Scenario: Combustion of a STARS Rocket, comprised of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (the 3rd. Stg. motor). This results in 11.25 lb. of Hydrogen Sulfide divided by percentages into layers, as represented in Table B-1 on page 80 and shown in Illustration B-1 on page 81. This is jettisoned, as an aerosol, into the atmosphere, under a Stability of F with wind speeds at corresponding elevations found in Table B-2 on page 80.

Solid Propellant Exhaust Byproduct Consequences

Respective Consequences		Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
By Layer	Found On Page	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 30 ppm (meters)	ESHE 100 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
1	B-109	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
1	B-110			<10				
1	B-111				<10			
1	B-112	8.02				Arrives in 45 seconds Departs at 2.1 minutes		
1	B-113		0.05				Arrives in 4 minutes Departs at 9 minutes	
2	B-114	INPUT PARAMETERS AND TEXT SUMMARY						
2	B-115	"Not Exceeded"		N/A	N/A	N/A	N/A	
3	B-116	INPUT PARAMETERS AND TEXT SUMMARY						
3	B-117	"Not Exceeded"		N/A	N/A	N/A	N/A	
4	B-118	INPUT PARAMETERS AND TEXT SUMMARY						
4	B-119	"Not Exceeded"		N/A	N/A	N/A	N/A	

Kauai Test Facility

Text Summary

2844944503

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

CHEMICAL INFORMATION:
Chemical Name: HYDROGEN SULFIDE
Molecular Weight: 34.08 kg/kmol
TLV-TWA: 10.00 ppm   IDLH: 300.00 ppm
Footprint Level of Concern: 30 ppm
Boiling Point: -60.35° 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: 3.7 meters/sec from 0° true
No Inversion Height
Stability Class: F   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: .004 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 0.0302 grams/sec
Total Amount Released: 1.81 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 10 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Footprint Window

Chemical Name: HYDROGEN SULFIDE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 10 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: 10 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 y
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Footprint Window 2849175906

Chemical Name: HYDROGEN SULFIDE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true

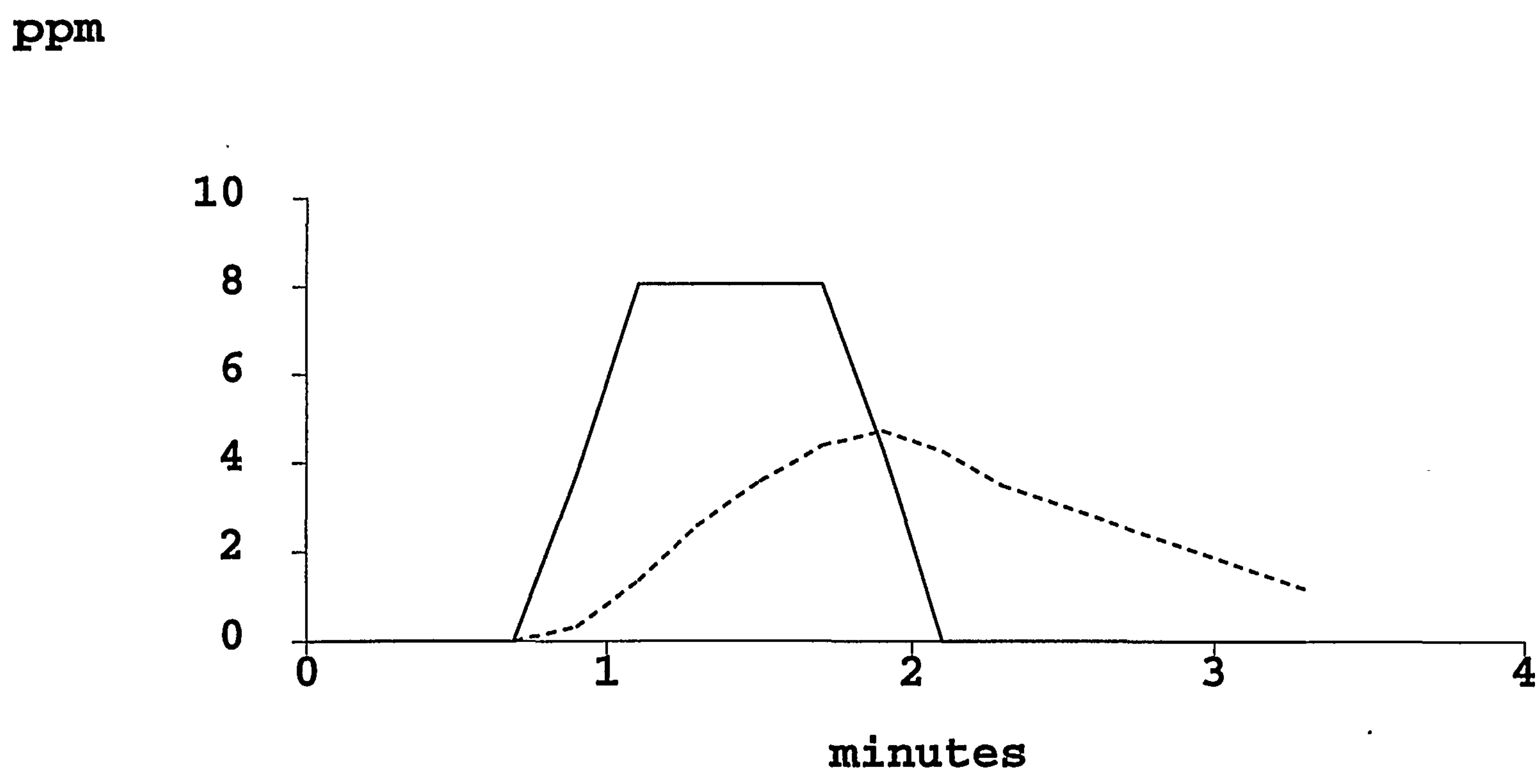
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 100 ppm
Max Threat Zone for LOC: less than 10 meters (10.9 yards)
Max Threat Zone for IDLH: less than 10 meters (10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 100 ppm
Max Threat Zone for LOC: less than 10 meters (10.9 y
Max Threat Zone for IDLH: less than 10 meters (10.9 y
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Concentration Window 2870434296

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

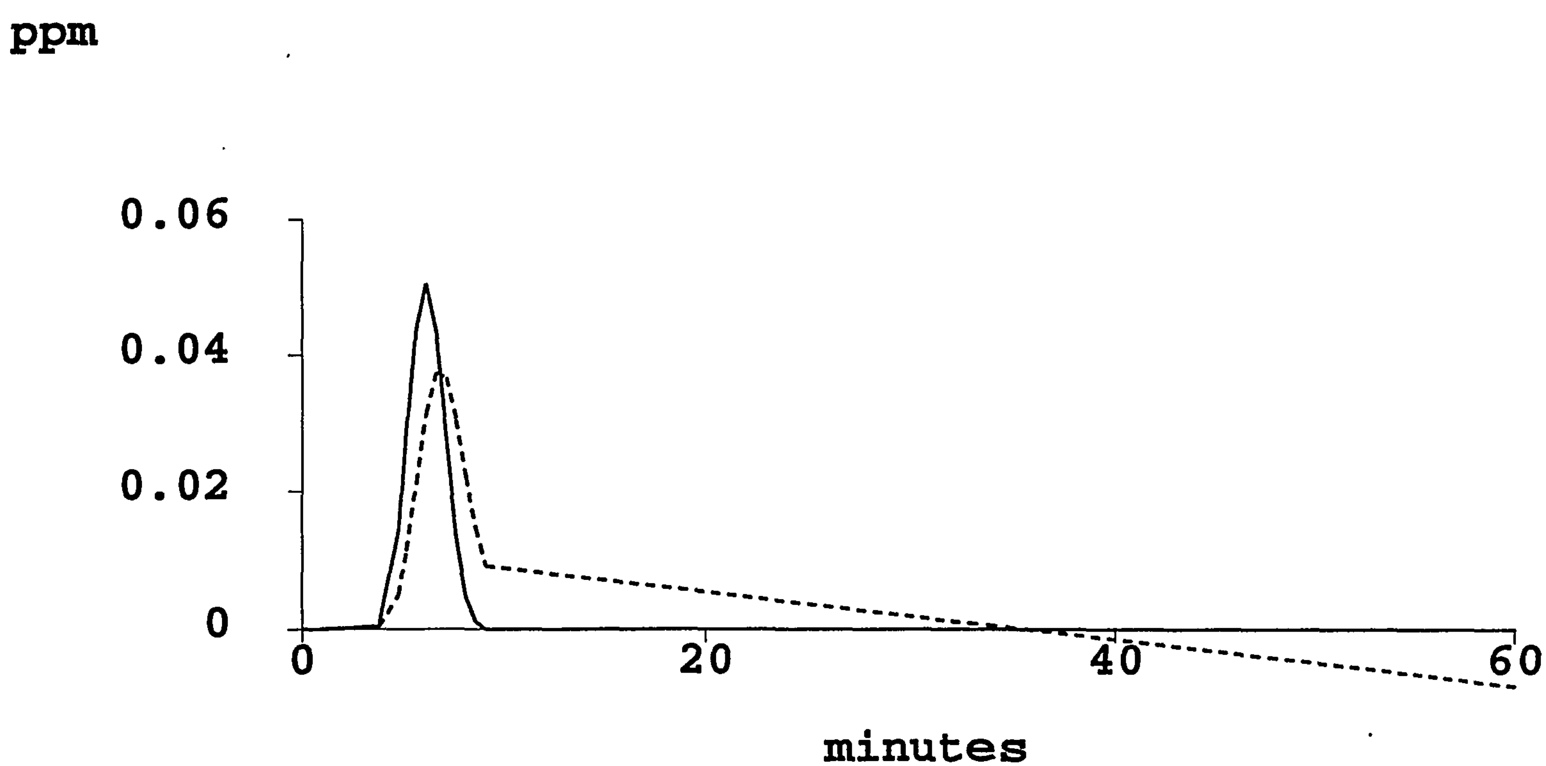
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 8.02 ppm
Indoor: 4.69 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2870434376

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 300 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.0504 ppm
Indoor: 0.0374 ppm
Note: Indoor graph is shown with a dotted line.



Text Summary

2844944621

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

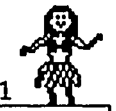
CHEMICAL INFORMATION:
Chemical Name: HYDROGEN SULFIDE
Molecular Weight: 34.08 kg/kmol
TLV-TWA: 10.00 ppm IDLH: 300.00 ppm
Footprint Level of Concern: 30 ppm
Boiling Point: -60.35° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 7 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: .6 pounds Source Height: 76.2 feet
Release Duration: 1 minute
Release Rate: 4.54 grams/sec
Total Amount Released: 272 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window

2844944621 

Chemical Name: HYDROGEN SULFIDE
Model Run: Gaussian
Wind: 7 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

Text Summary

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

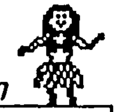
CHEMICAL INFORMATION:
Chemical Name: HYDROGEN SULFIDE
Molecular Weight: 34.08 kg/kmol
TLV-TWA: 10.00 ppm   IDLH: 300.00 ppm
Footprint Level of Concern: 30 ppm
Boiling Point: -60.35° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 9.4 meters/sec from 0° true
No Inversion Height
Stability Class: F   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 10.3 pounds
Source Height: 232 feet
Release Duration: 1 minute
Release Rate: 77.9 grams/sec
Total Amount Released: 4.67 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window

2844944687 

Chemical Name: HYDROGEN SULFIDE
Model Run: Gaussian
Wind: 9.4 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

R.116

Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

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

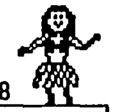
CHEMICAL INFORMATION:
Chemical Name: HYDROGEN SULFIDE
Molecular Weight: 34.08 kg/kmol
TLV-TWA: 10.00 ppm   IDLH: 300.00 ppm
Footprint Level of Concern: 30 ppm
Boiling Point: -60.35° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 12.1 meters/sec from 0° true
No Inversion Height
Stability Class: F   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: .4 pounds   Source Height: 328 feet
Release Duration: 1 minute
Release Rate: 3.02 grams/sec
Total Amount Released: 181 grams
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window



2844944758

Chemical Name: HYDROGEN SULFIDE
Model Run: Gaussian
Wind: 12.1 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 30 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never excee
Note: Footprint was not drawn because
the ground level concentrations never exceed the

KTF "Main Compound" Byproduct

Hydrogen Chloride (HCl)

Release Designation B - 5

Scenario: Combustion of a STARS Rocket, comprised of a Polaris A3 1st. Stg. motor, a Polaris A3 2nd. Stg. motor, and an Orbus 1 (the 3rd. Stg. motor). This results in 3,771 lb. of Hydrogen Chloride divided by percentages into layers, as represented in Table B-1 on page 80 and shown in Illustration B-1 on page 81. This is jettisoned, as an aerosol, into the atmosphere, under a Stability of F with wind speeds at corresponding elevations found in Table B-2 on page 80.

Solid Propellant Exhaust Byproduct Consequences

Respective Consequences		Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
By Layer	Found On Page	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 20 ppm (meters)	ESHE 100 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
1	B-121	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
1	B-122			205				
1	B-123				90			
1	B-124	612				Arrives in 5 seconds Departs at 1.3 minutes		
1	B-125		10.3				Arrives in 1.3 minutes Departs at 3.5 minutes	
2	B-126	INPUT PARAMETERS AND TEXT SUMMARY						
2	B-127	"Not Exceeded"		N/A	N/A	N/A	N/A	
3	B-128	INPUT PARAMETERS AND TEXT SUMMARY						
3	B-129	"Not Exceeded"		N/A	N/A	N/A	N/A	
4	B-130	INPUT PARAMETERS AND TEXT SUMMARY						
4	B-131	"Not Exceeded"		N/A	N/A	N/A	N/A	

Kauai Test Facility

Text Summary 2844945573

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

CHEMICAL INFORMATION:
Chemical Name: HYDROGEN CHLORIDE
Molecular Weight: 36.46 kg/kmol
TLV-TWA: 5.00 ppm IDLH: 100.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -85.00° 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: 3.7 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 1.13 pounds
Source Height: 0
Release Duration: 1 minute
Release Rate: 8.54 grams/sec
Total Amount Released: 513 grams
Note: This chemical may flash boil and/or result in two phase flow.

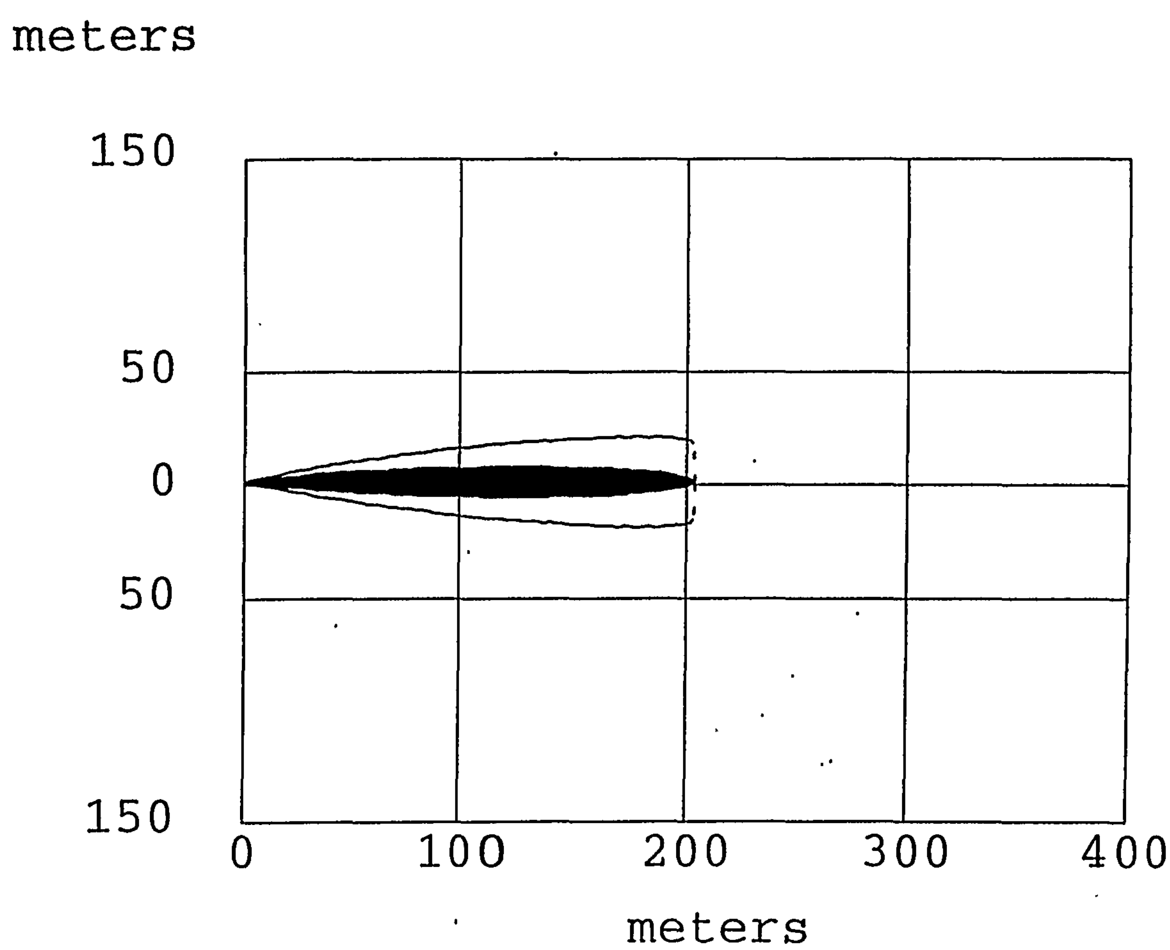
FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: 205 meters
Max Threat Zone for IDLH: 90 meters

Footprint Window

2844945567

Chemical Name: HYDROGEN CHLORIDE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 20 ppm
  Max Threat Zone for LOC: 205 meters
  Max Threat Zone for IDLH: 90 meters



Footprint Window 2849177615

```
Chemical Name: HYDROGEN CHLORIDE
Model Run: Gaussian
Wind: 3.7 meters/sec from 0° true


FOOTPRINT INFORMATION:  (GAUSS SELECTED)
  Dispersion Module: Gaussian
  User specified LOC: 100 ppm
  Max Threat Zone for LOC:  90 meters
  Max Threat Zone for IDLH: 90 meters
  Note: Footprint was not drawn because
     effects of near-field patchiness make plume
     presentation unreliable for short distances.
```


Dispersion Module: Gaussian

User specified LOC: 100 ppm

Max Threat Zone for LOC: 90 meters

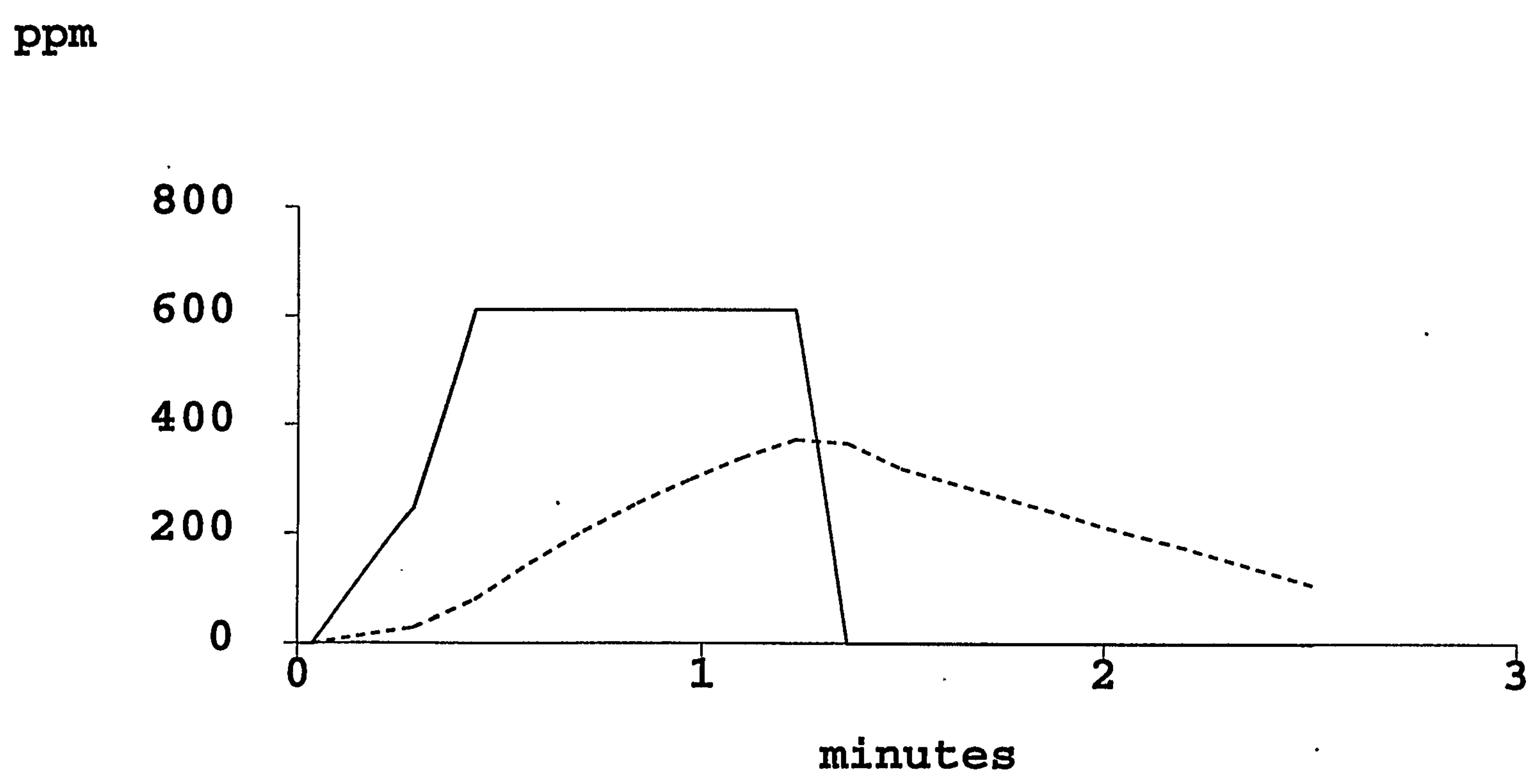
Max Threat Zone for IDLH: 90 meters

Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Concentration Window 2870434619

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 30 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 612 ppm
Indoor: 373 ppm
Note: Indoor graph is shown with a dotted line.

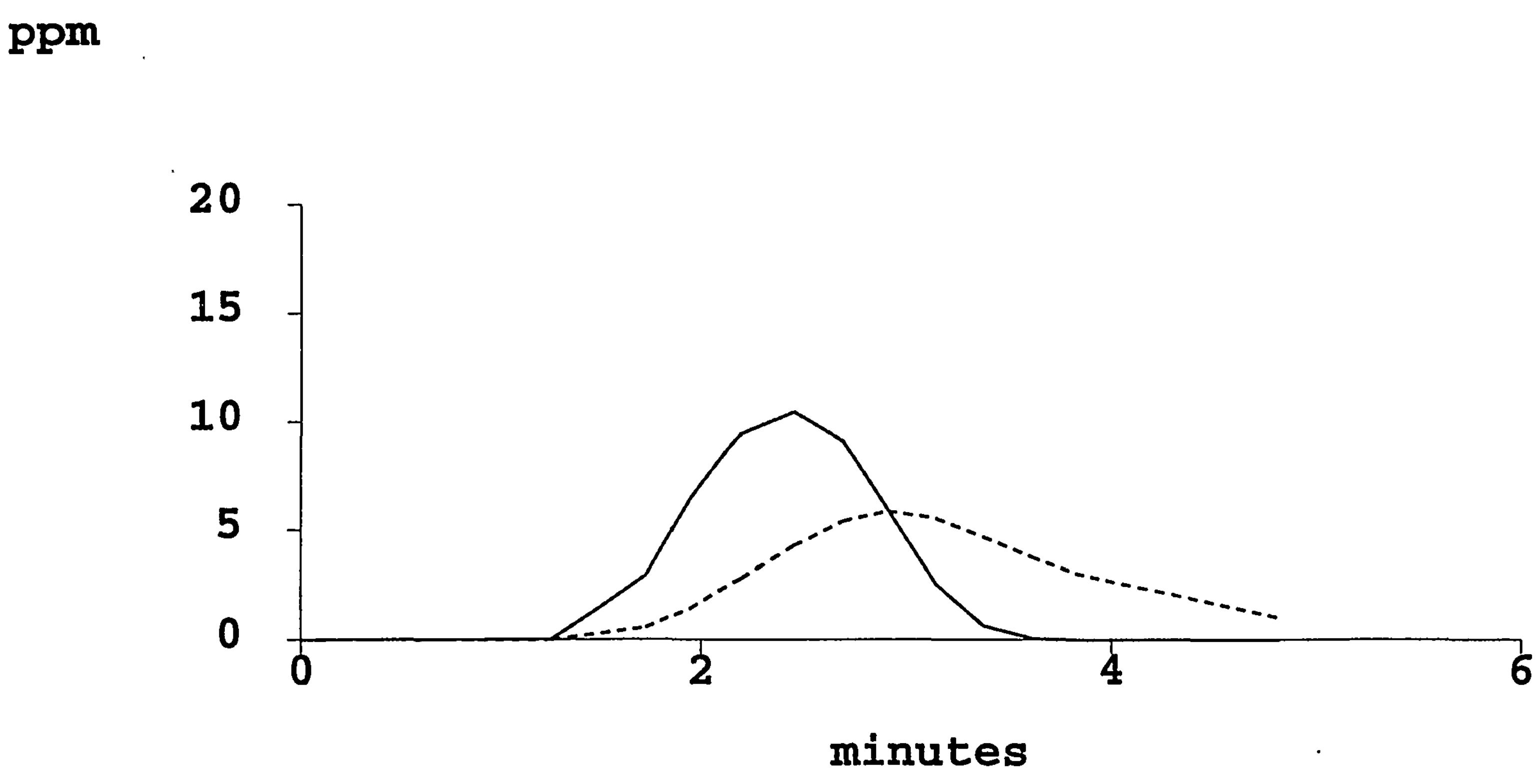


Concentration Window

2870434608

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

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 300 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 10.3 ppm
     Indoor: 5.81 ppm
  Note: Indoor graph is shown with a dotted line.



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

CHEMICAL INFORMATION:
Chemical Name: HYDROGEN CHLORIDE
Molecular Weight: 36.46 kg/kmol
TLV-TWA: 5.00 ppm   IDLH: 100.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -85.00° 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: 7 meters/sec from 0° true
No Inversion Height
Stability Class: F   Air Temperature: 85° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 184.8 pounds
Source Height: 76.2 feet
Release Duration: 1 minute
Release Rate: 1.4 kilograms/sec
Total Amount Released: 83.8 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window

2844945643 

Chemical Name: HYDROGEN CHLORIDE
Model Run: Gaussian
Wind: 7 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exce
Note: Footprint was not drawn because
the ground level concentrations never exceed th

Text Summary

2844945812

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

CHEMICAL INFORMATION:
Chemical Name: HYDROGEN CHLORIDE
Molecular Weight: 36.46 kg/kmol
TLV-TWA: 5.00 ppm IDLH: 100.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -85.00° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

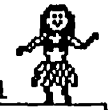
ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 9.4 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 3448.6 pounds
Source Height: 232 feet
Release Duration: 1 minute
Release Rate: 26.1 kilograms/sec
Total Amount Released: 1,564 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 6.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.07 ppm
Indoor: 2.61 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2844945811 

Chemical Name: HYDROGEN CHLORIDE
Model Run: Gaussian
Wind: 9.4 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exce
Note: Footprint was not drawn because
the ground level concentrations never exceed th

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

CHEMICAL INFORMATION:
Chemical Name: HYDROGEN CHLORIDE
Molecular Weight: 36.46 kg/kmol
TLV-TWA: 5.00 ppm IDLH: 100.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -85.00° 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: 12.1 meters/sec from 0° true
No Inversion Height
Stability Class: F Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 136.9 pounds
Source Height: 328 feet
Release Duration: 1 minute
Release Rate: 1.03 kilograms/sec
Total Amount Released: 62.1 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Footprint Window

Chemical Name: HYDROGEN CHLORIDE
Model Run: Gaussian
Wind: 12.1 meters/sec from 0° true

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exceeded
Note: Footprint was not drawn because
the ground level concentrations never exceed the LOC.

Dispersion Module: Gaussian
User specified LOC: 20 ppm
Max Threat Zone for LOC: LOC is not exceeded
Max Threat Zone for IDLH: IDLH level is never exce
Note: Footprint was not drawn because
the ground level concentrations never exceed th

KTF "Main Compound" Byproduct Lead (Pb)

Release Designation B - 6

Scenario: Combustion of a Talos motor system. This results in 48 lb. of Lead being jettisoned into the atmosphere. A Talos motor system is smaller in solid propellant inventory than a STARS Rocket. Therefore, by utilizing the consequences associated with a gas byproduct from a STARS Rocket the expected area impacted is conservatively summarized below.

Solid Propellant Exhaust Byproduct Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 0.068 ppm (meters)	ESHE 0.155 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
LEAD IS A PARTICULATE. DUE TO MODELING CONSTRAINTS NO CONSEQUENCES ARE AVAILABLE. HOWEVER, IT IS ACCEPTED THAT THE CONSEQUENCES FOR A PARTICULATE WILL FALL WITHIN THOSE OF A GAS. THEREFORE, THE CONSEQUENCES IDENTIFIED IN RELEASE DESIGNATION B-3 (INVOLVING CARBON MONOXIDE GAS) AND RELEASE DESIGNATION B-6 (INVOLVING HYDROGEN CHLORIDE GAS) SHOULD EXCEED THOSE OF ANY PARTICULATE.							SITE AREA EMERGENCY

Note: **The majority of lead particulate will be larger than 10 microns.**

Kauai Test Facility

KTF Kokole Point Byproduct Aluminum Oxide (Al_2O_3)

Release Designation K - 1

Scenario: Combustion of a Terrier motor. This results in 87.11lb. of Aluminum Oxide being jettisoned into the atmosphere. A Terrier motor system is 25 times smaller in solid propellant inventory than a STARS Rocket. Therefore, by utilizing the consequences associated with a gas byproduct from a STARS Rocket the expected area impacted is conservatively summarized below.

Solid Propellant Exhaust Byproduct Consequences

Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 15 ppm (meters)	ESHE 35 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
ALUMINUM OXIDE IS A PARTICULATE. DUE TO MODELING CONSTRAINTS NO CONSEQUENCES ARE AVAILABLE. HOWEVER, IT IS ACCEPTED THAT THE CONSEQUENCES FOR A PARTICULATE WILL FALL WITHIN THOSE OF A GAS. THEREFORE, THE CONSEQUENCES IDENTIFIED IN RELEASE DESIGNATION B-3 (INVOLVING CARBON MONOXIDE GAS) AND RELEASE DESIGNATION B-6 (INVOLVING HYDROGEN CHLORIDE GAS) SHOULD EXCEED THOSE OF ANY PARTICULATE.							SITE AREA EMERGENCY

Note: **The majority of Aluminum Oxide particulate will be larger than 10 microns.**

Kauai Test Facility

KTF Kokole Point Byproduct Carbon Monoxide (CO)

Release Designation K - 2

Scenario: Combustion of a Terrier motor system results in 484.34 lb. of Carbon Monoxide being jettisoned, as an aerosol, into the atmosphere. A Terrier motor system is 25 times smaller in solid propellant inventory than a STARS Rocket. Therefore, utilizing the consequences associated with a gas byproduct from a STARS Rocket the expected area impacted is conservatively summarized below.

Note: The consequences are those calculated and previously identified in Release Designation B-3.

Solid Propellant Exhaust Byproduct Consequences

Respective Consequences		Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
By Layer	Found On Page	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 400 ppm (meters)	ESHE 1000 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
1	B-97	INPUT PARAMETERS AND TEXT SUMMARY						SITE AREA EMERGENCY
1	B-98			175				
1	B-99				114			
1	B-100	46,400				Arrives in 20 seconds Departs at 1.8 minutes		
1	B-101		262				Arrives in 3.2 minutes Departs at 9 minutes	
2	B-102	INPUT PARAMETERS AND TEXT SUMMARY						
2	B-103	"Not Exceeded"		N/A	N/A	N/A	N/A	
3	B-104	INPUT PARAMETERS AND TEXT SUMMARY						
3	B-105	"Not Exceeded"		N/A	N/A	N/A	N/A	
4	B-106	INPUT PARAMETERS AND TEXT SUMMARY						
4	B-107	"Not Exceeded"		N/A	N/A	N/A	N/A	

Kauai Test Facility

KTF Kokole Point Byproduct
Lead (Pb)

Release Designation K - 3

Scenario: Combustion of a Terrier motor system. This results in 20.25 lb. of Lead being jettisoned into the atmosphere. A Terrier motor system is 25 times smaller in solid propellant inventory than a STARS Rocket. Therefore, by utilizing the consequences associated with a gas byproduct from a STARS Rocket the expected area impacted is conservatively summarized below.

Solid Propellant Exhaust Byproduct Consequences

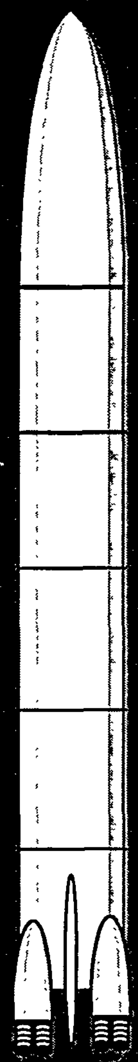
Page Each Respective Consequence Can Be Found	Concentrations at		Distance to		Time Till Plume		Emergency Classification of Event
	Facility Boundary (30 meters)	Site Boundary (300 meters)	ERPG-2 0.068 ppm (meters)	ESHE 0.155 ppm (meters)	Arrive/Depart KTF/Facility Boundary	Arrive/Depart PMRF/Site Boundary	
LEAD IS A PARTICULATE. DUE TO MODELING CONSTRAINTS NO CONSEQUENCES ARE AVAILABLE. HOWEVER, IT IS ACCEPTED THAT THE CONSEQUENCES FOR A PARTICULATE WILL FALL WITHIN THOSE OF A GAS. THEREFORE, THE CONSEQUENCES IDENTIFIED IN RELEASE DESIGNATION B-3 (INVOLVING CARBON MONOXIDE GAS) AND RELEASE DESIGNATION B-6 (INVOLVING HYDROGEN CHLORIDE GAS) SHOULD EXCEED THOSE OF ANY PARTICULATE.							SITE AREA EMERGENCY

Note: **The majority of lead particulate will be larger than 10 microns.**

Kauai Test Facility

Appendix C

K A U A I T E S T F A C I L I T Y



May, 1995

Plume Dispersion Modeling Of Non-KTF Hazards

Offsite Hazards

Hazards that are not Owned or Controlled by SNL/KTF

In Section 3.0 of this Hazard Assessment possible impacts, to KTF personnel and property, by an incident at the PMRF or from agricultural activities were examined. "Offsite" materials identified as potentially hazardous through the hazard assessment screening process are provided in the following pages. The computer model ALOHA was utilized for the calculation of plume dispersion. The meteorological conditions employed in these calculations were consistent with those employed in Appendix B of this Hazard Assessment Document. Release scenarios and tables provide a synopsis of information derived from ensuing ALOHA computer printouts within each section of Appendix C.

Note: Sodium Hydroxide was not modeled under "average" meteorological conditions because consequences under "worst case" meteorological conditions were diminutive. Modeling confirmed that KTF personnel and/or visitors were not at risk from a release of Sodium Hydroxide under average meteorological conditions while at the KTF. Therefore, to eliminate unnecessary pages of documentation these calculations were excluded from this document.

Hazards not Owned or Controlled by SNL/KTF

Chlorine (Cl)

PMRF Buildings 338, 394, 415, and 821

Scenario: The release of 150 pounds (68 kg.) of Chlorine from a cylinder via cylinder rupture, valve damage, or a malevolent act. This results in 150 lb. of Chlorine being released into the atmosphere, under a Stability Factor of F with a wind speed of 1 meter per second (2.2 mph).

150 Pound Chlorine Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 3 ppm (meters)	ESHE 20 ppm (meters)	Arrive/Depart KTF/Facility Boundary
338	C-3, C-4, C-5, C-6, C-7, C-8, and C-9	1.64 ppm > ERPG-1	10,000 ft. (3.0 km.) "Main Complex"	6,600 ft. (2.0 km.)	1,950 ft. (587 m)	Arrives in 50 minutes Departs at 1 hour
394	C-3, C-4, C-5, C-6, C-7, C-8, and C-10	2.45 ppm > ERPG-1	8,000 ft. (2.4 km.) "Main Complex"	6,600 ft. (2.0 km.)	1,950 ft. (587 m)	Arrives in 40 minutes Departs at 50 minutes
415	C-3, C-4, C-5, C-6, C-7, C-81, and C-11	4.96 ppm > ERPG-2	5,000 ft. (1.5 km.) "Main Complex"	6,600 ft. (2.0 km.)	1,950 ft. (587 m)	Arrives in 25 minutes Departs at 35 minutes
821	C-3, C-4, C-5, C-6, C-7, C-8, and C-12	23.3 ppm > ERPG-3	1,800 ft. (546 m) Kokole Point	6,600 ft. (2.0 km.)	1,950 ft. (587 m)	Arrives in 9 minutes Departs at 19 minutes

"Worst Case" Meteorological Conditions

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE   Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm   IDLH: 30.00 ppm
Footprint Level of Concern: 1 ppm
Boiling Point: -34.03° 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 feet
Stability Class: F   Air Temperature: 68° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

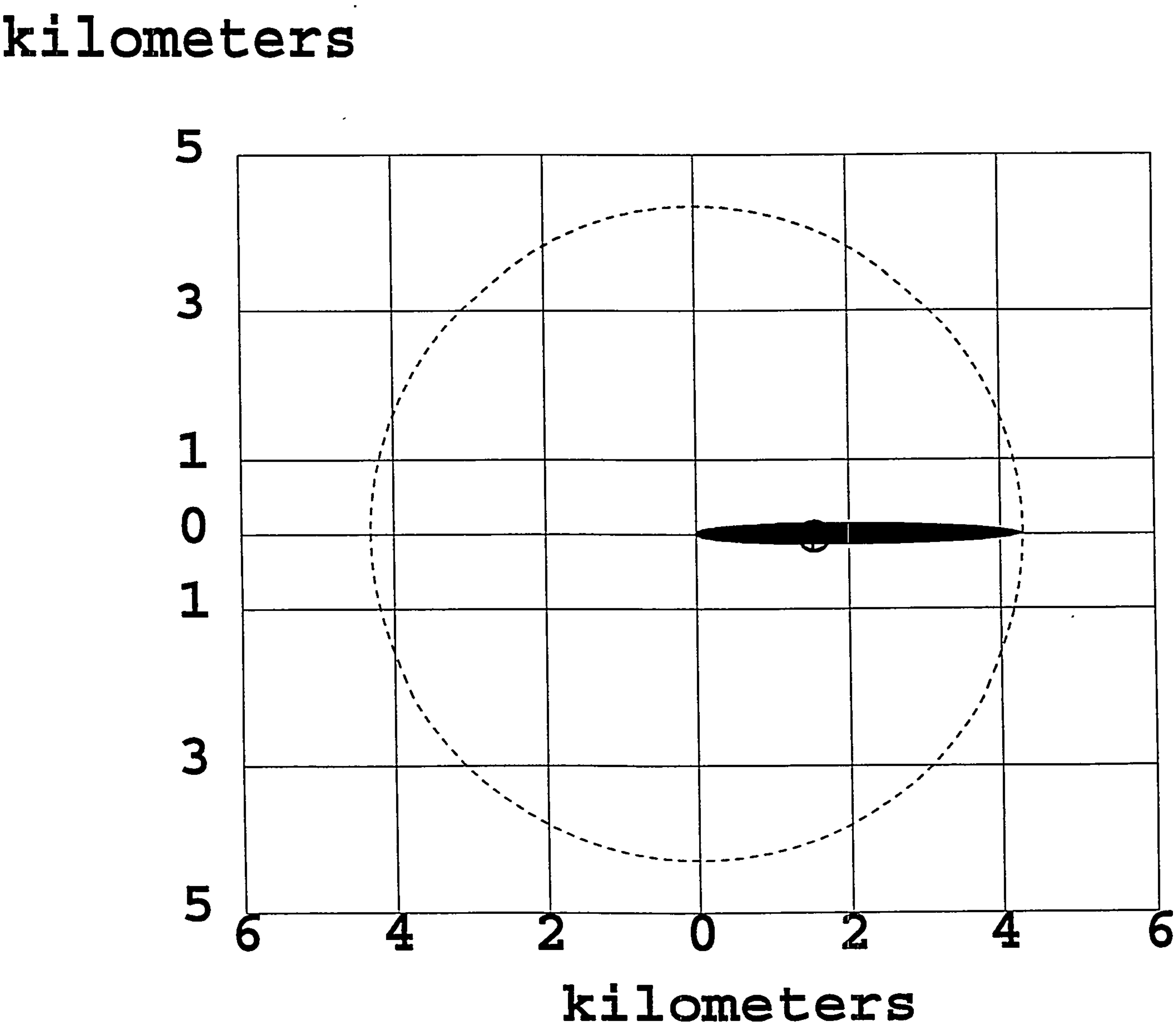
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 4.3 kilometers
Max Threat Zone for IDLH: 449 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 4.96 ppm
Indoor: 4.96 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883117075

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 1 ppm
  Max Threat Zone for LOC: 4.3 kilometers
  Max Threat Zone for IDLH: 449 meters
  Note: The Heavy Gas footprint is an initial screening.
    For short releases it may be an overestimation.
    Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

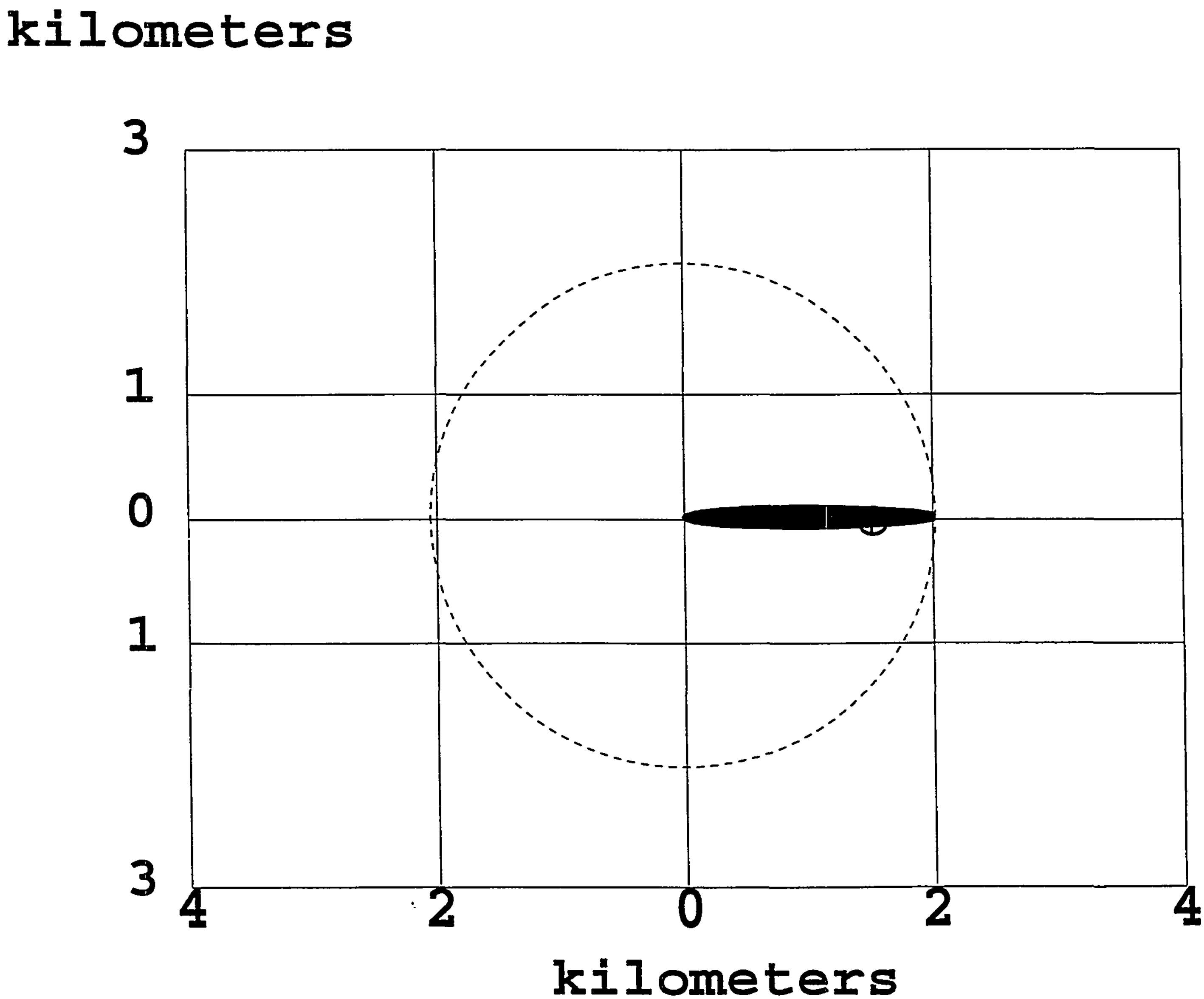
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 2.0 kilometers
Max Threat Zone for IDLH: 449 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 4.96 ppm
Indoor: 4.96 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883117141

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 2.0 kilometers
Max Threat Zone for IDLH: 449 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -34.03° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

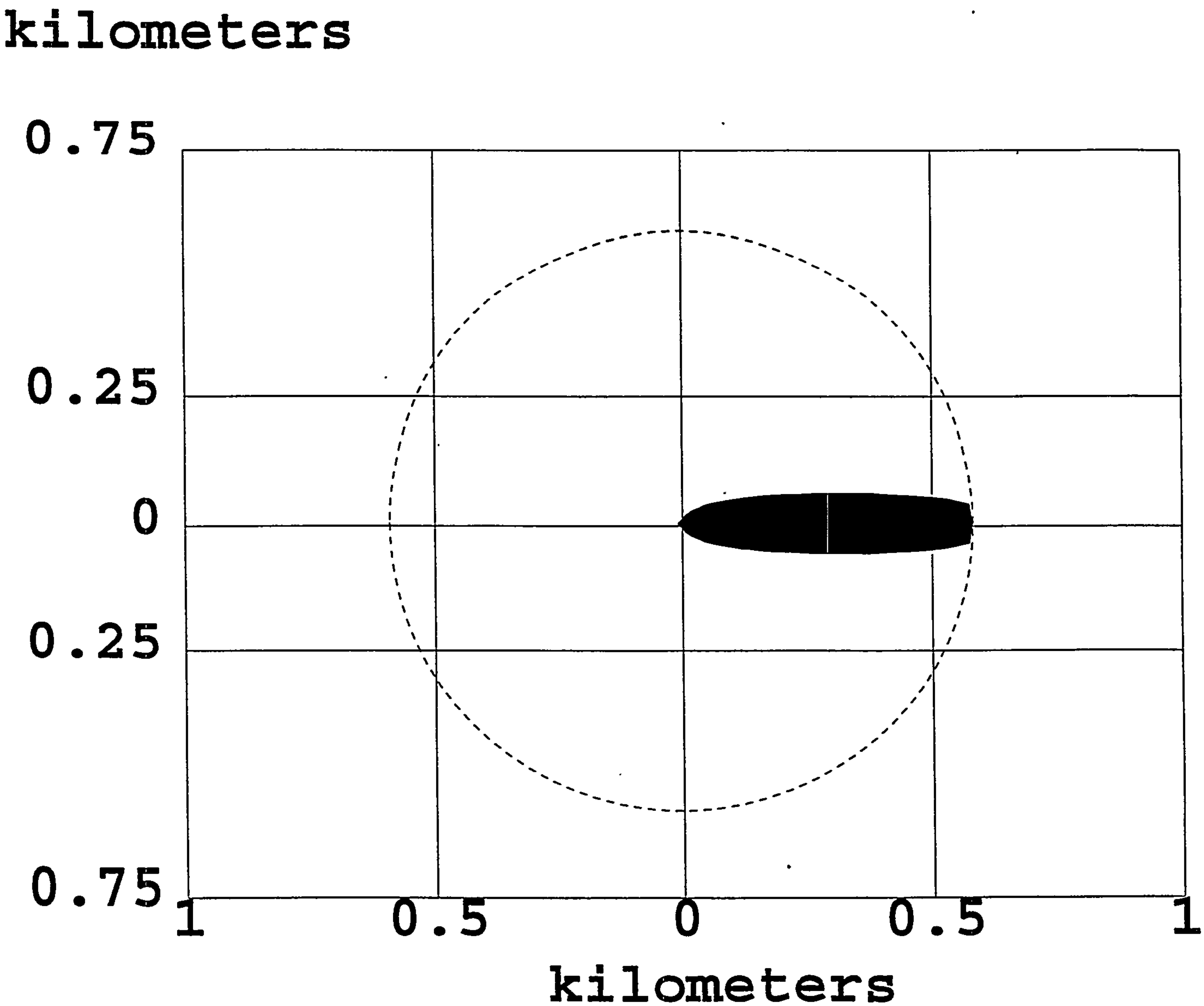
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 587 meters
Max Threat Zone for IDLH: 449 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 4.96 ppm
Indoor: 4.96 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883117157

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

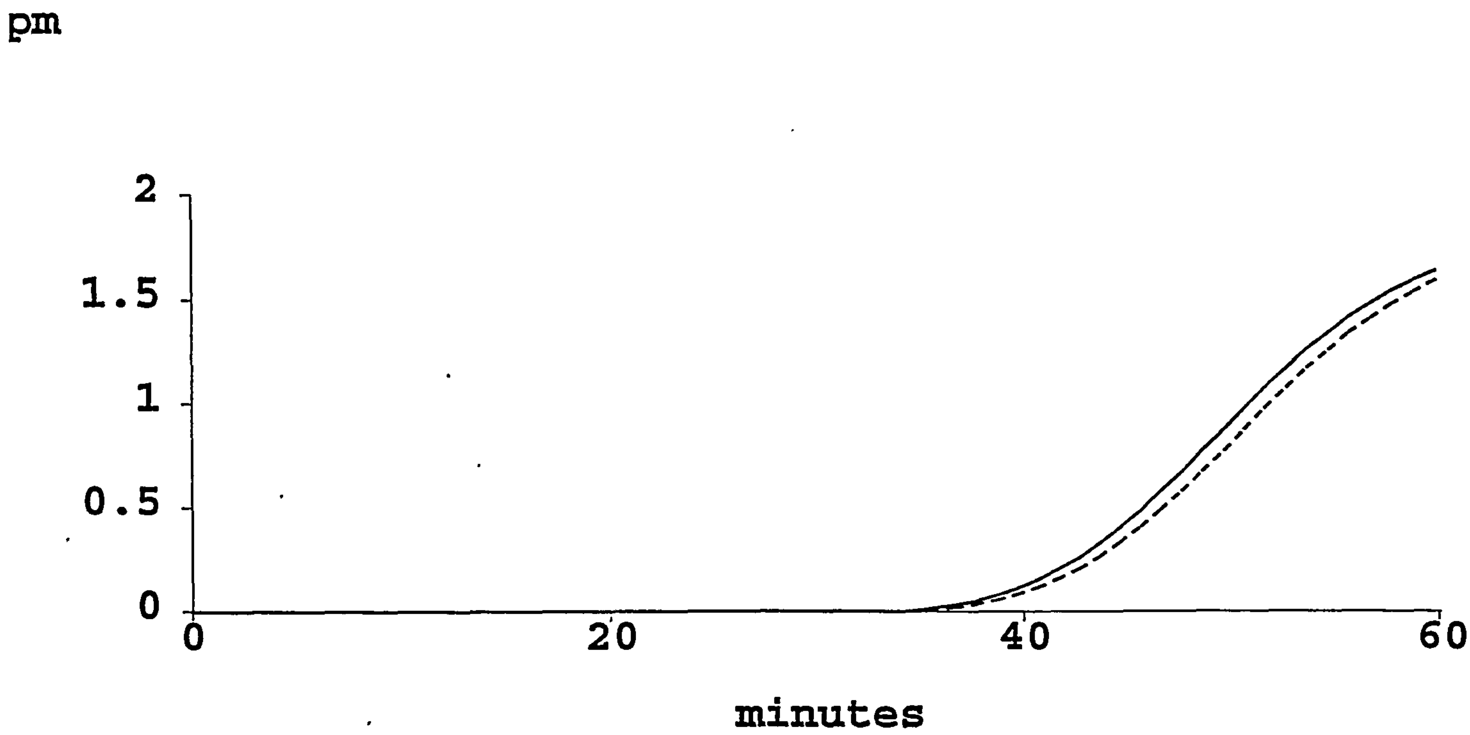
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 587 meters
Max Threat Zone for IDLH: 449 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



Concentration Window 2883117408

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

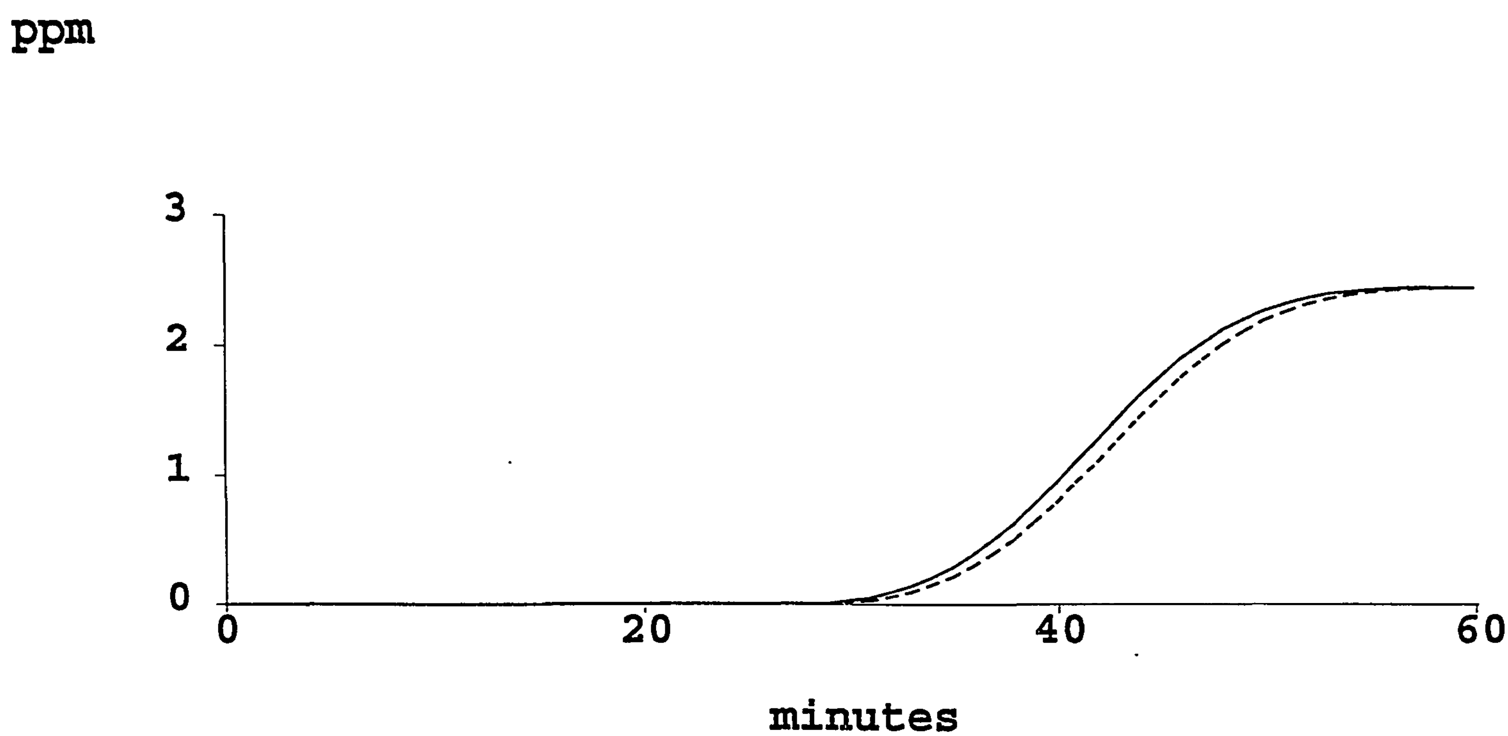
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1.64 ppm
Indoor: 1.59 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2883117372

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


TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind:        2.4 kilometers
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 2.45 ppm
     Indoor:  2.45 ppm
  Note: Indoor graph is shown with a dotted line.
```

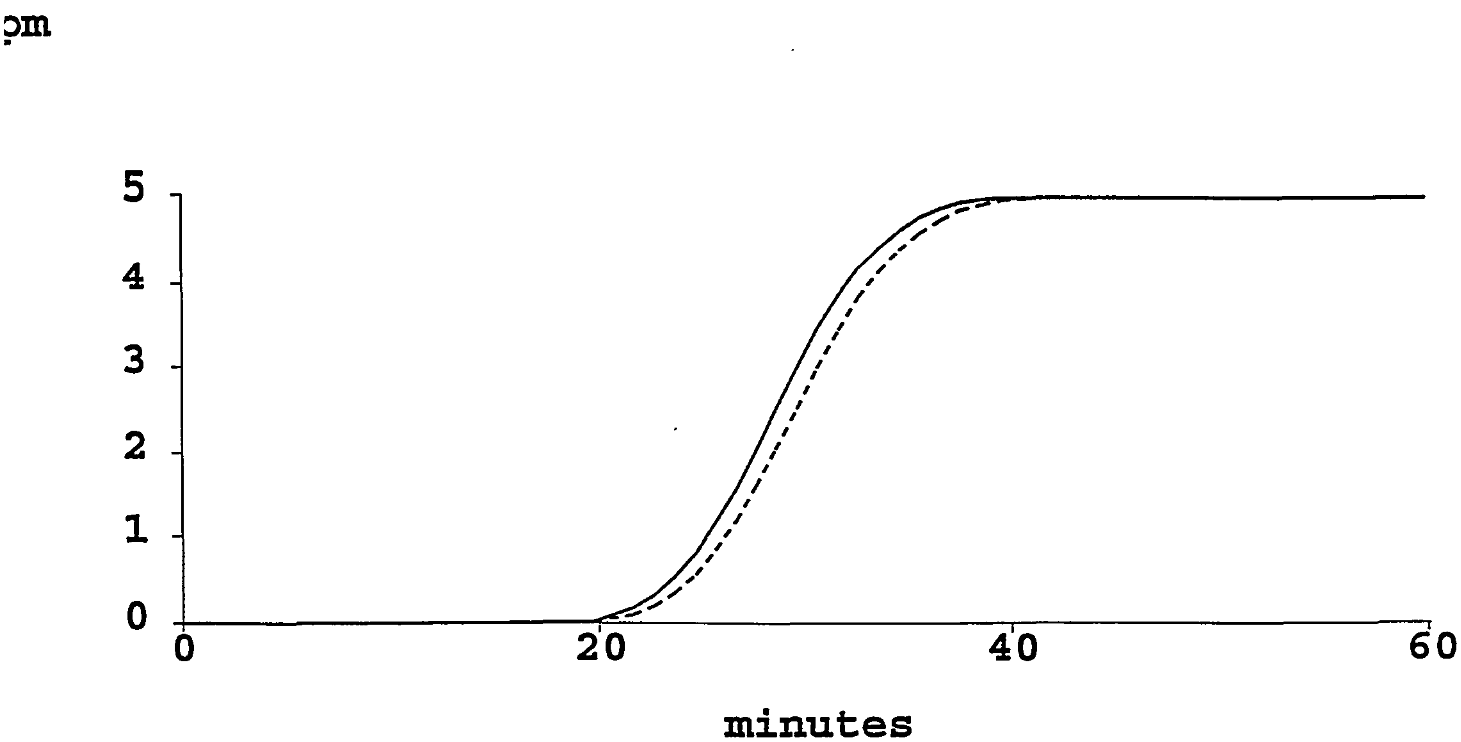


Concentration Window

2883117075

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 4.96 ppm
Indoor: 4.96 ppm
Note: Indoor graph is shown with a dotted line.

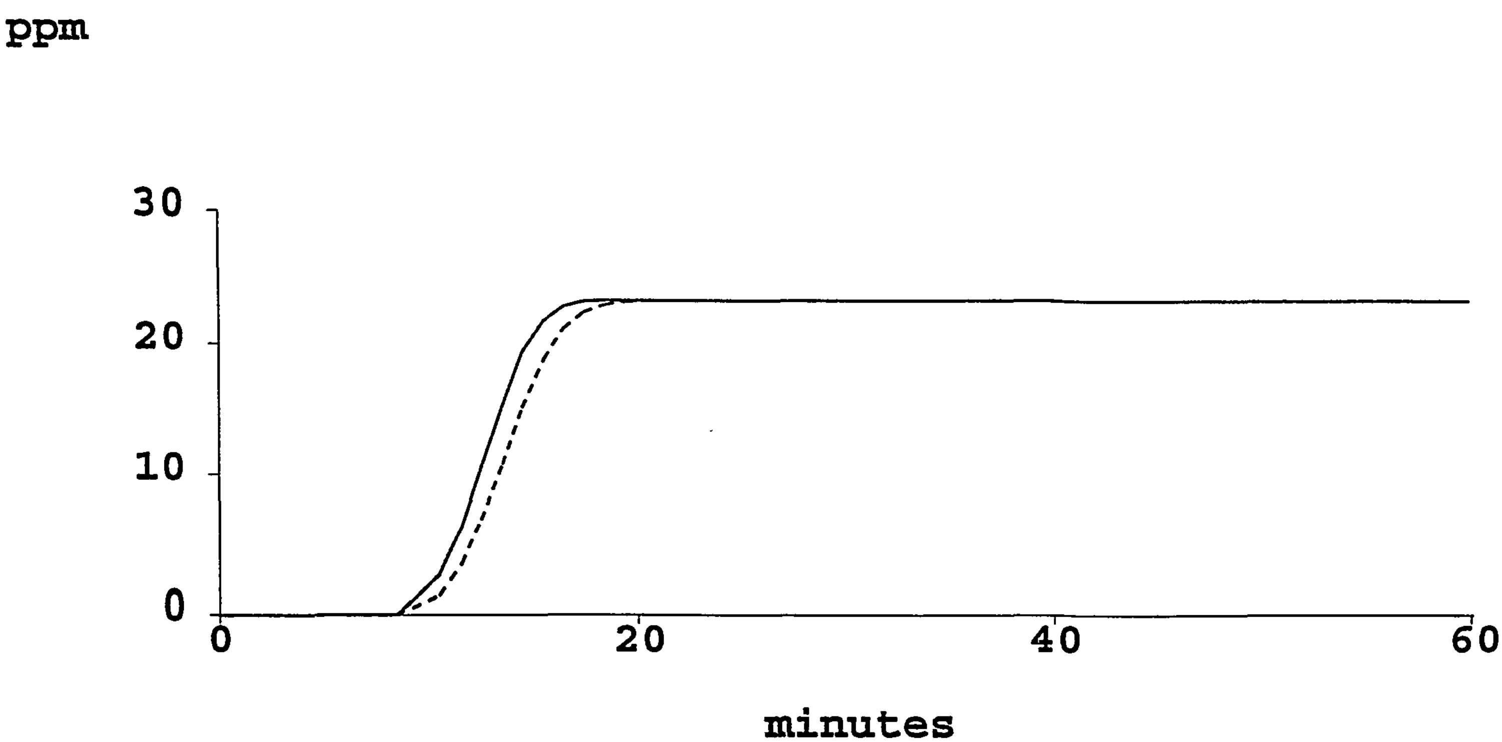


Concentration Window

2883117484

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 546 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 23.3 ppm
Indoor: 23.3 ppm
Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Chlorine (Cl)

PMRF Buildings 338, 394, 415, and 821

Scenario: The release of 150 pounds (68 kg.) of Chlorine from a cylinder via cylinder rupture, valve damage, or a malevolent act. This results in 150 lb. of Chlorine being released into the atmosphere, under a Stability Factor of C with a wind speed of 10 mph. (4.5 meters per second).

150 Pound Chlorine Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 3 ppm (meters)	ESHE 20 ppm (meters)	Arrive/Depart KTF/Facility Boundary
338	C-14, C-15, C-16, C-17, C-18, C-19, and C-20	0.154 ppm < ERPG-1	10,000 ft. (3.0 km.) "Main Complex"	2,050 ft. (618 m.)	755 ft. (229 m)	Arrives in 11 minutes Departs at 21 minutes
394	C-14, C-15, C-16, C-17, C-18, C-19, and C-21	0.235 ppm < ERPG-1	8,000 ft. (2.4 km.) "Main Complex"	2,050 ft. (618 m.)	755 ft. (229 m)	Arrives in 9 minutes Departs at 19 minutes
415	C-14, C-15, C-16, C-17, C-18, C-19, and C-22	0.57 ppm < ERPG-1	5,000 ft. (1.5 km.) "Main Complex"	2,050 ft. (618 m.)	755 ft. (229 m)	Arrives in 5.5 minutes Departs at 15.5 minutes
821	C-14, C-15, C-16, C-17, C-18, C-19, and C-23	3.87 ppm > ERPG-2	1,800 ft. (546 m) Kokole Point	2,050 ft. (618 m.)	755 ft. (229 m)	Arrives in 2 minutes Departs at 12 minutes

"Low End" Average Meteorological Conditions

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 1 ppm
Boiling Point: -34.03° 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: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

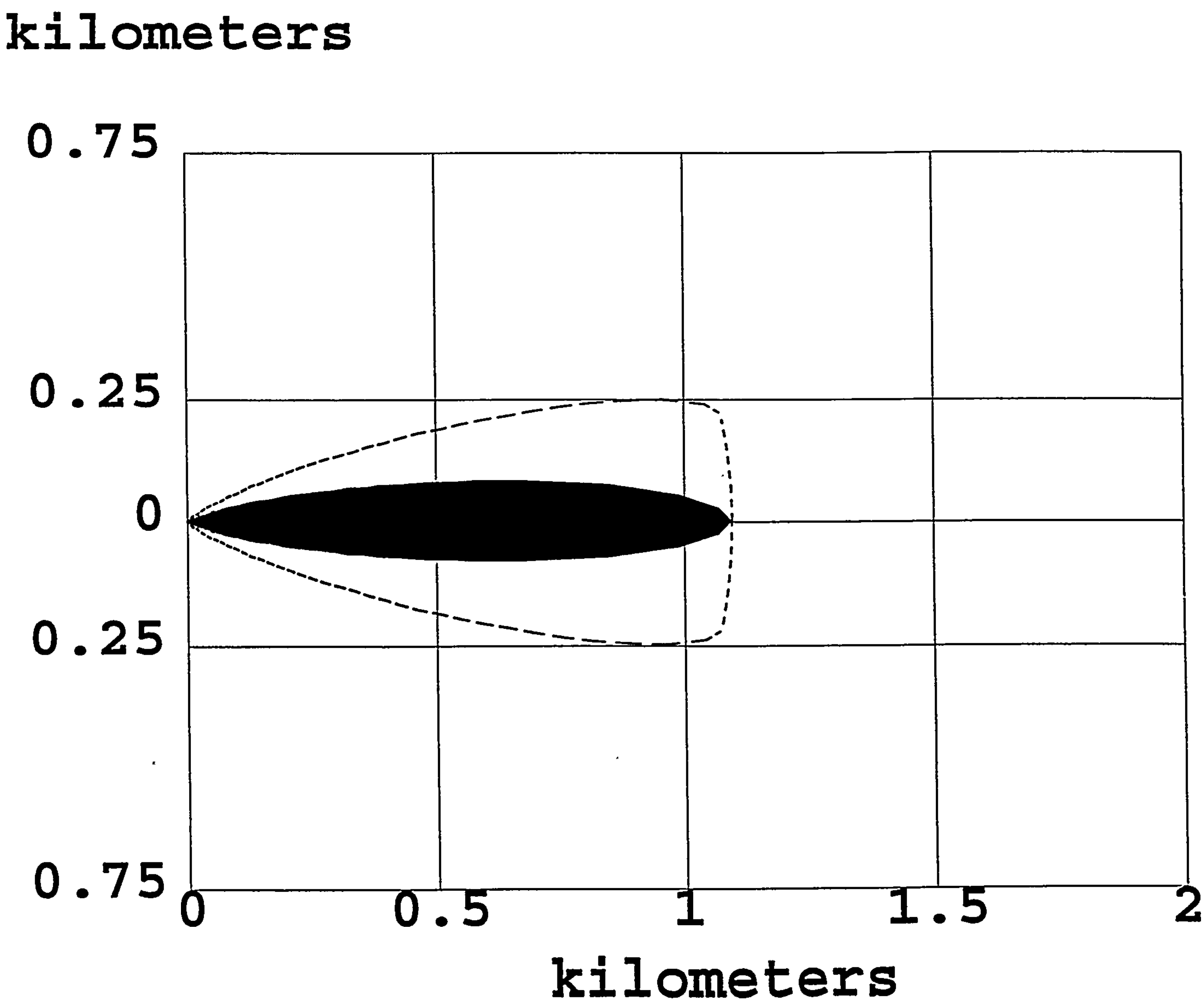
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 1.1 kilometers
Max Threat Zone for IDLH: 184 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 546 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.87 ppm
Indoor: 3.87 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883119357

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 1.1 kilometers
Max Threat Zone for IDLH: 184 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

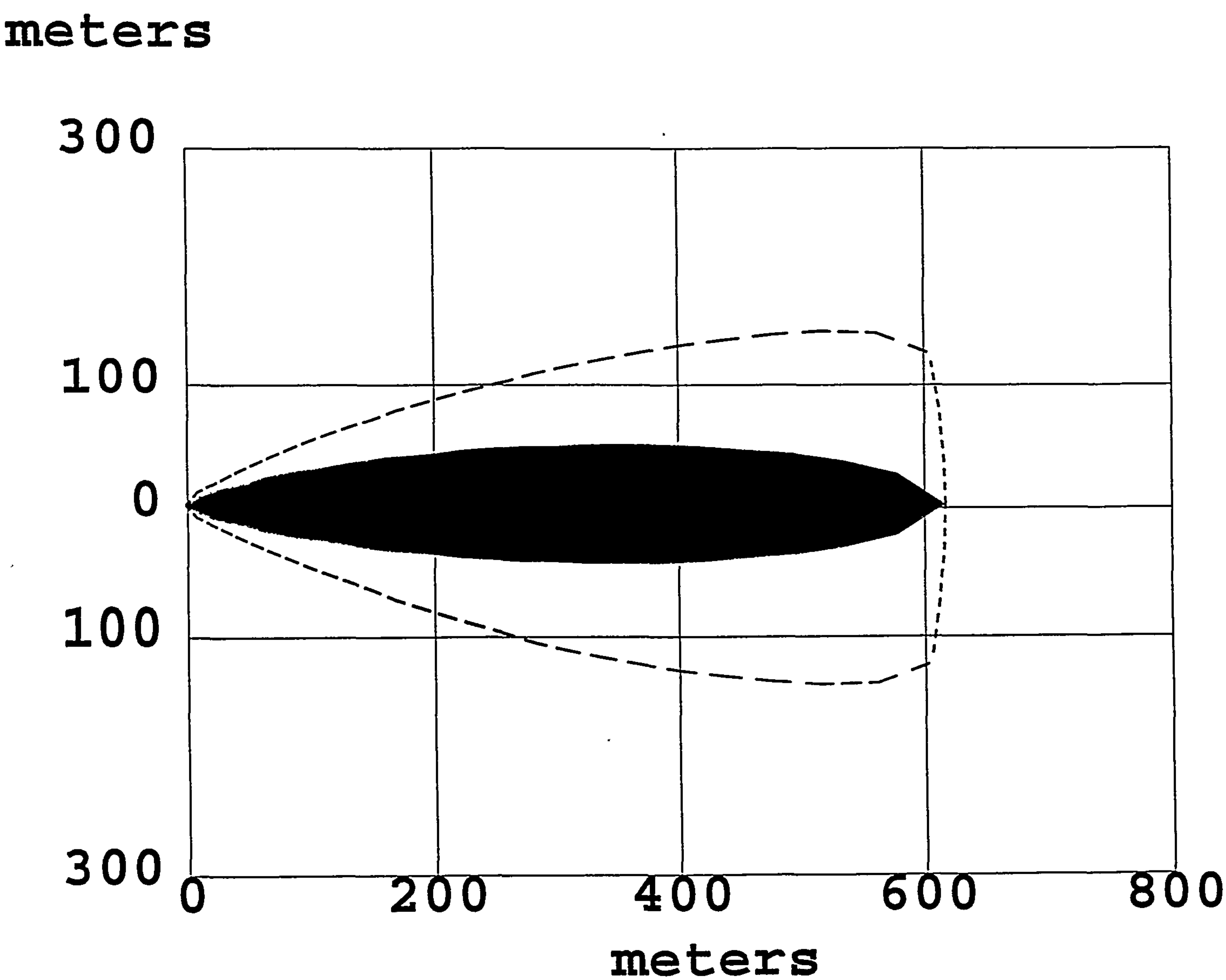
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 618 meters
Max Threat Zone for IDLH: 184 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 546 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.87 ppm
Indoor: 3.87 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883119368

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 618 meters
Max Threat Zone for IDLH: 184 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



Text Summary 2883119382

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -34.03° 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: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

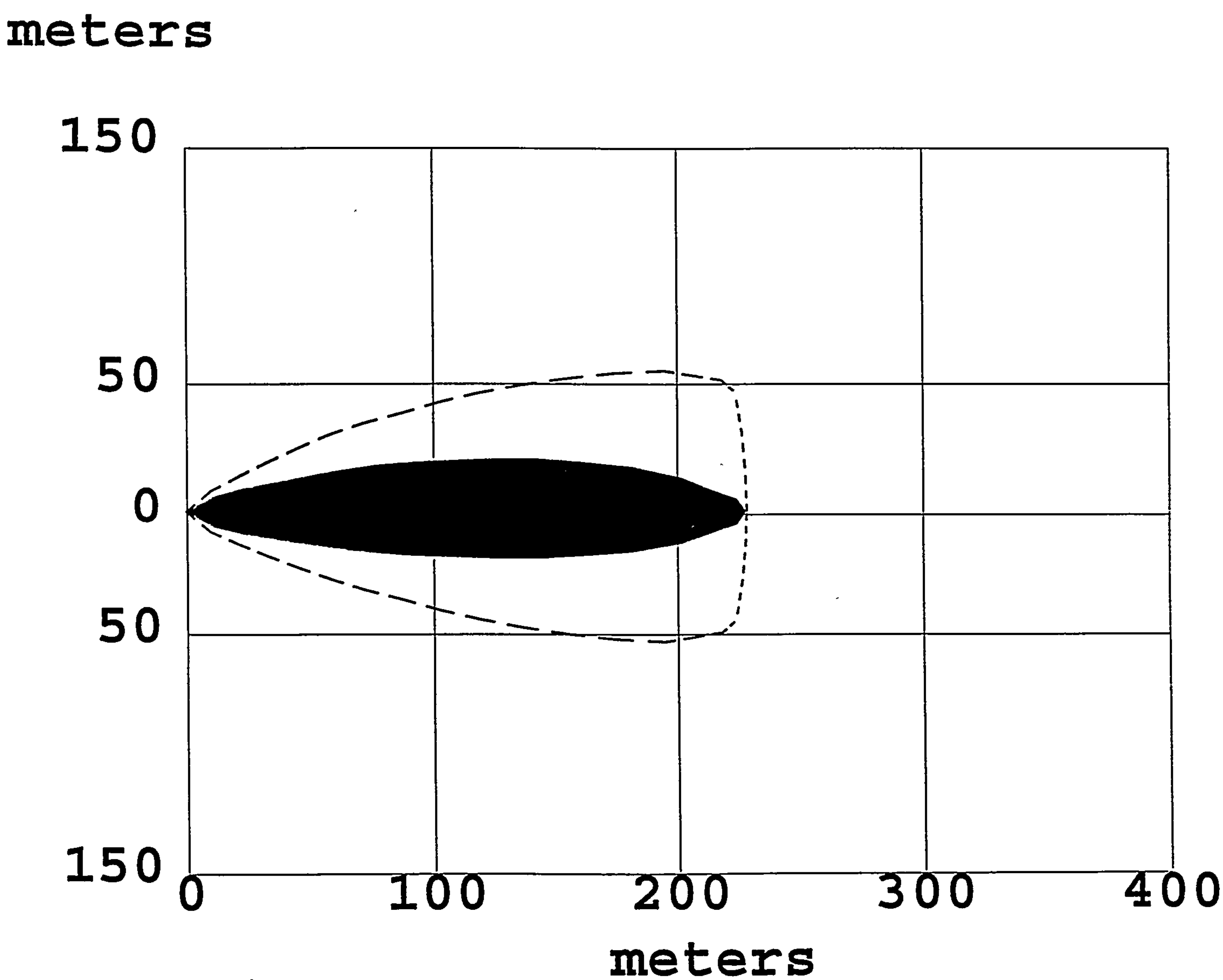
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 229 meters
Max Threat Zone for IDLH: 184 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 546 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.87 ppm
Indoor: 3.87 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883119382

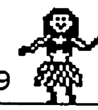
Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 20 ppm
  Max Threat Zone for LOC: 229 meters
  Max Threat Zone for IDLH: 184 meters
  Note: The Heavy Gas footprint is an initial screening.
    For short releases it may be an overestimation.
    Be sure to check concentration information at specific locations.



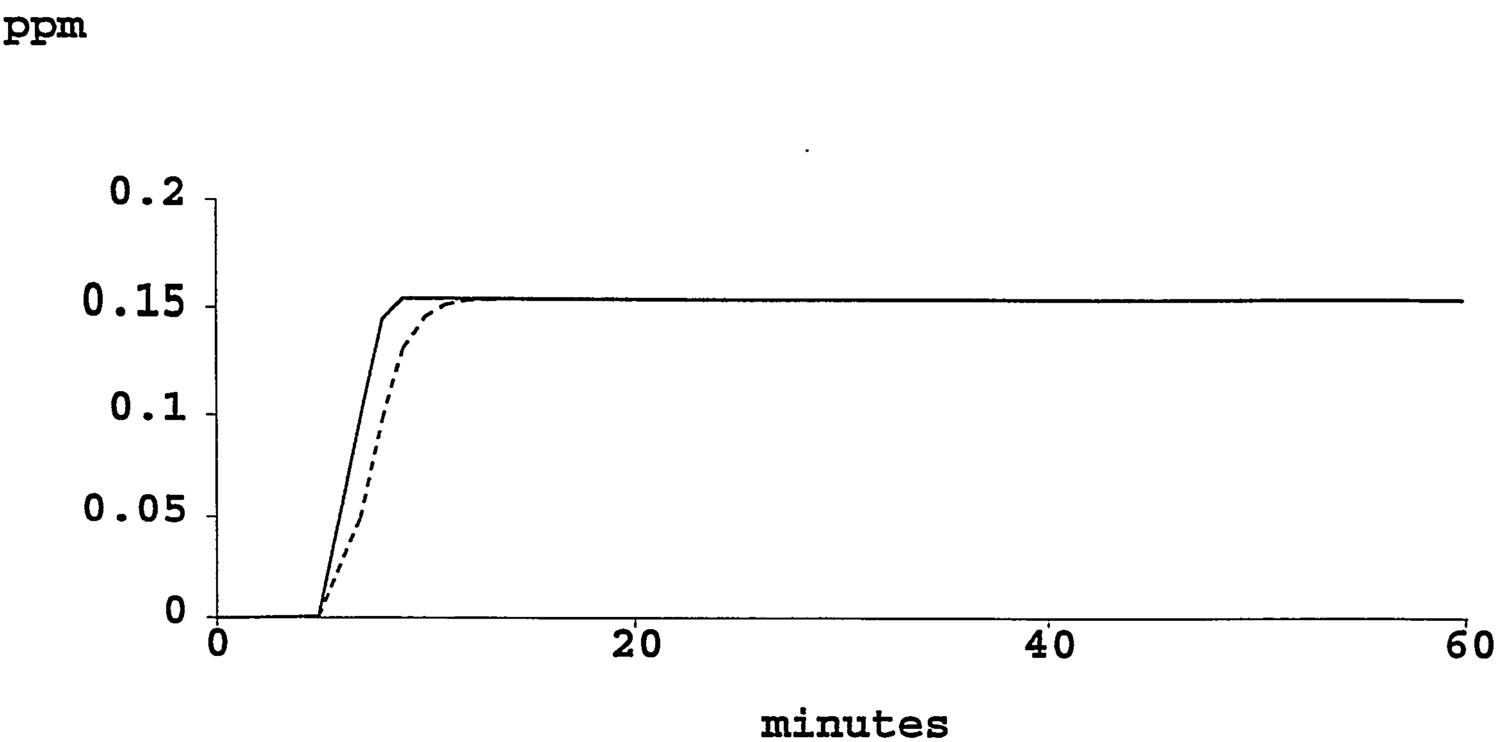
Concentration Window

2883119439



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

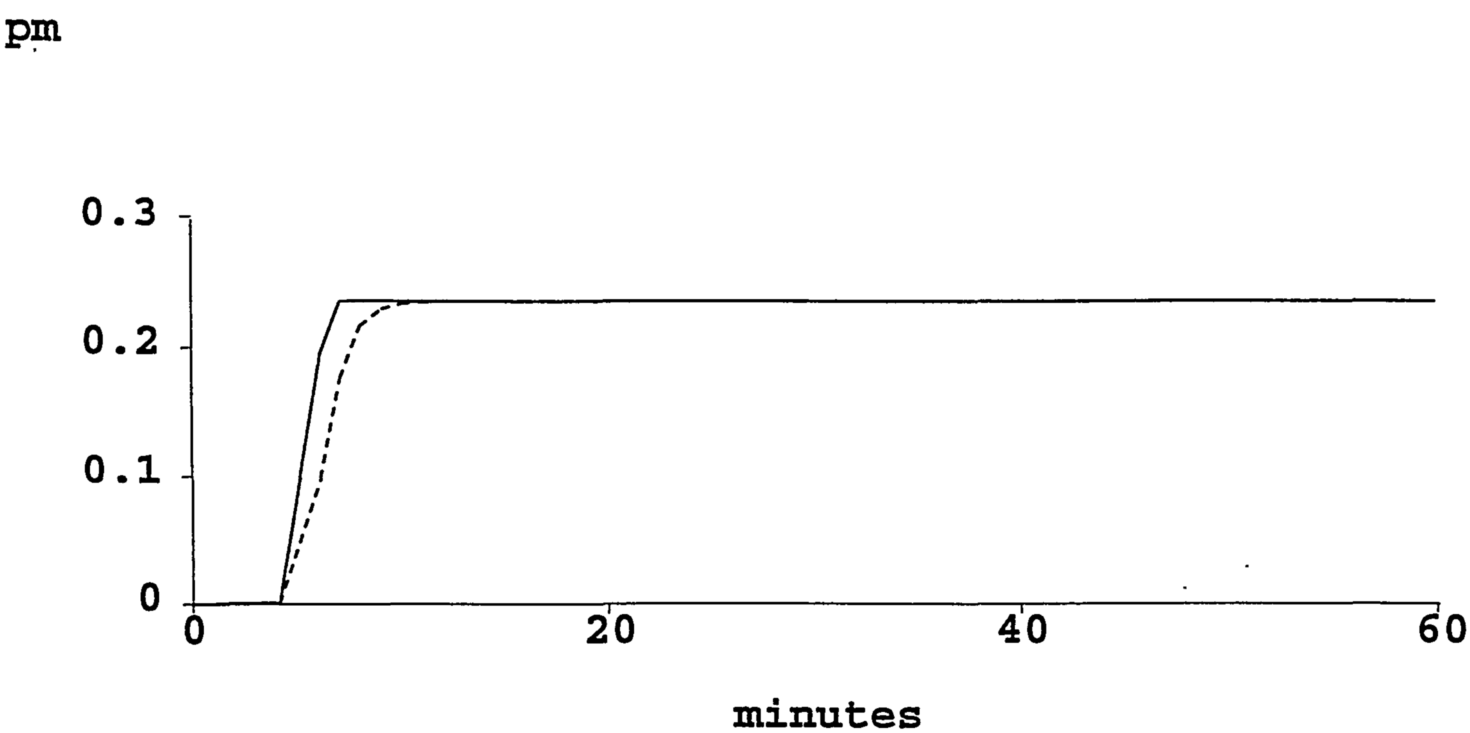
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.154 ppm
Indoor: 0.154 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2883119413

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

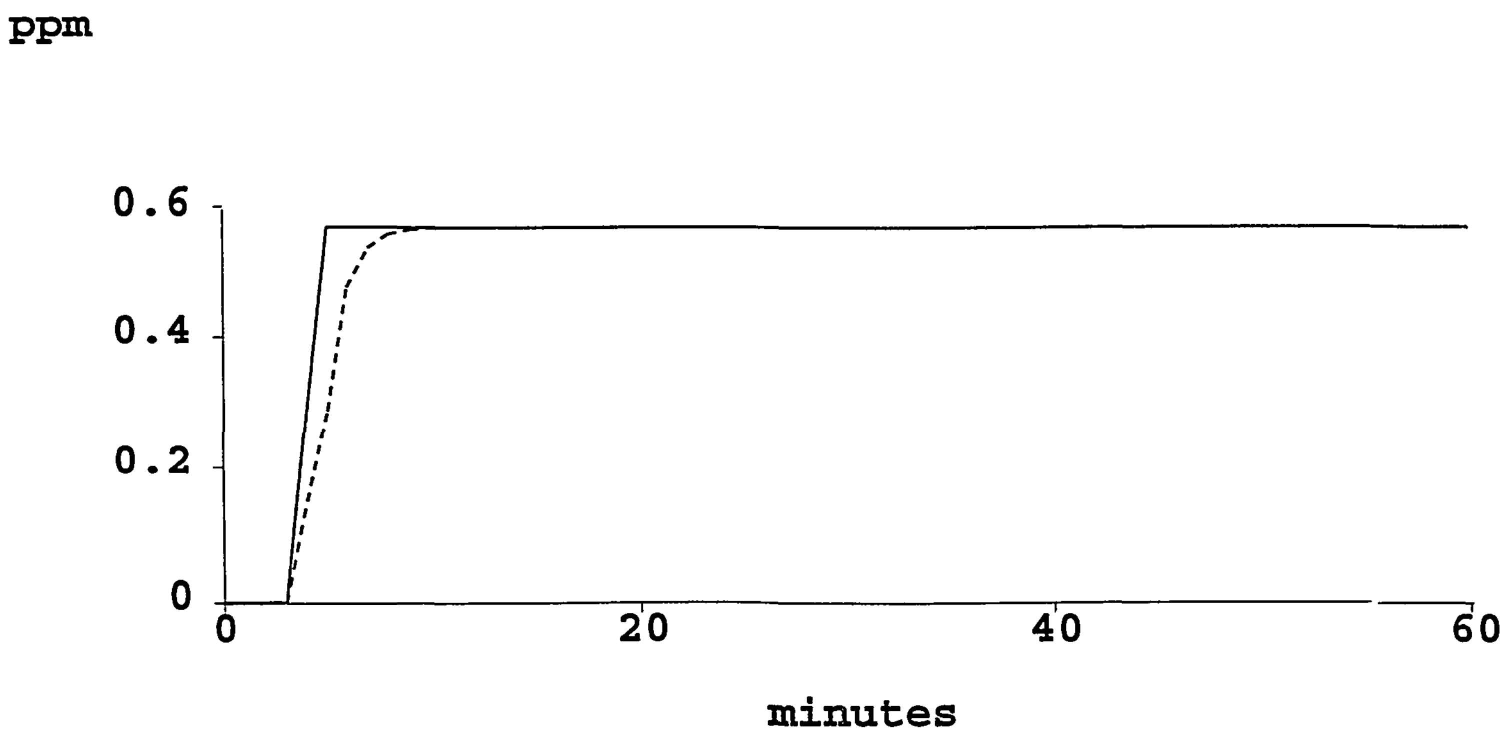
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 2.4 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.235 ppm
Indoor: 0.235 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2883119398

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

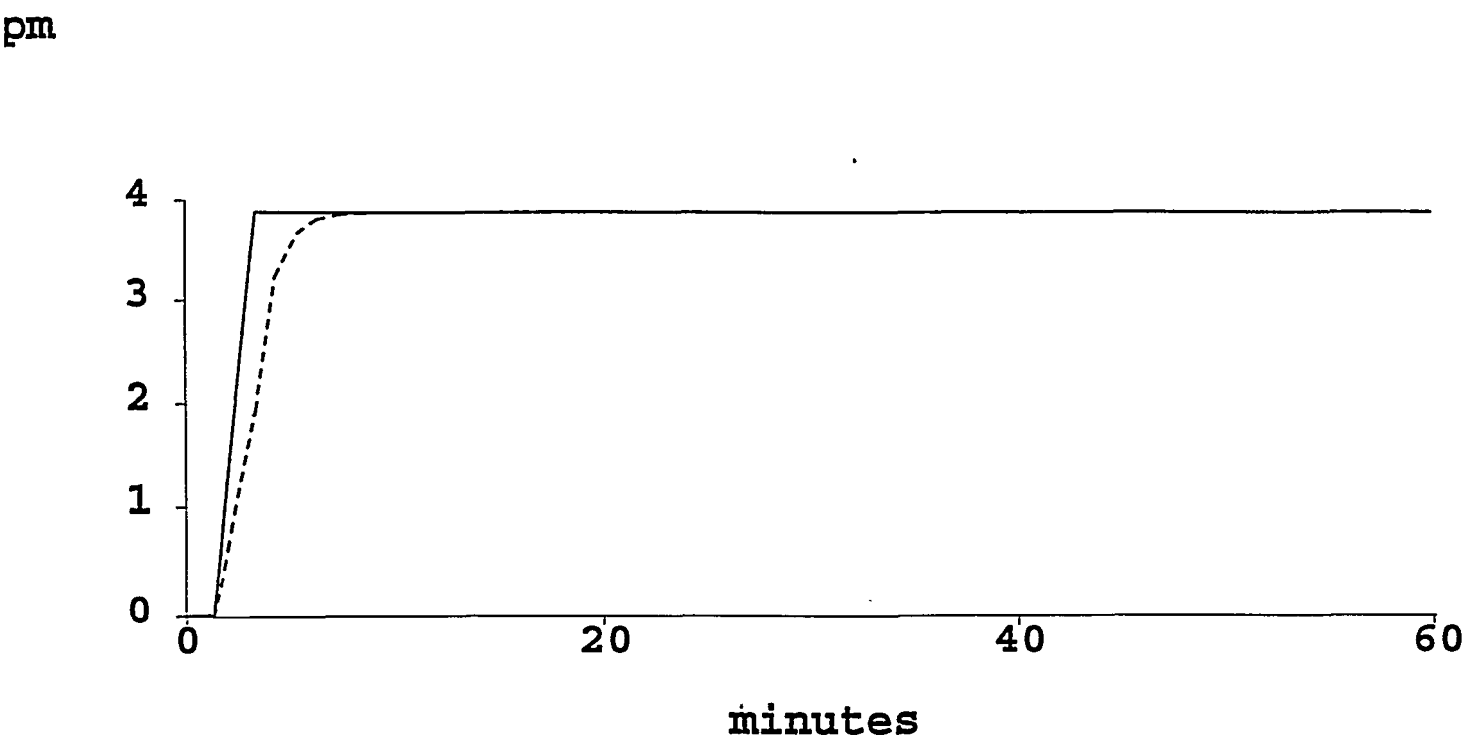
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.57 ppm
Indoor: 0.57 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2883119382

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 546 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.87 ppm
Indoor: 3.87 ppm
Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Chlorine (Cl)

PMRF Buildings 338, 394, 415, and 821

Scenario: The release of 150 pounds (68 kg.) of Chlorine from a cylinder via cylinder rupture, valve damage, or a malevolent act. This results in 150 lb. of Chlorine being released into the atmosphere, under a Stability Factor of C with a wind speed of 20 mph. (9 meters per second).

150 Pound Chlorine Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 3 ppm (meters)	ESHE 20 ppm (meters)	Arrive/Depart KTF/Facility Boundary
338	C-25, C-26, C-27, C-28, C-29, C-30, and C-31	0.077 ppm < ERPG-1	10,000 ft. (3.0 km.) "Main Complex"	1,400 ft. (427 m.)	520 ft. (158 m)	Arrives in 5.5 minutes Departs at 15.5 minutes
394	C-25, C-26, C-27, C-28, C-29, C-30, and C-32	0.117 ppm < ERPG-1	8,000 ft. (2.4 km.) "Main Complex"	1,400 ft. (427 m.)	520 ft. (158 m)	Arrives in 4.5 minutes Departs at 14.5 minutes
415	C-25, C-26, C-27, C-28, C-29, C-30, and C-33	0.285 ppm < ERPG-1	5,000 ft. (1.5 km.) "Main Complex"	1,400 ft. (427 m.)	520 ft. (158 m)	Arrives in 3 minutes Departs at 13 minutes
821	C-25, C-26, C-27, C-28, C-29, C-30, and C-34	1.92 ppm > ERPG-1	1,800 ft. (546 m) Kokole Point	1,400 ft. (427 m.)	520 ft. (158 m)	Arrives in 1 minutes Departs at 11 minutes

"High End" Average Meteorological Conditions

Text Summary 2883119224

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 1 ppm
Boiling Point: -34.03° 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: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

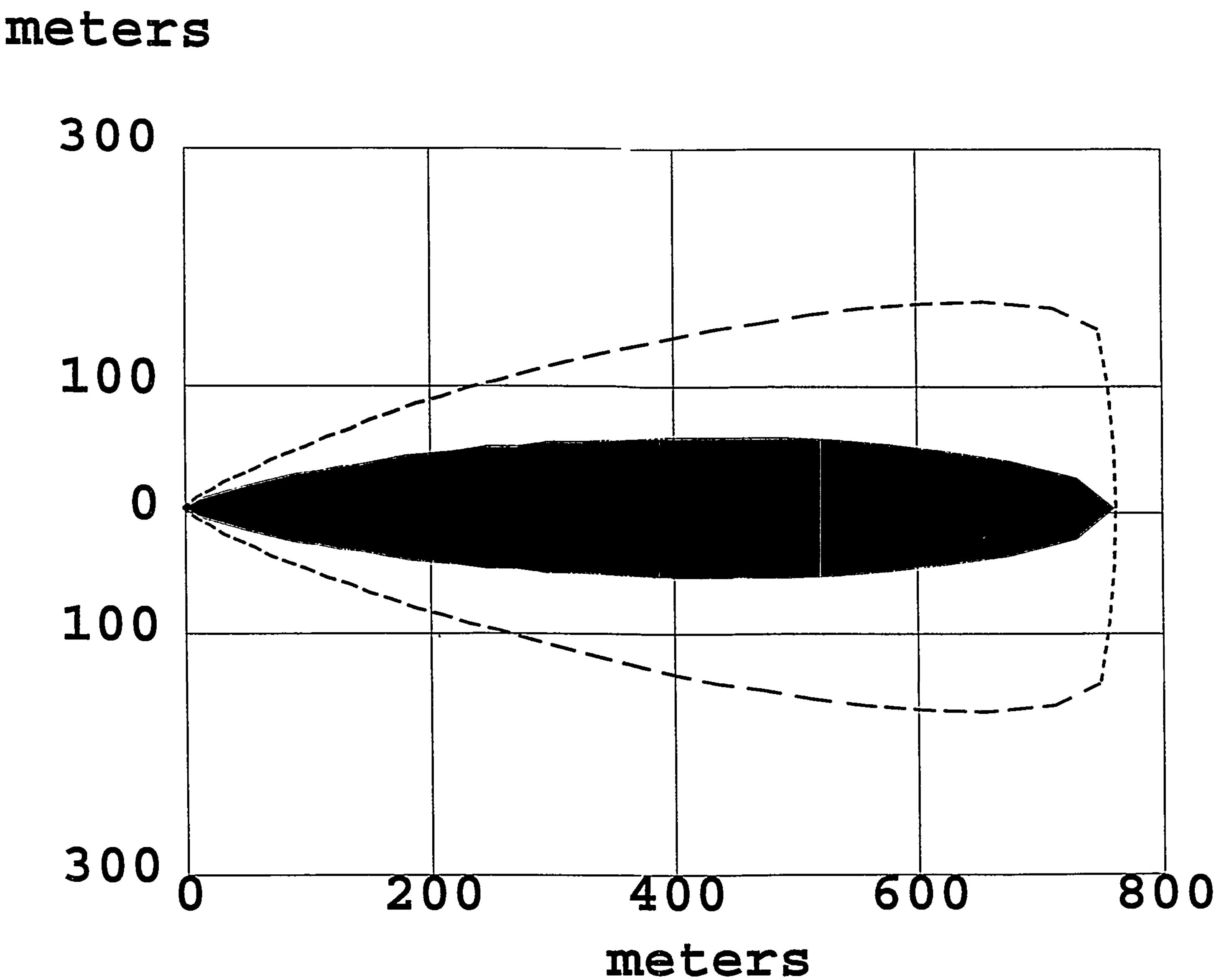
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 763 meters
Max Threat Zone for IDLH: 128 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.077 ppm
Indoor: 0.077 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883119223

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 763 meters
Max Threat Zone for IDLH: 128 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

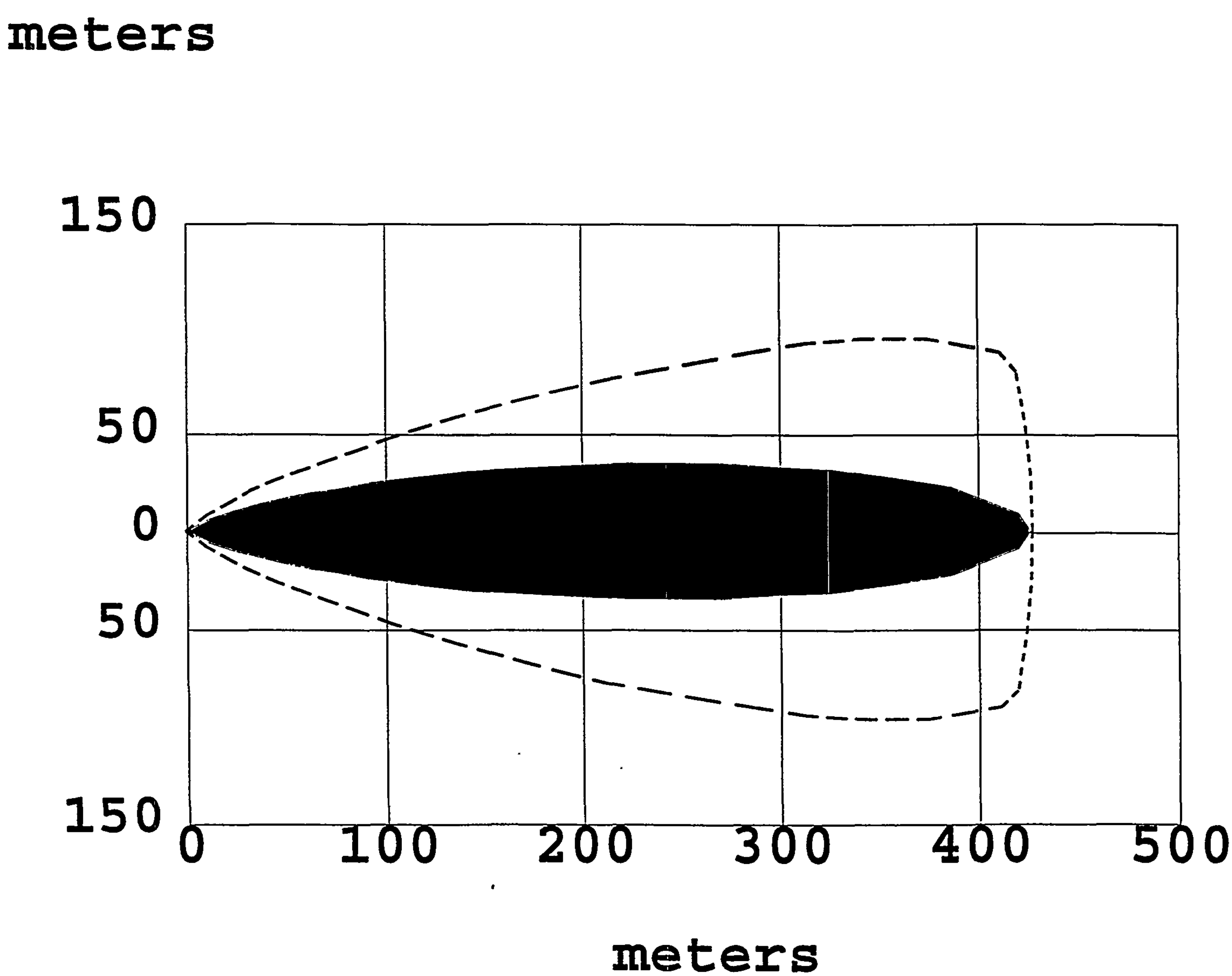
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 427 meters
Max Threat Zone for IDLH: 128 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.077 ppm
Indoor: 0.077 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883119208

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 427 meters
Max Threat Zone for IDLH: 128 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -34.03° 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: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 15 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 6.8 kilograms/min
Total Amount Released: 408 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 158 meters
Max Threat Zone for IDLH: 128 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

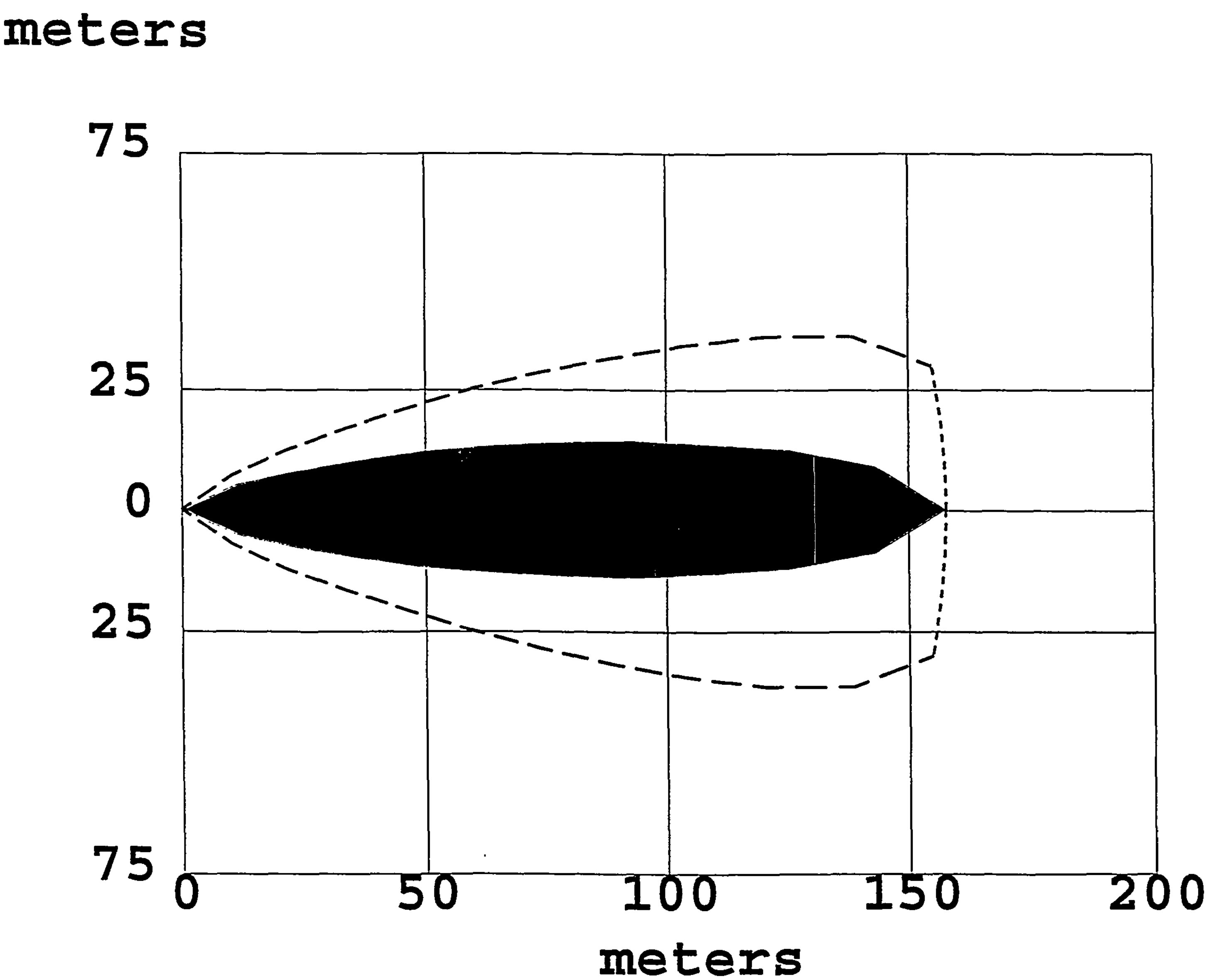
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.077 ppm
Indoor: 0.077 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2883119192

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 158 meters
Max Threat Zone for IDLH: 128 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

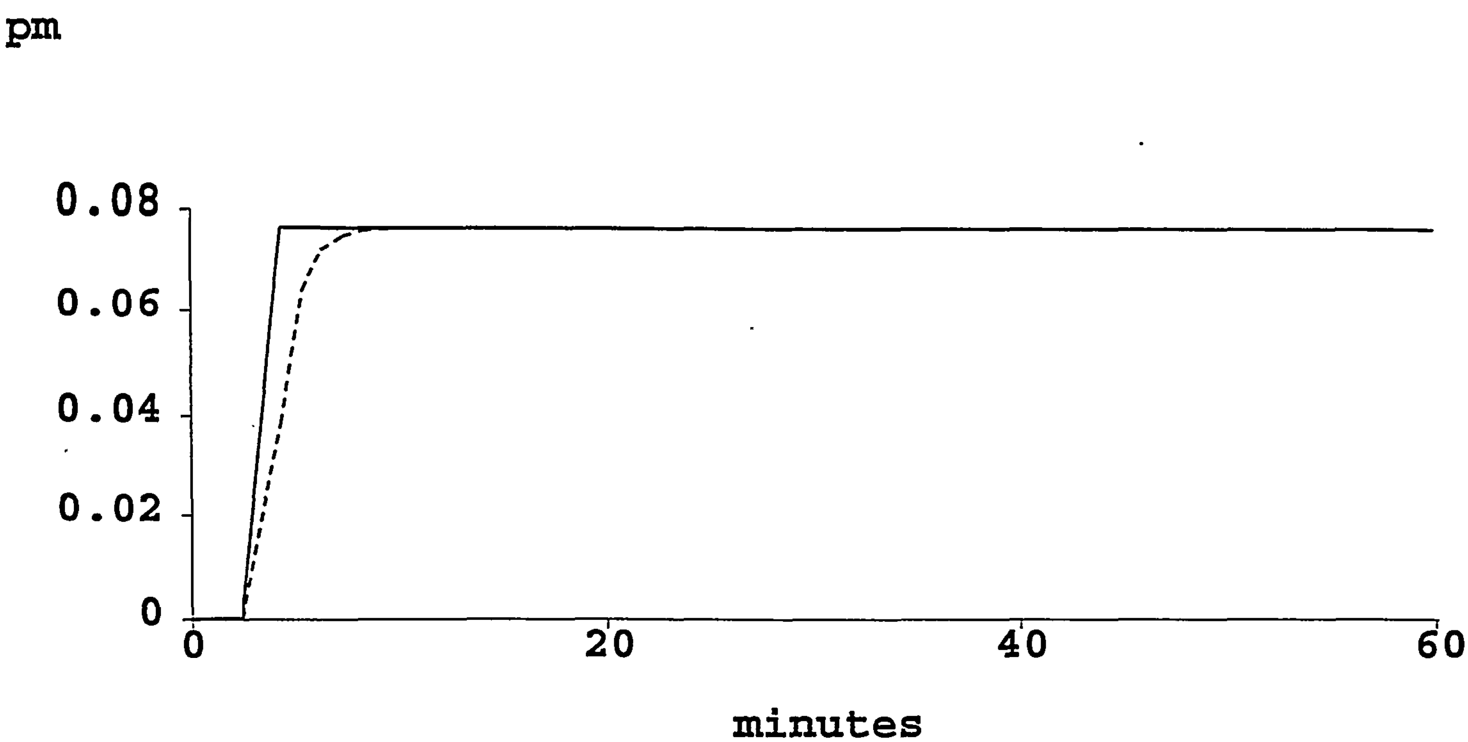


Concentration Window

2883119223

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

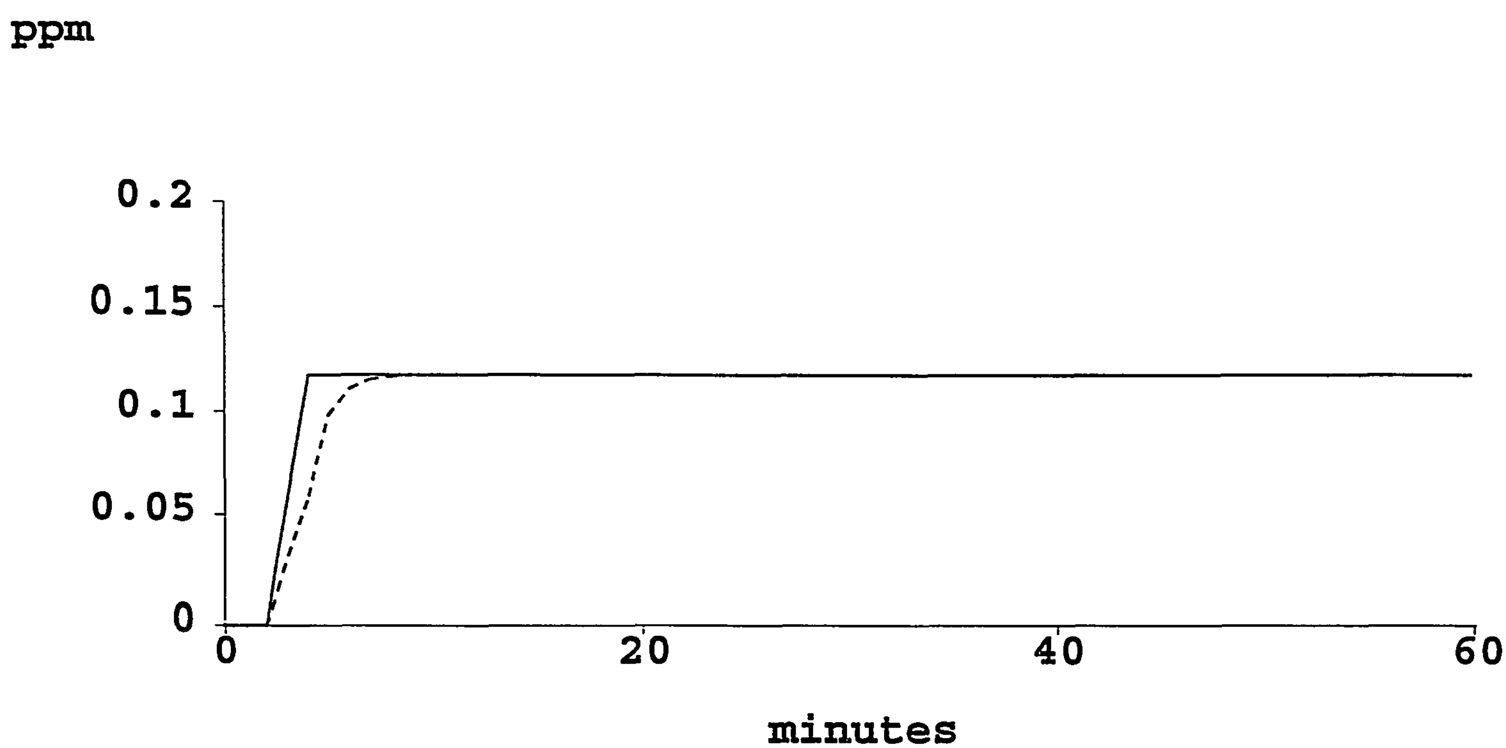
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.077 ppm
Indoor: 0.077 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2883119242

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 2.4 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.117 ppm
Indoor: 0.117 ppm
Note: Indoor graph is shown with a dotted line.

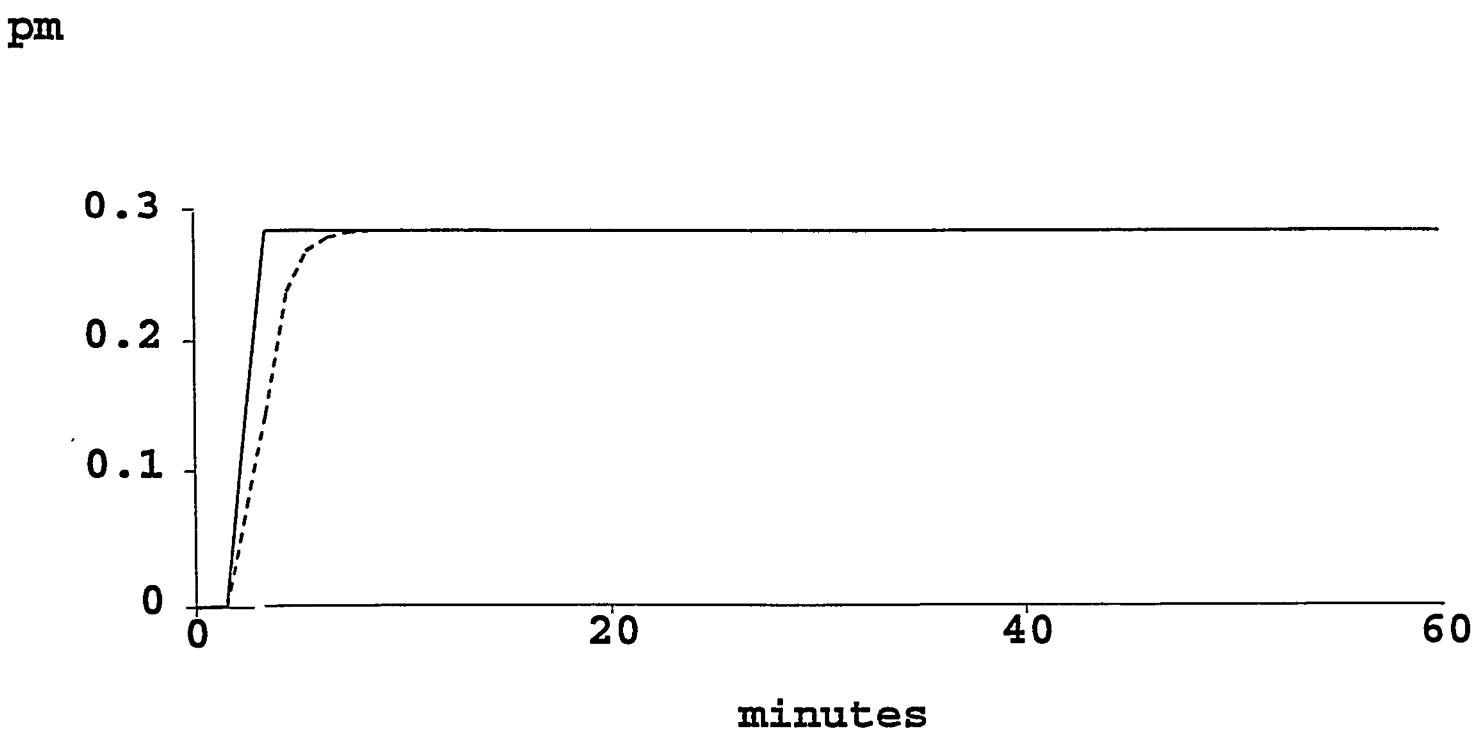


Concentration Window

2883119257

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

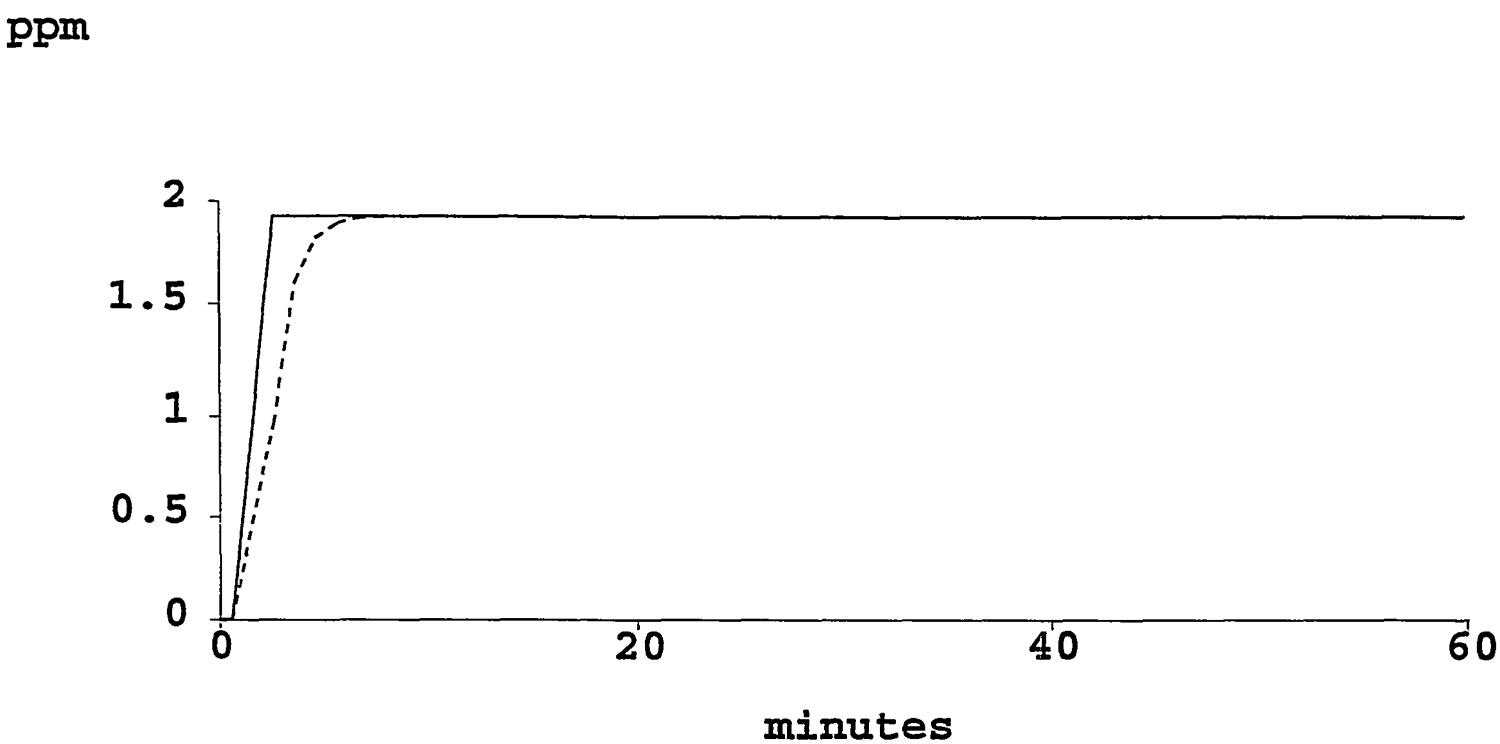
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.285 ppm
Indoor: 0.285 ppm
Note: Indoor graph is shown with a dotted line.



Concentration Window 2883119283

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 546 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1.92 ppm
Indoor: 1.92 ppm
Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Chlorine (Cl)

PMRF Building 338

Scenario: The release of 600 pounds (273 kg.) of Chlorine from a cylinder via cylinder rupture, valve damage, or a malevolent act. This results in 600 lb. of Chlorine being released into the atmosphere, under a Stability Factor of F with a wind speed of 1 meter per second (2.2 mph).

600 Pound Chlorine Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 3 ppm (meters)	ESHE 20 ppm (meters)	Arrive/Depart KTF/Facility Boundary
338	C-36, C-37, C-38, C-39, C-40, C-41, and C-42	3.24 ppm > ERPG-2	10,000 ft. (3.0 km.) "Main Complex"	13,200 ft. (4.0 km.)	3,960 ft. (1.2 km.)	Arrives in 50 minutes Departs at 1 hour

"Worst Case" Meteorological Conditions

Text Summary 2883117892

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 1 ppm
Boiling Point: -34.03° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

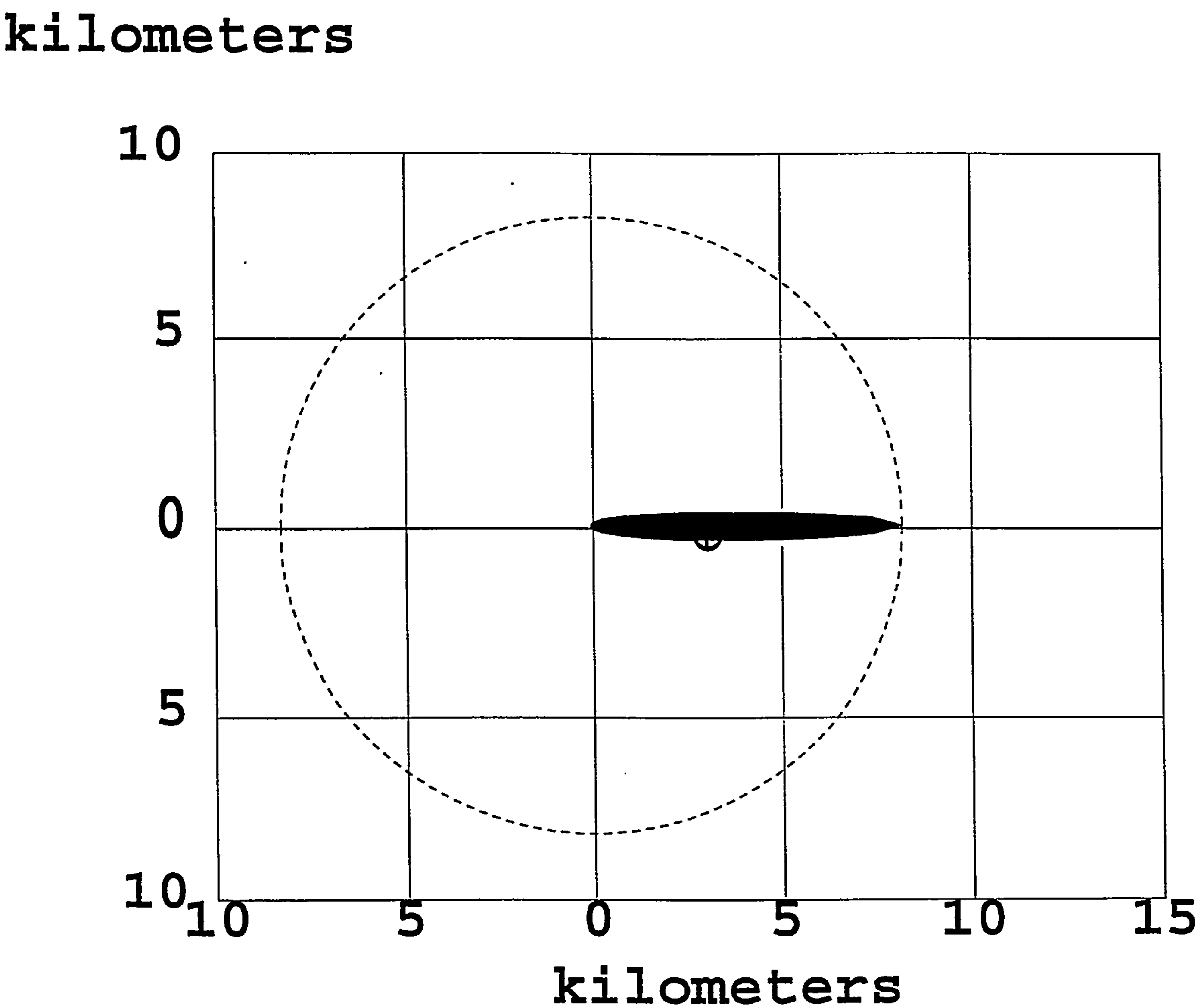
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 8.2 kilometers
Max Threat Zone for IDLH: 896 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.24 ppm
Indoor: 3.01 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883117892

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 8.2 kilometers
Max Threat Zone for IDLH: 896 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

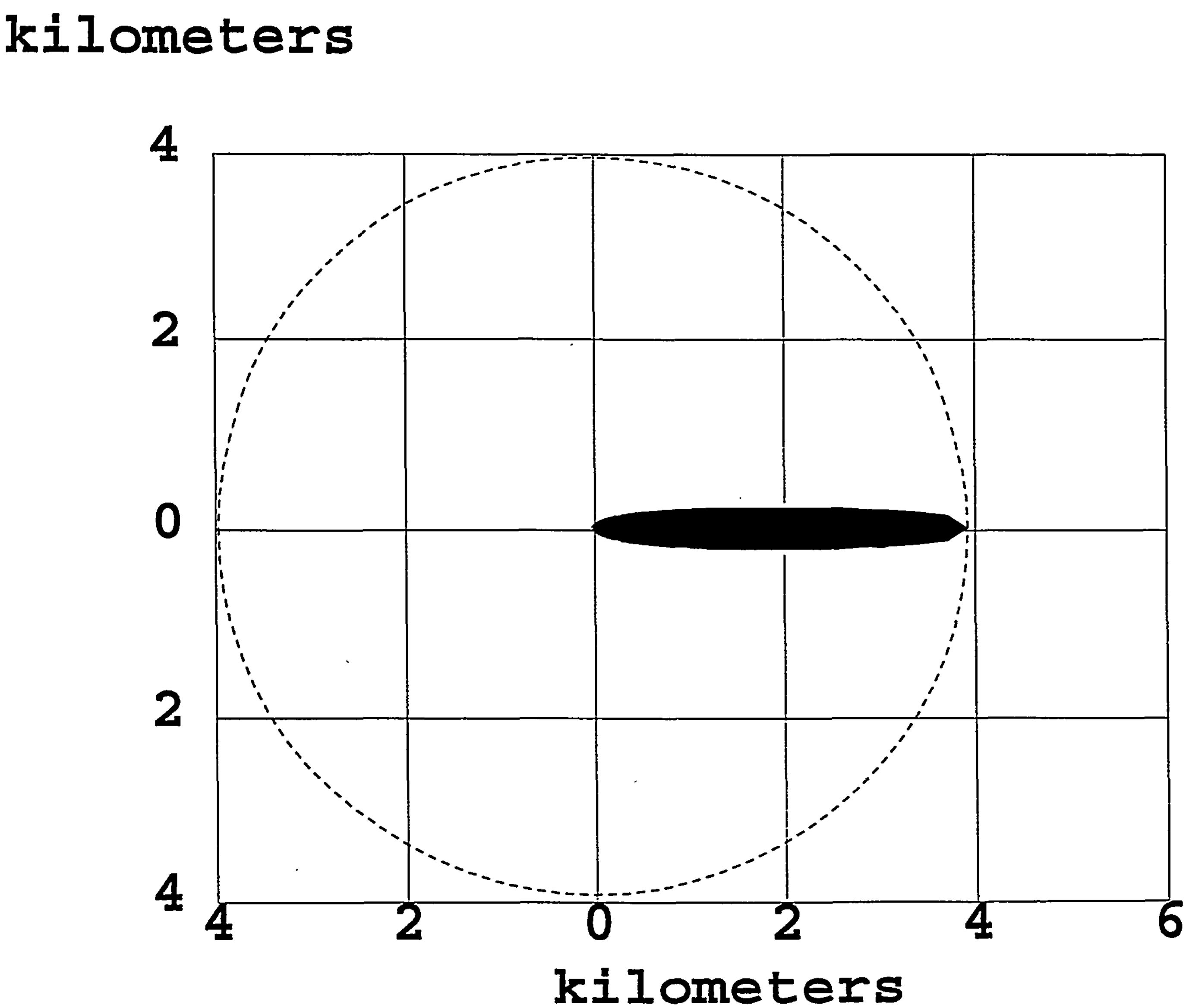
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 4.0 kilometers
Max Threat Zone for IDLH: 896 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.24 ppm
Indoor: 3.01 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883117904

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 4.0 kilometers
Max Threat Zone for IDLH: 896 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -34.03° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

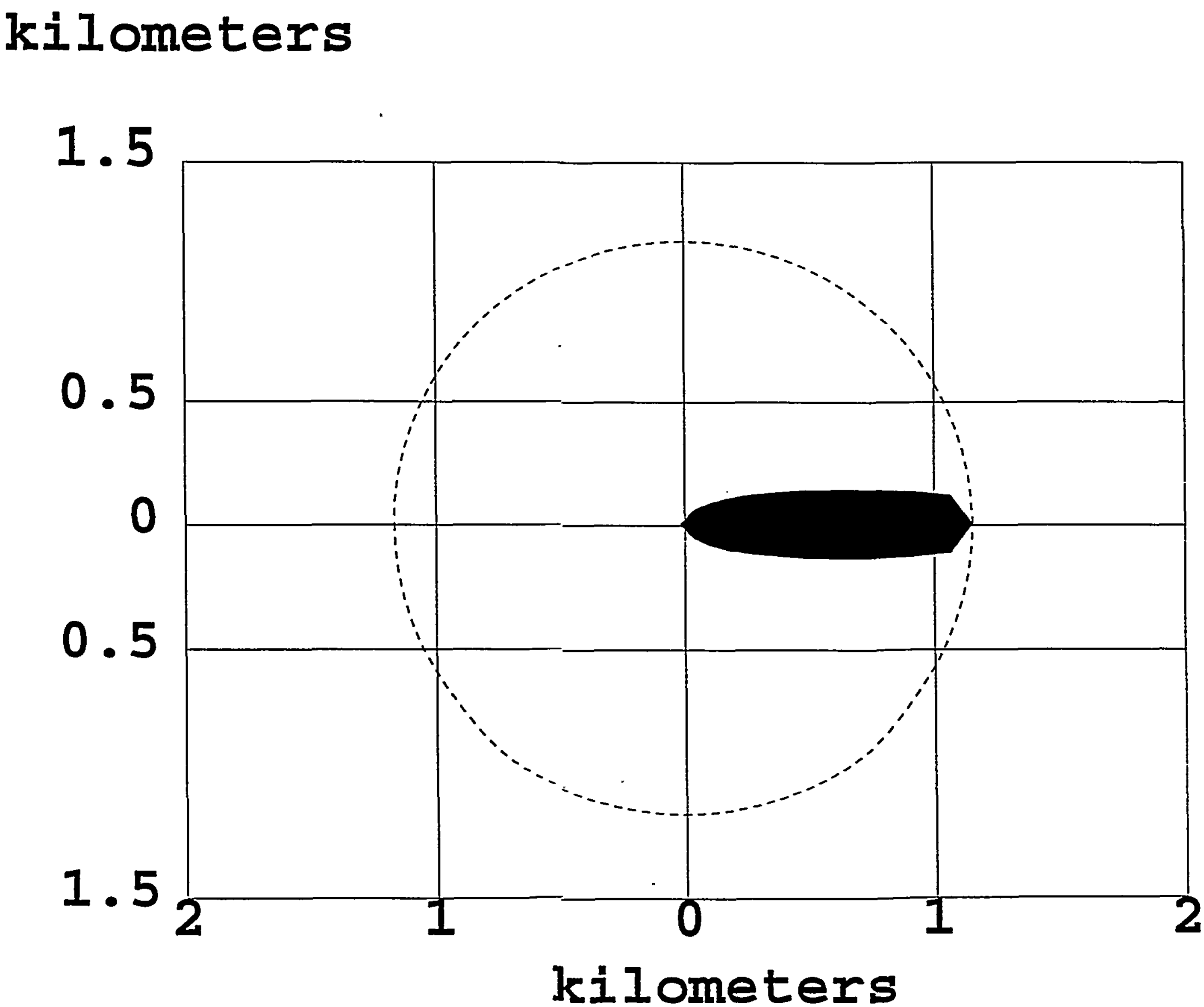
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 1.2 kilometers
Max Threat Zone for IDLH: 896 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.24 ppm
Indoor: 3.01 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883117916

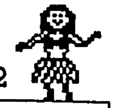
Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 20 ppm
  Max Threat Zone for LOC: 1.2 kilometers
  Max Threat Zone for IDLH: 896 meters
  Note: The Heavy Gas footprint is an initial screening.
    For short releases it may be an overestimation.
    Be sure to check concentration information at specific
locations.



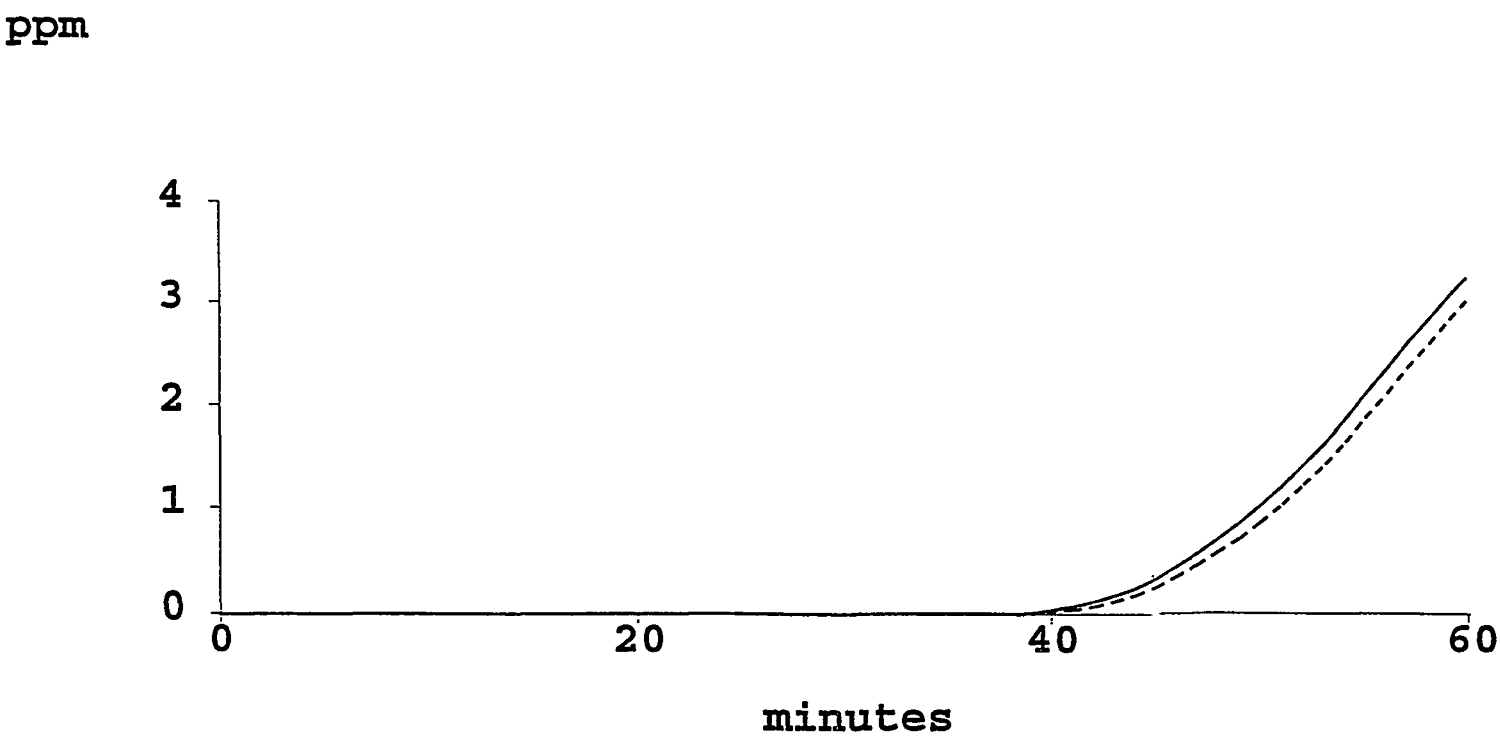
Concentration Window

2883117892



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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 3.24 ppm
Indoor: 3.01 ppm
Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Chlorine (Cl)

PMRF Building 338

Scenario: The release of 600 pounds (273 kg.) of Chlorine from a cylinder via cylinder rupture, valve damage, or a malevolent act. This results in 600 lb. of Chlorine being released into the atmosphere, under a Stability Factor of C with a wind speed of 10 mph. (4.5 meters per second).

600 Pound Chlorine Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 3 ppm (meters)	ESHE 20 ppm (meters)	Arrive/Depart KTF/Facility Boundary
338	C-44, C-45, C-46, C-47, C-48, C-49, and C-50	0.618ppm < ERPG-1	10,000 ft. (3.0 km.) "Main Complex"	4,290 ft. (1.3 m.)	1,260 ft. (382 m)	Arrives in 11 minutes Departs at 21 minutes

"Low End" Average Meteorological Conditions

Text Summary 2883118854

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 1 ppm
Boiling Point: -34.03° 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: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

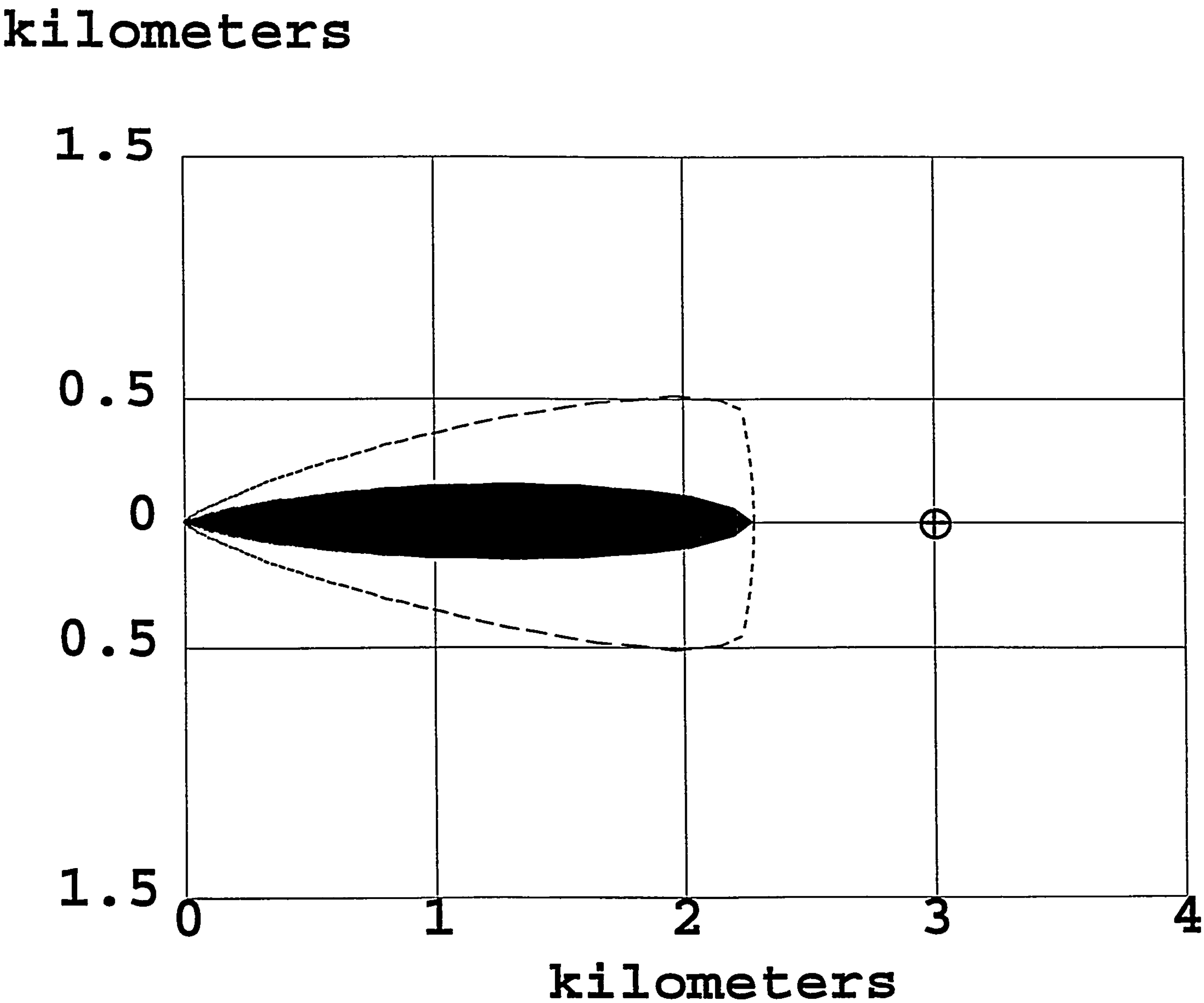
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 2.3 kilometers
Max Threat Zone for IDLH: 382 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.618 ppm
Indoor: 0.618 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883118852

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 1 ppm
  Max Threat Zone for LOC: 2.3 kilometers
  Max Threat Zone for IDLH: 382 meters
  Note: The Heavy Gas footprint is an initial screening.
    For short releases it may be an overestimation.
    Be sure to check concentration information at specific locations.



Text Summary 2883118840

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

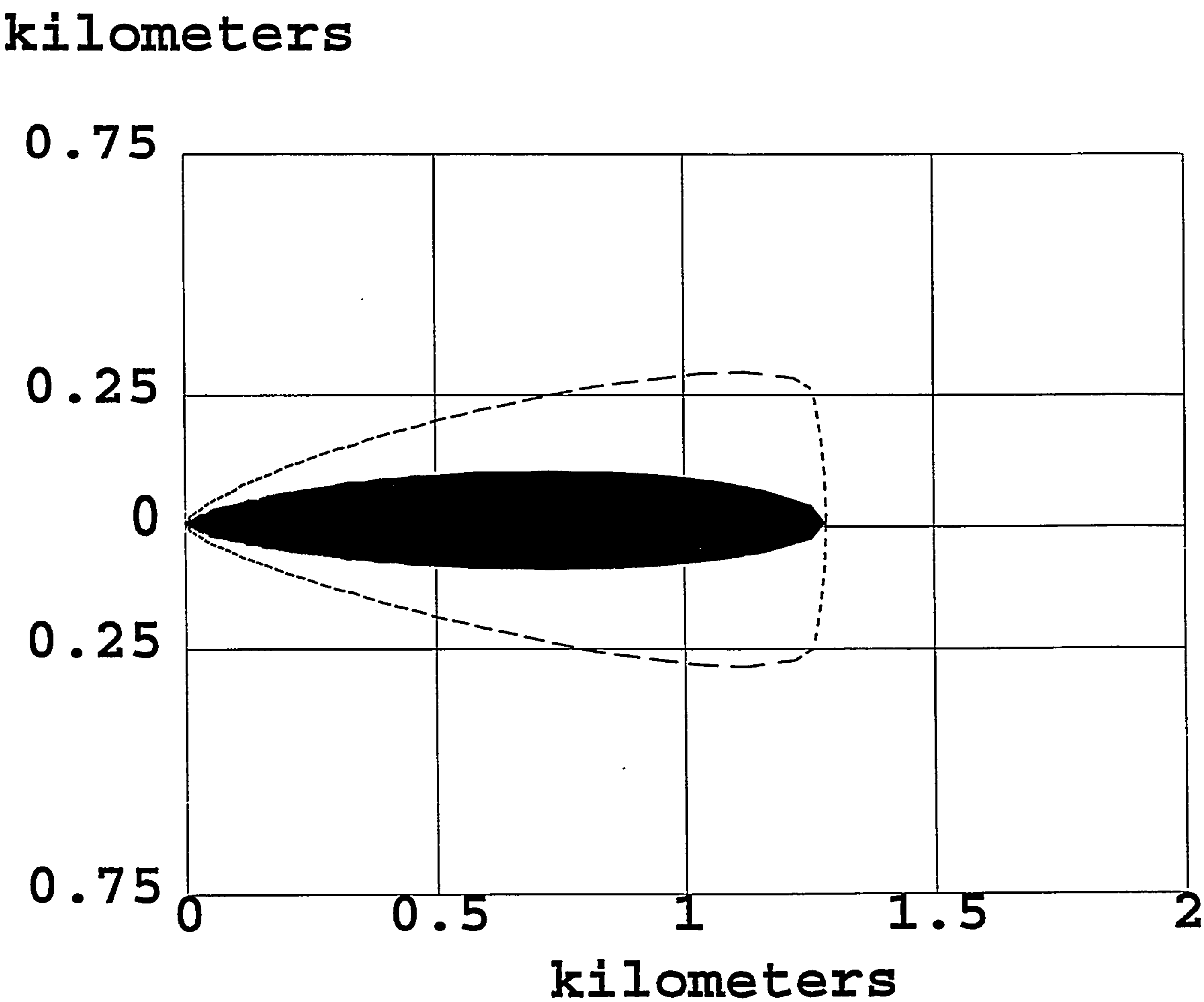
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 1.3 kilometers
Max Threat Zone for IDLH: 382 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.618 ppm
Indoor: 0.618 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883118839

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 1.3 kilometers
Max Threat Zone for IDLH: 382 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



Text Summary 2883118828

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -34.03° 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: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

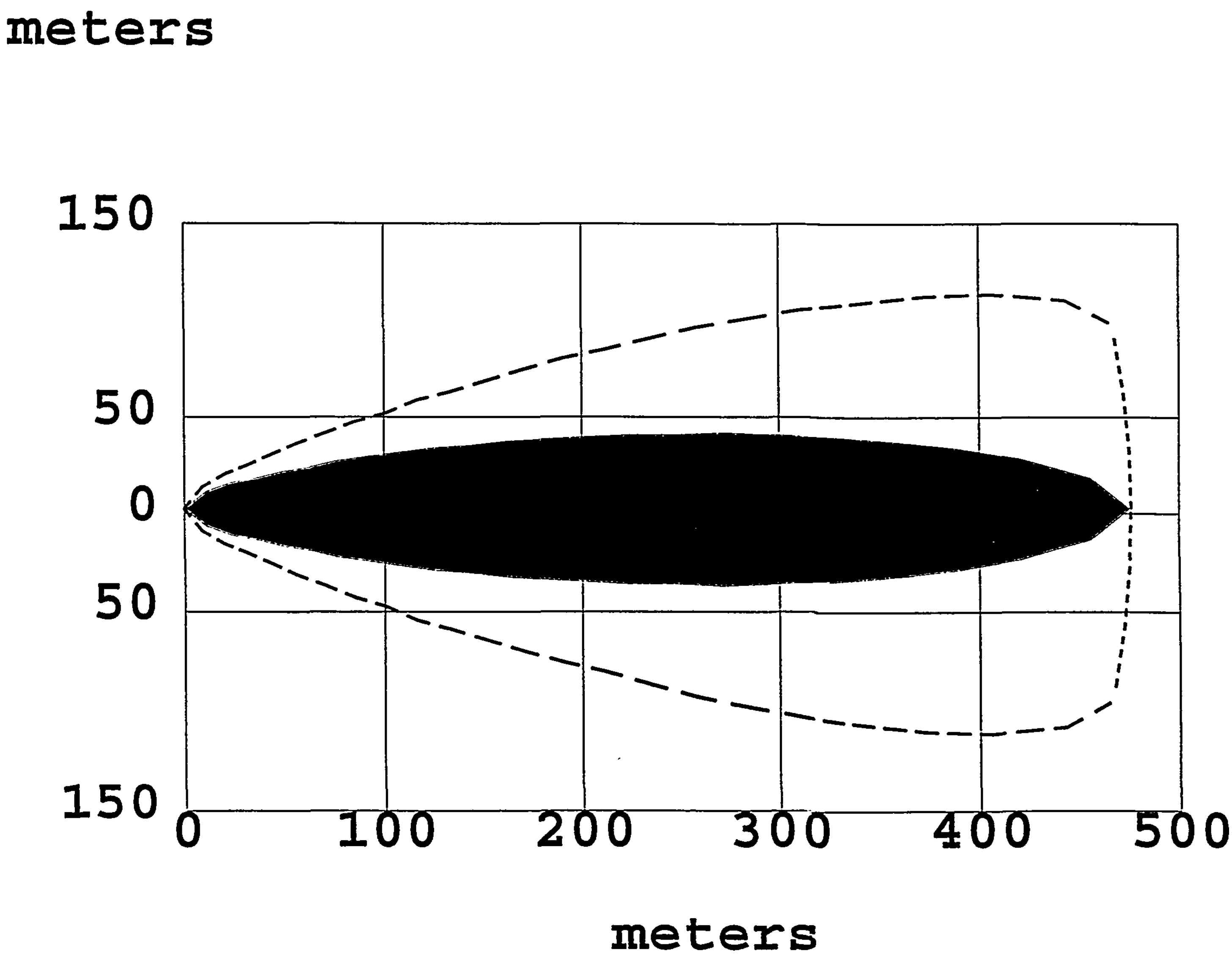
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 475 meters
Max Threat Zone for IDLH: 382 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.618 ppm
Indoor: 0.618 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883118827

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 20 ppm
  Max Threat Zone for LOC: 475 meters
  Max Threat Zone for IDLH: 382 meters
  Note: The Heavy Gas footprint is an initial screening.
    For short releases it may be an overestimation.
    Be sure to check concentration information at specific
locations.

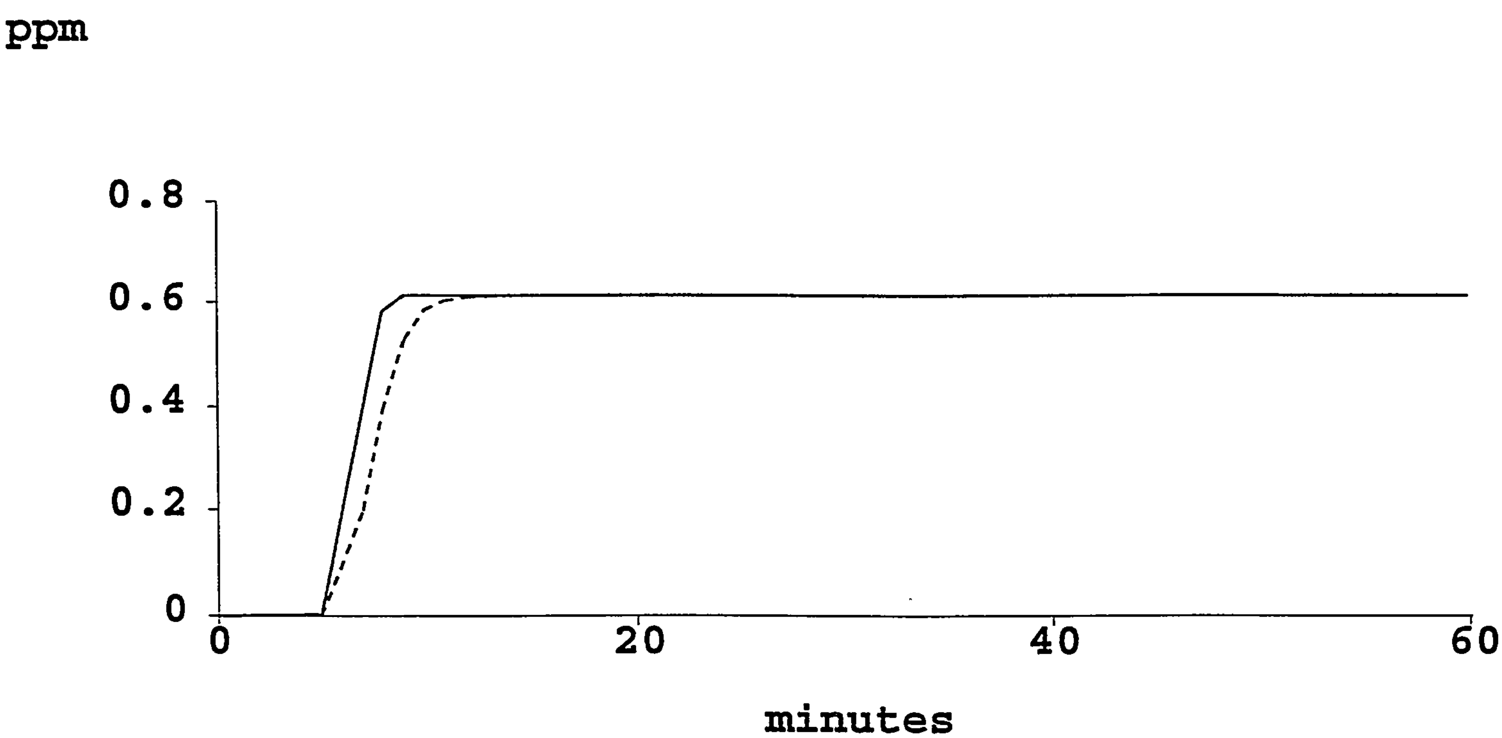


Concentration Window

2883118827

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.618 ppm
Indoor: 0.618 ppm
Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Chlorine (Cl)

PMRF Building 338

Scenario: The release of 600 pounds (273 kg.) of Chlorine from a cylinder via cylinder rupture, valve damage, or a malevolent act. This results in 600 lb. of Chlorine being released into the atmosphere, under a Stability Factor of C with a wind speed of 20 mph. (9 meters per second).

600 Pound Chlorine Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 3 ppm (meters)	ESHE 20 ppm (meters)	Arrive/Depart KTF/Facility Boundary
338	C-52, C-53, C-54, C-55, C-56, C-57, and C-58	0.308 ppm < ERPG-1	10,000 ft. (3.0 km.) "Main Complex"	2,930 ft. (888 m.)	1,075 ft. (325 m)	Arrives in 5.5 minutes Departs at 15.5 minutes

"High End" Average Meteorological Conditions

Text Summary 2883119017

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 1 ppm
Boiling Point: -34.03° 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: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

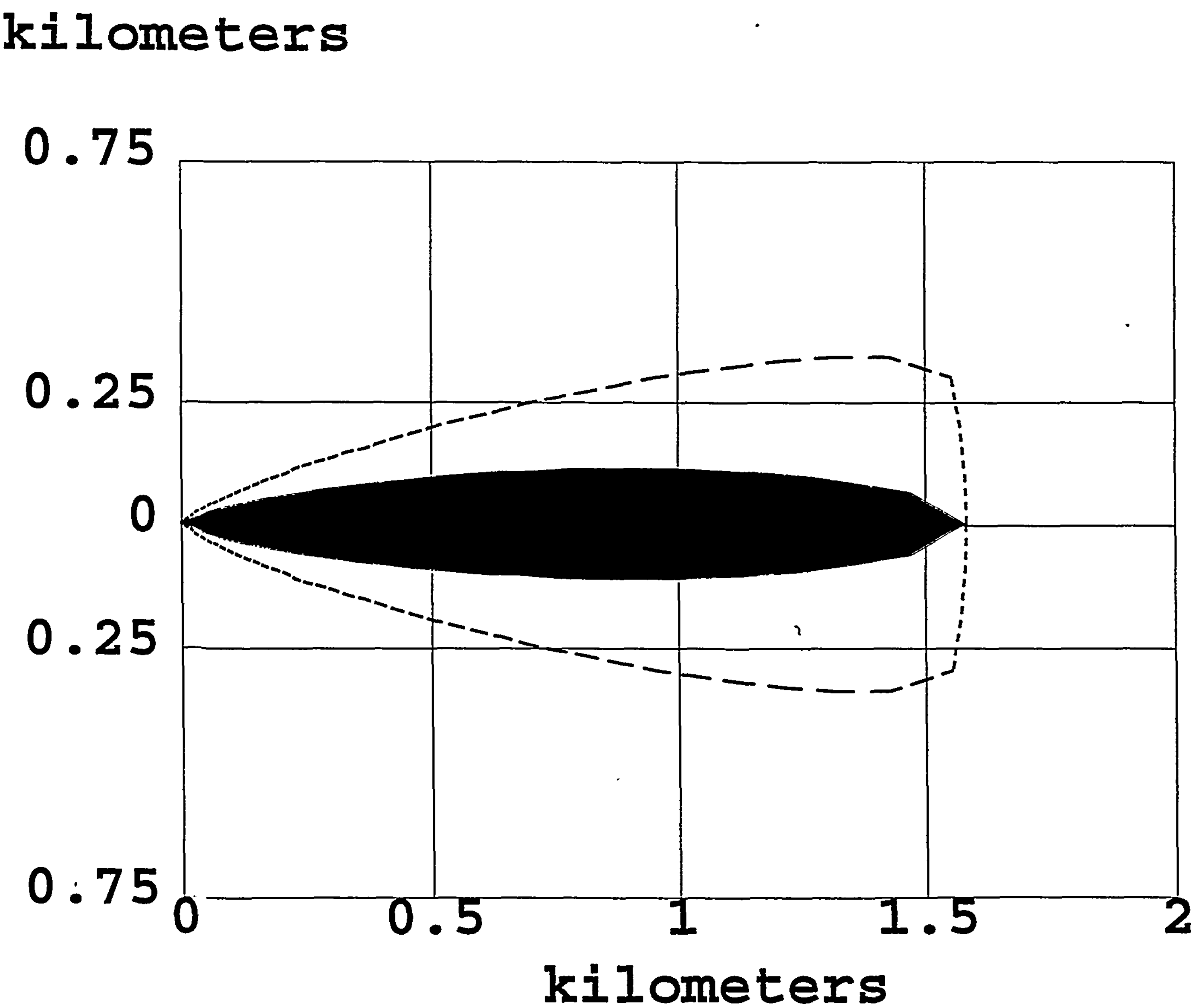
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 1 ppm
Max Threat Zone for LOC: 1.6 kilometers
Max Threat Zone for IDLH: 262 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.308 ppm
Indoor: 0.308 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883119016

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 1 ppm
  Max Threat Zone for LOC: 1.6 kilometers
  Max Threat Zone for IDLH: 262 meters
  Note: The Heavy Gas footprint is an initial screening.
    For short releases it may be an overestimation.
    Be sure to check concentration information at specific locations.



Text Summary 2883119039

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE
Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm
IDLH: 30.00 ppm
Footprint Level of Concern: 3 ppm
Boiling Point: -34.03° 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: 20 mph from 0° true
Inversion Height: 500 feet
Stability Class: C
Air Temperature: 85° F
Relative Humidity: 50%
Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

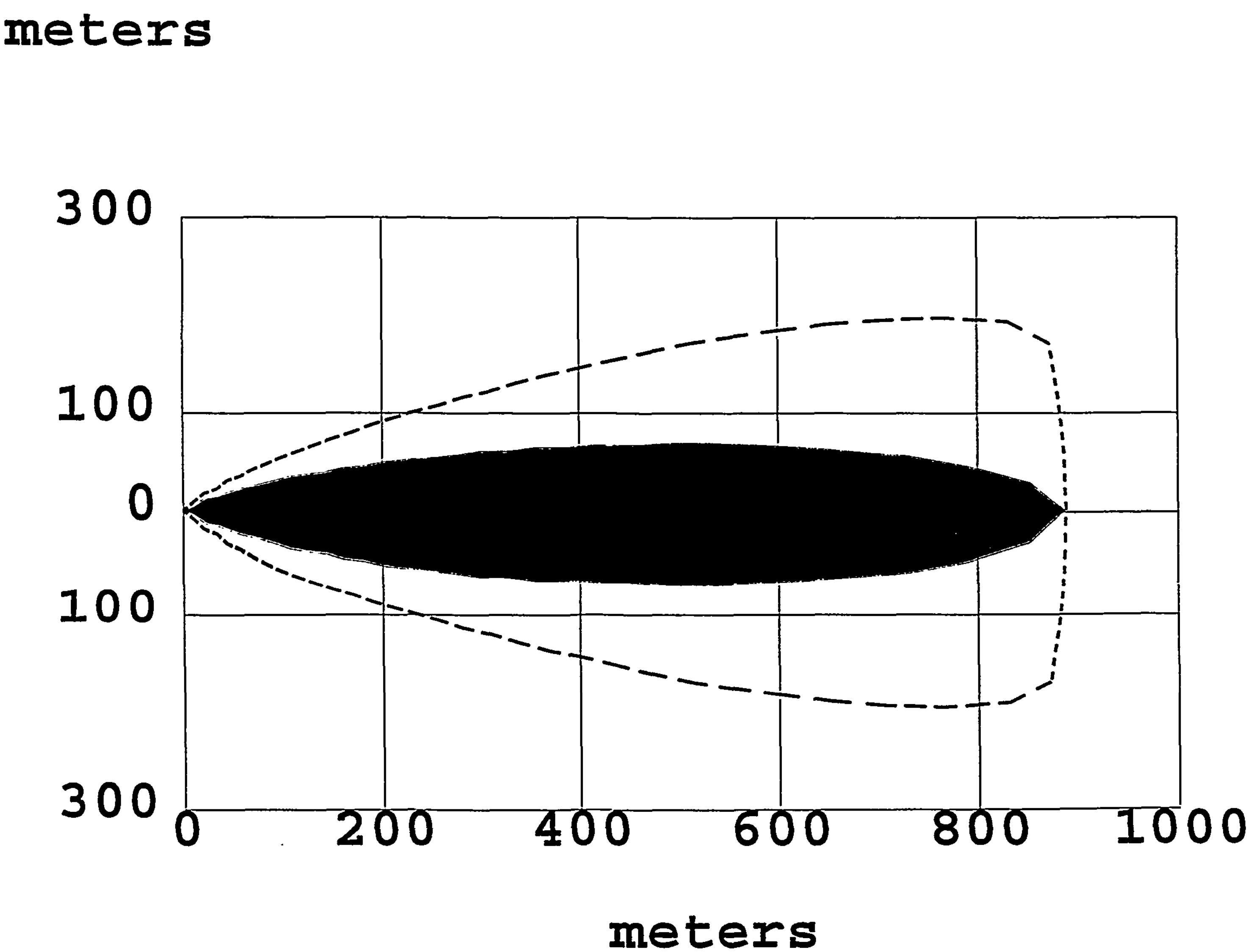
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 888 meters
Max Threat Zone for IDLH: 262 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.308 ppm
Indoor: 0.308 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883119038

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 3 ppm
Max Threat Zone for LOC: 888 meters
Max Threat Zone for IDLH: 262 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.90 kg/kmol
TLV-TWA: 0.50 ppm IDLH: 30.00 ppm
Footprint Level of Concern: 20 ppm
Boiling Point: -34.03° 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: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 60 pounds/min
Source Height: 0
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 27.2 kilograms/min
Total Amount Released: 1,633 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 325 meters
Max Threat Zone for IDLH: 262 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

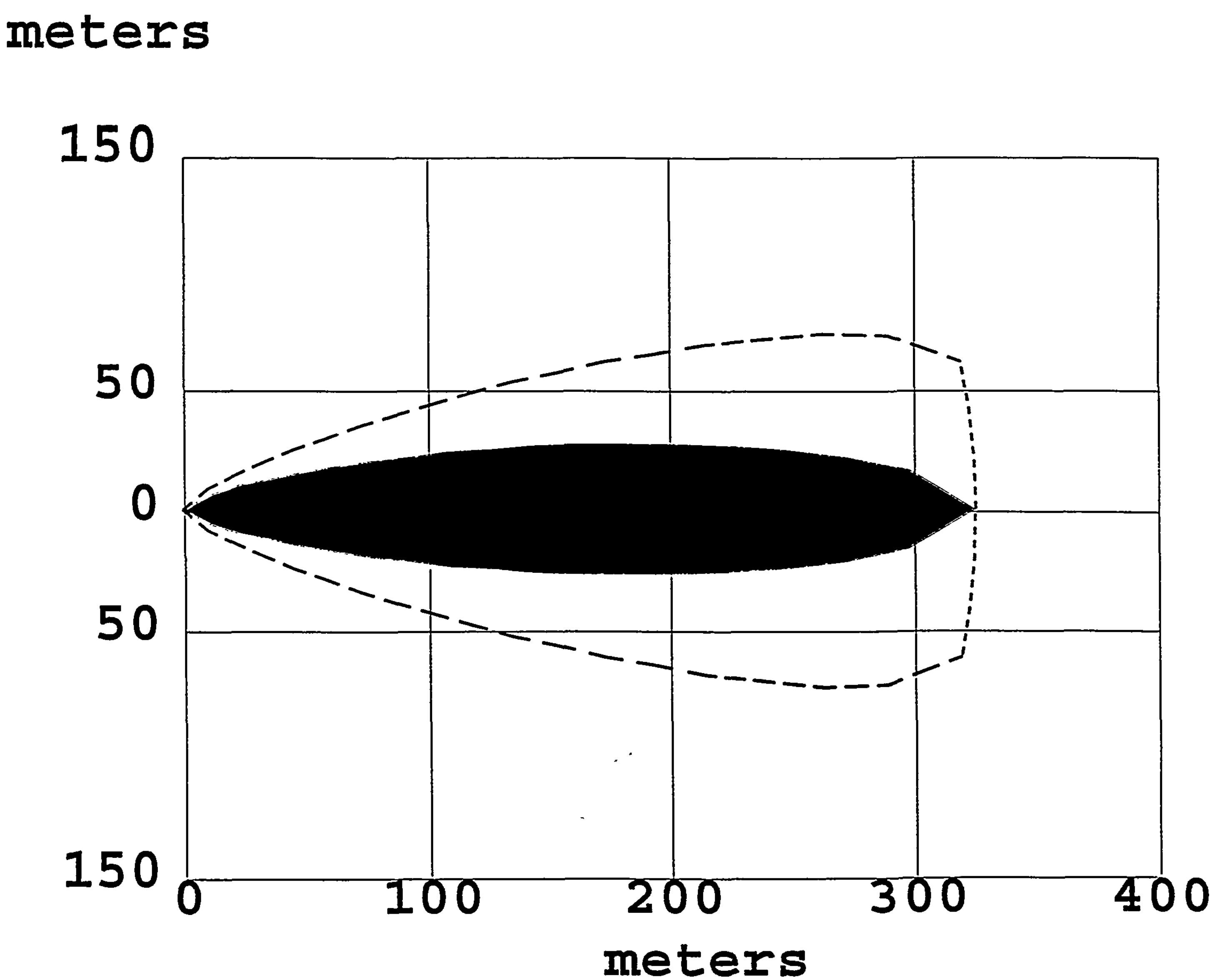
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.308 ppm
Indoor: 0.308 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2883119053

Chemical Name: CHLORINE
Model Run: Heavy Gas
Wind: 20 mph from 0° true

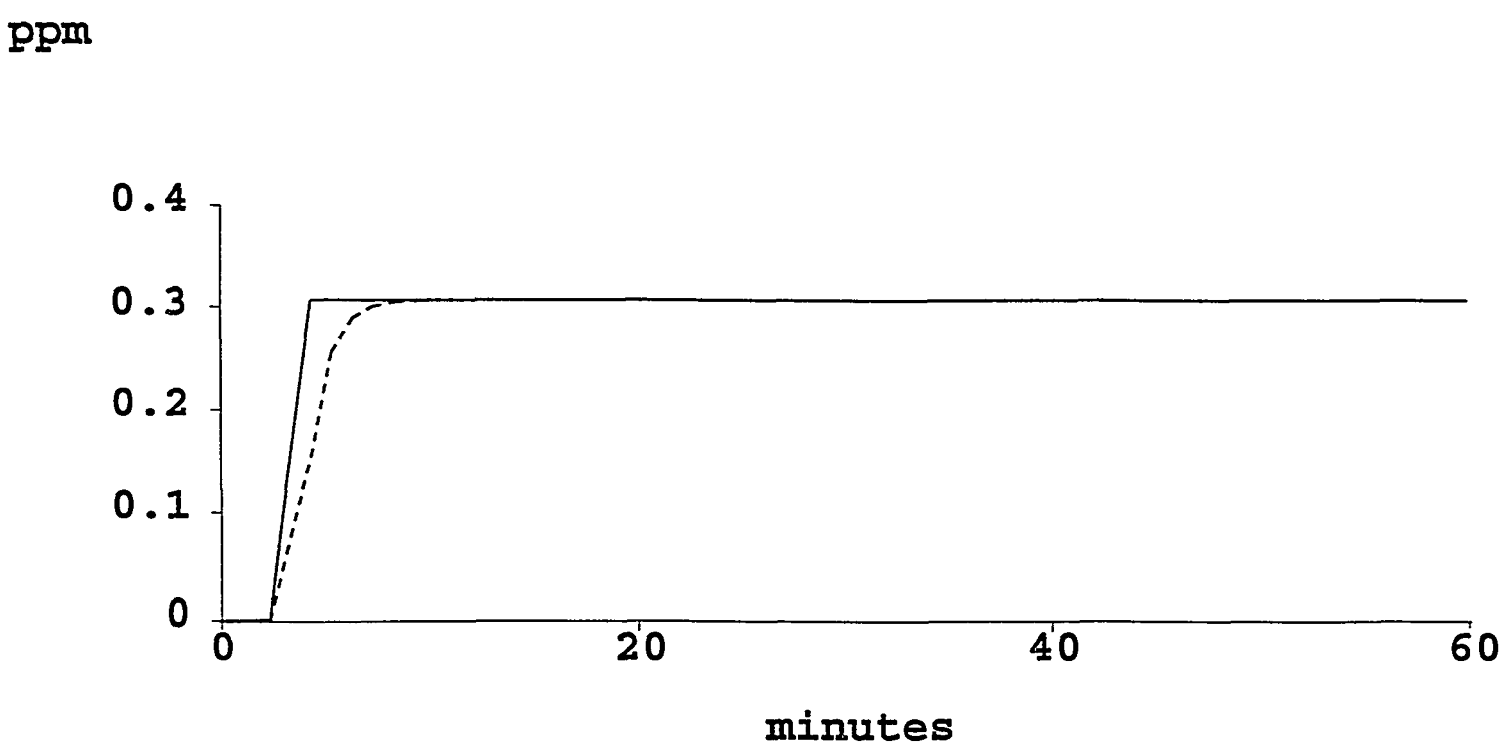
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 20 ppm
Max Threat Zone for LOC: 325 meters
Max Threat Zone for IDLH: 262 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



Concentration Window 2883119017

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 3.0 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.308 ppm
Indoor: 0.308 ppm
Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Sodium Hydroxide HNaO

PMRF Building 419

Scenario: The release of 200 gallons (760 liters) of Sodium Hydroxide from a ruptured vessel, damaged valve, or a malevolent act. This results in 200 gallons of HNaO being released into the environment, under a Stability Factor of F with a wind speed of a meter per second (2.2 mph.).

200 Gallon Sodium Hydroxide Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 40 ppm (meters)	ESHE 100 ppm (meters)	Arrive/Depart KTF/Facility Boundary
419	C-60, C-61, C-62, C-63, C-64, C-65, and C-66	0.981 ppm < ERPG-1	5,000 ft. (1.5 km.) "Main Complex"	460 ft. (139 m.)	250 ft. (75 m)	Arrives in 25 minutes Departs at 25 minutes

"Worst Case" Meteorological Conditions

Text Summary 2883116325

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: SODIUM HYDROXIDE
Molecular Weight: 40.00 kg/kmol
TLV-TWA: 2.00 ppm IDLH: -unavail-
Footprint Level of Concern: 2 ppm
Boiling Point: 140.00° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 20 gallons/min
Source Height: 0
Source State: Liquid
Source Temperature: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 439 grams/min
Total Amount Released: 26.3 kilograms

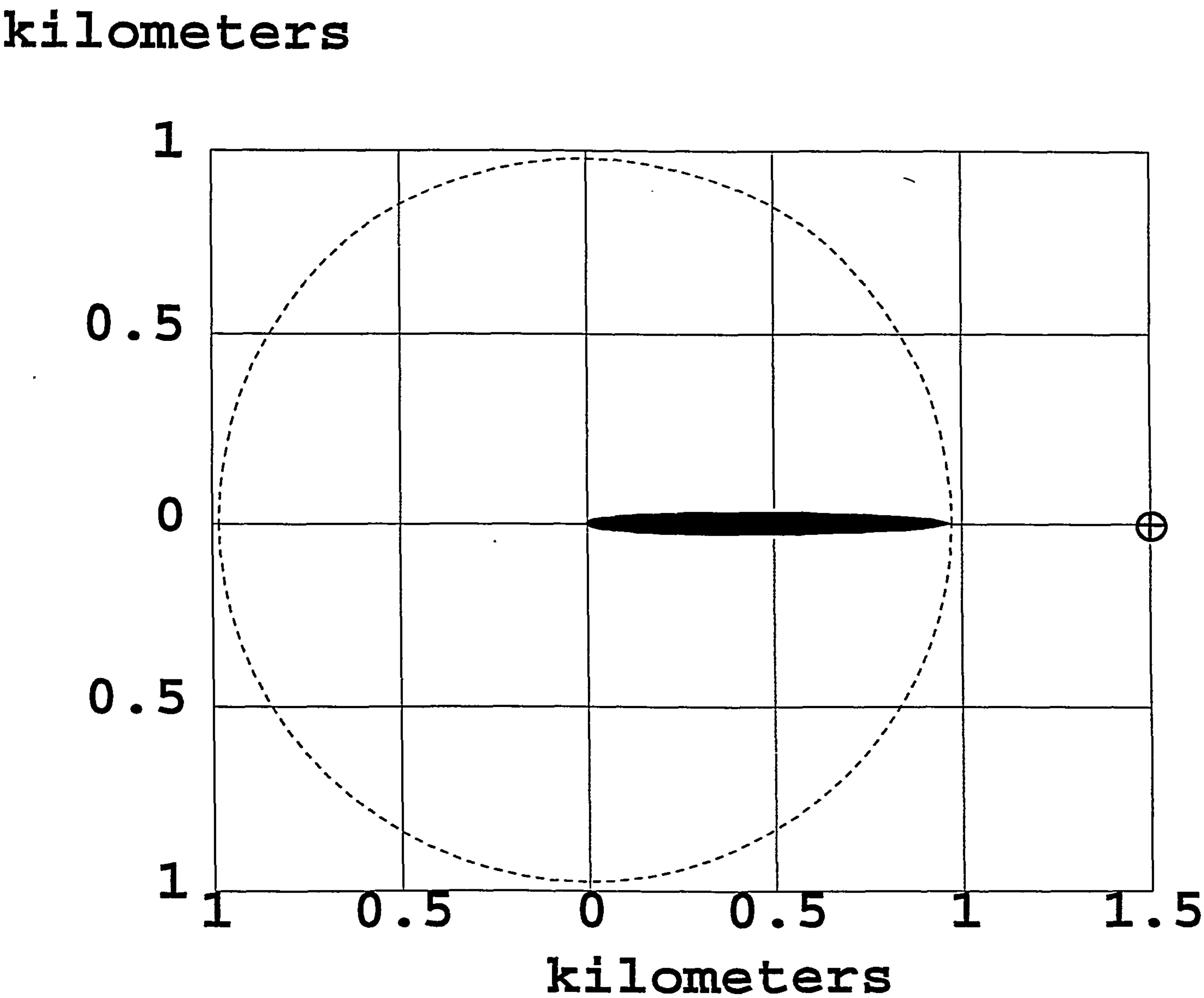
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 2 ppm
Max Threat Zone for LOC: 976 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.981 ppm
Indoor: 0.981 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883116324

Chemical Name: SODIUM HYDROXIDE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 2 ppm
Max Threat Zone for LOC: 976 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



Text Summary 2883116336

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: SODIUM HYDROXIDE
Molecular Weight: 40.00 kg/kmol
TLV-TWA: 2.00 ppm IDLH: -unavail-
Footprint Level of Concern: 40 ppm
Boiling Point: 140.00° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 20 gallons/min
Source Height: 0
Source State: Liquid
Source Temperature: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 439 grams/min
Total Amount Released: 26.3 kilograms

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 40 ppm
Max Threat Zone for LOC: 139 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.

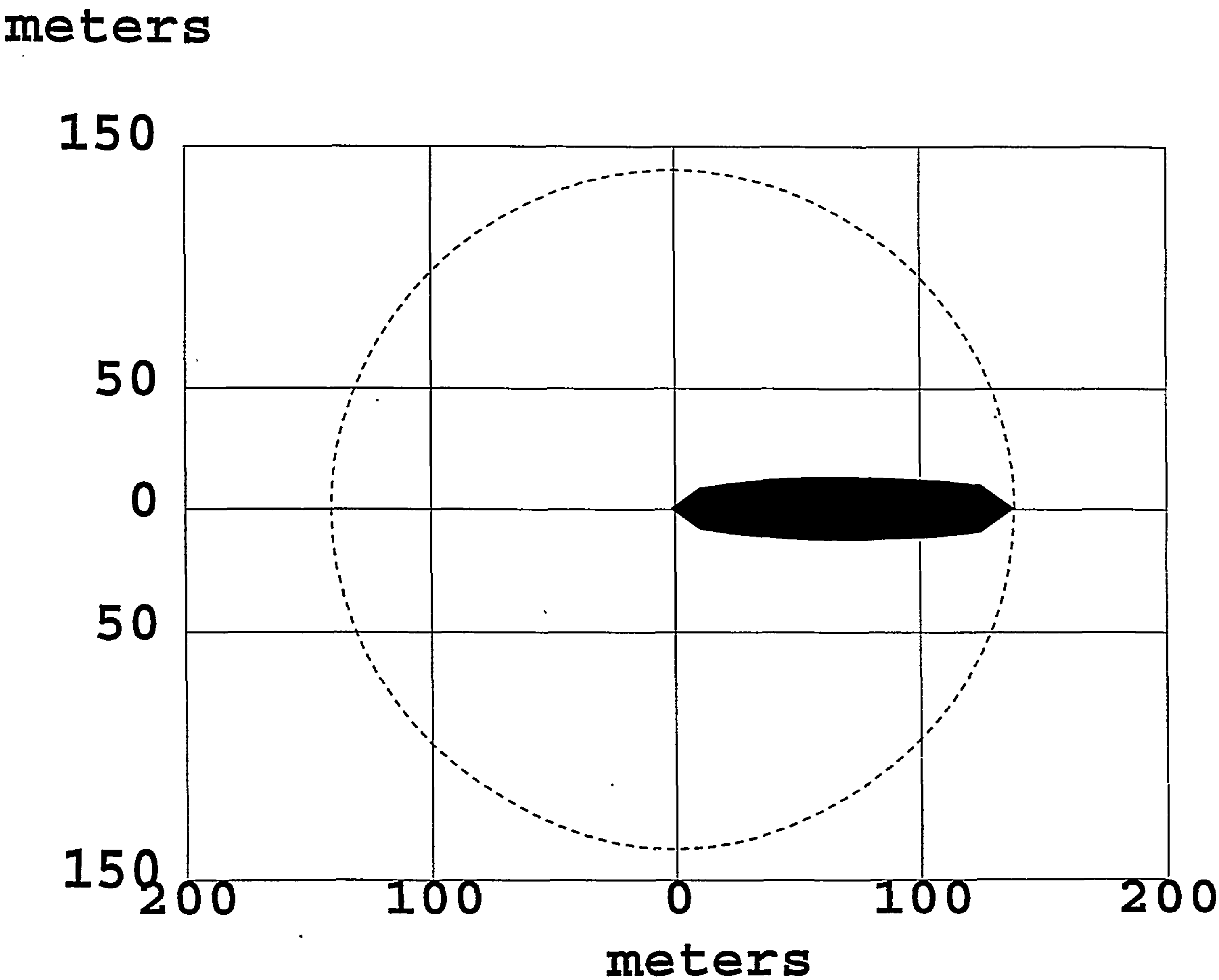
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.981 ppm
Indoor: 0.981 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2883116336

Chemical Name: SODIUM HYDROXIDE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 40 ppm
Max Threat Zone for LOC: 139 meters
Note: The Heavy Gas footprint is an initial screening.
For short releases it may be an overestimation.
Be sure to check concentration information at specific locations.



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: SODIUM HYDROXIDE
Molecular Weight: 40.00 kg/kmol
TLV-TWA: 2.00 ppm IDLH: -unavail-
Footprint Level of Concern: 100 ppm
Boiling Point: 140.00° 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 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 20 gallons/min
Source Height: 0
Source State: Liquid
Source Temperature: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 439 grams/min
Total Amount Released: 26.3 kilograms

FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User specified LOC: 100 ppm
Max Threat Zone for LOC: 75 meters
Note: Footprint wasn't drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.981 ppm
Indoor: 0.981 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883116347

Chemical Name: SODIUM HYDROXIDE
Model Run: Heavy Gas
Wind: 1 meters/sec from 0° true

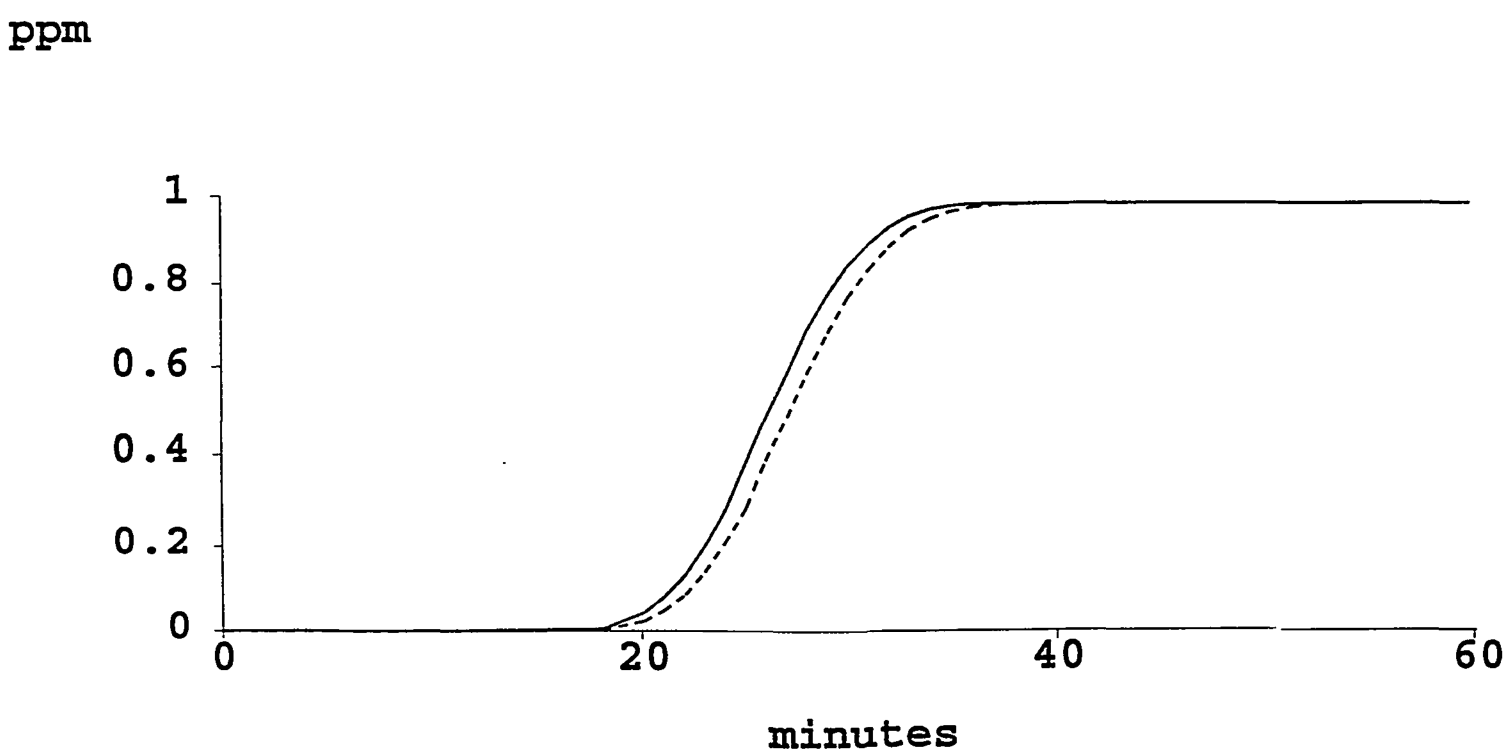
FOOTPRINT INFORMATION:
  Model Run: Heavy Gas
  User specified LOC: 100 ppm
  Max Threat Zone for LOC: 75 meters
  Note: Footprint wasn't drawn because effects of
    near-field patchiness make plume presentation
    unreliable for short distances.

Model Run: Heavy Gas
User specified LOC: 100 ppm
Max Threat Zone for LOC: 75 meter
Note: Footprint wasn't drawn beca
  near-field patchiness make plum
  unreliable for short distances.

Concentration Window 2883116324

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 1.5 kilometers
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.981 ppm
Indoor: 0.981 ppm
Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Anhydrous Ammonia

Agricultural Applications

Scenario: The release of 1,000 gallons (3,800 liters) of Anhydrous Ammonia from a furtalizer tank, damaged valve, or a malevolent act. This results in 1,000 gallons of Ammonia being released into the environment, under a Stability Factor of F with a wind speed of a meter per second (2.2 mph.).

1,000 Gallon Anhydrous Ammonia Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 40 ppm (meters)	ESHE 300 ppm (meters)	Arrive/Depart KTF/Facility Boundary
Sugar Cane Field	C-68, C-69, C-70, C-71, C-72, C-73, and C-74	70.3 ppm > ERPG-2	660 ft. (200 m.) "Main Complex"	884 ft. (268 m.)	314 ft. (95 m)	Arrives in 3 minutes Departs at 13 minutes

"Worst Case" Meteorological Conditions

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 3 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 224 grams/min
Total Amount Released: 13.5 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 1.1 kilometers
Max Threat Zone for IDLH: 74 meters

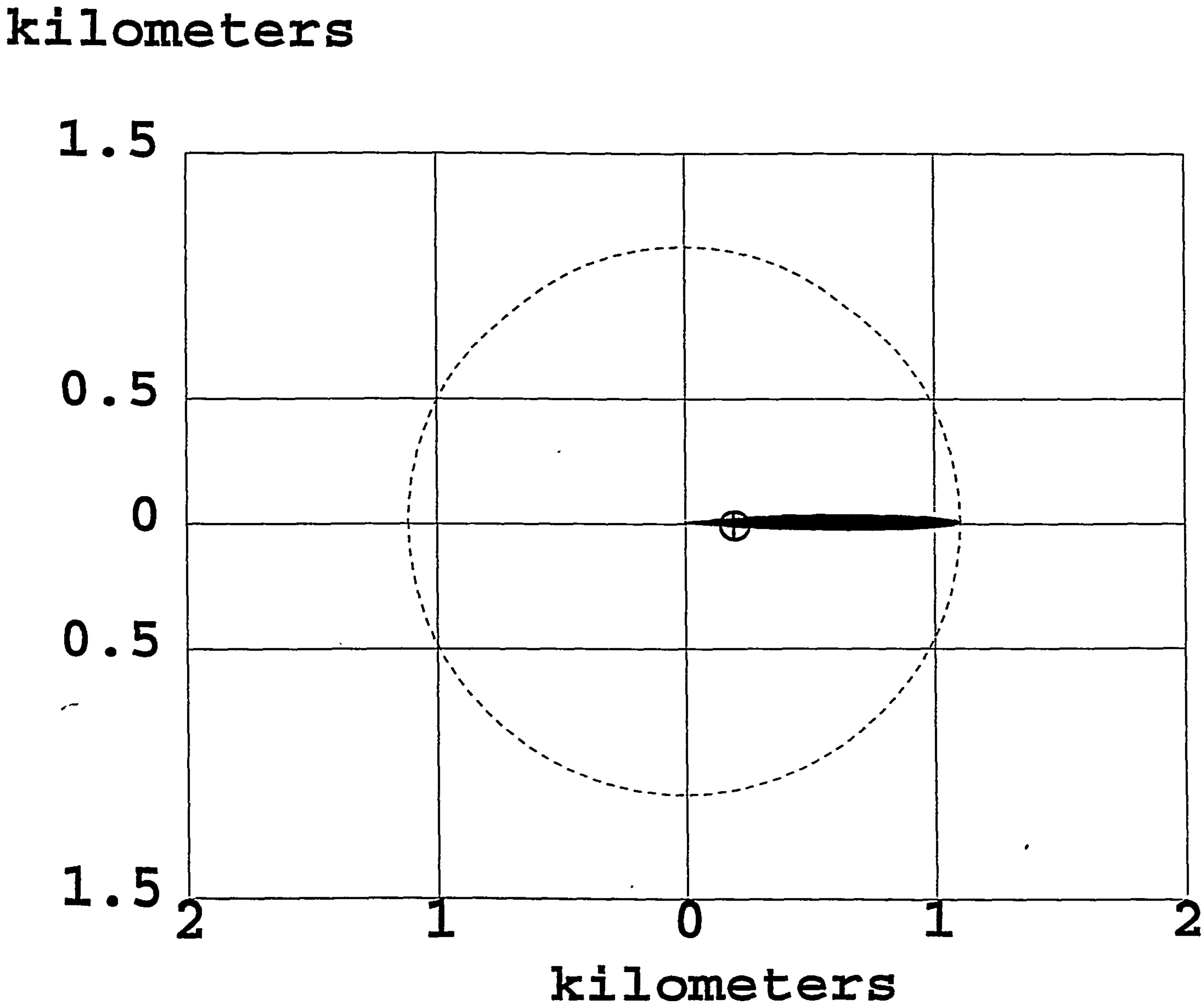
TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 70.3 ppm
Indoor: 70.3 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window

2883120196

Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 1.1 kilometers
Max Threat Zone for IDLH: 74 meters



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 40 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 feet
Stability Class: F Air Temperature: 68° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 224 grams/min
Total Amount Released: 13.5 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

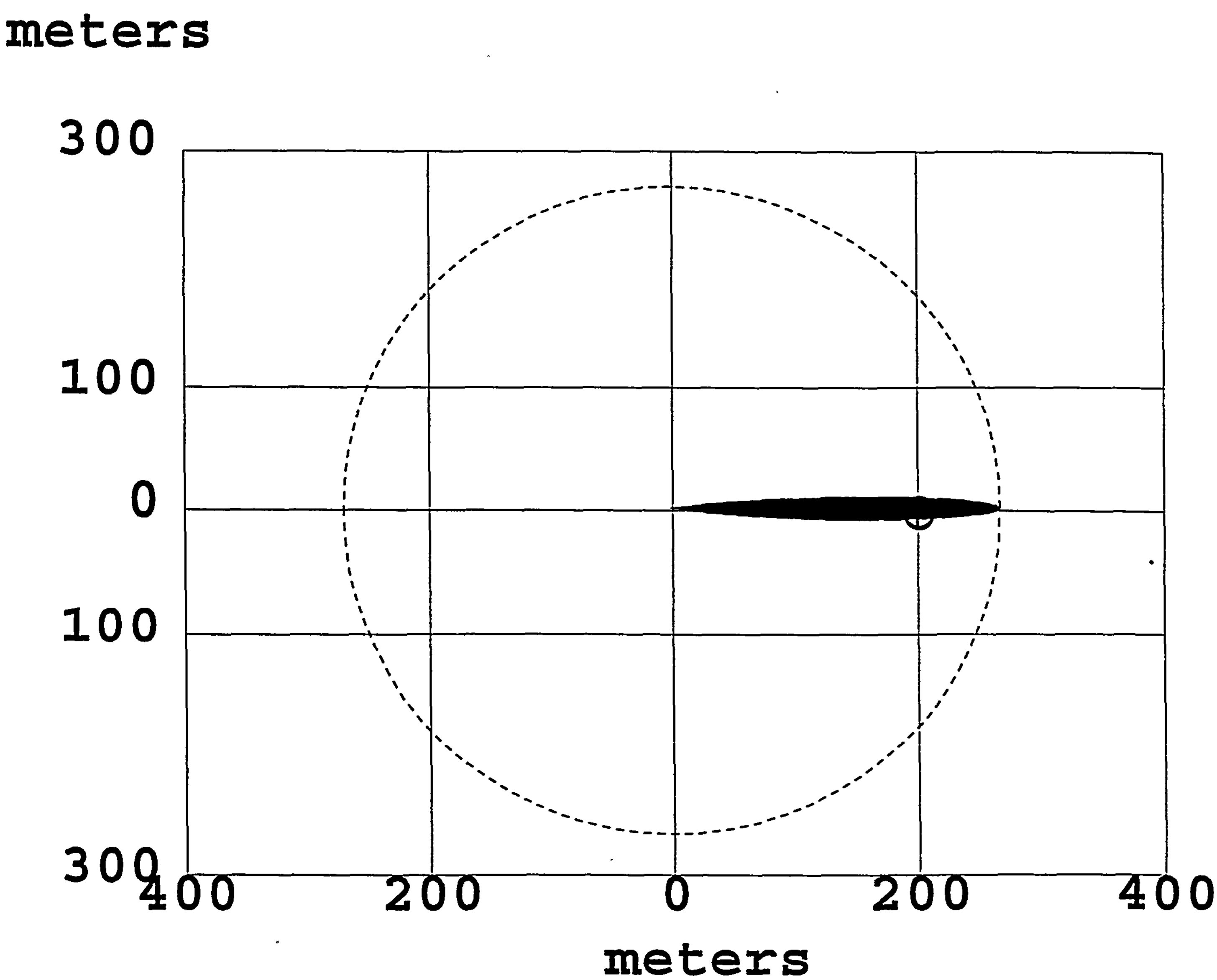
FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 40 ppm
Max Threat Zone for LOC: 268 meters
Max Threat Zone for IDLH: 74 meters

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 70.3 ppm
Indoor: 70.3 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120188

Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 40 ppm
Max Threat Zone for LOC: 268 meters
Max Threat Zone for IDLH: 74 meters



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm   IDLH: 500.00 ppm
Footprint Level of Concern: 300 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 1 meters/sec from 0° true
Inversion Height: 500 feet
Stability Class: F   Air Temperature: 68° F
Relative Humidity: 50%   Ground Roughness: Open country
Cloud Cover: 1 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 224 grams/min
Total Amount Released: 13.5 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: 95 meters
Max Threat Zone for IDLH: 74 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: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 70.3 ppm
Indoor: 70.3 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120178

Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 1 meters/sec from 0° true

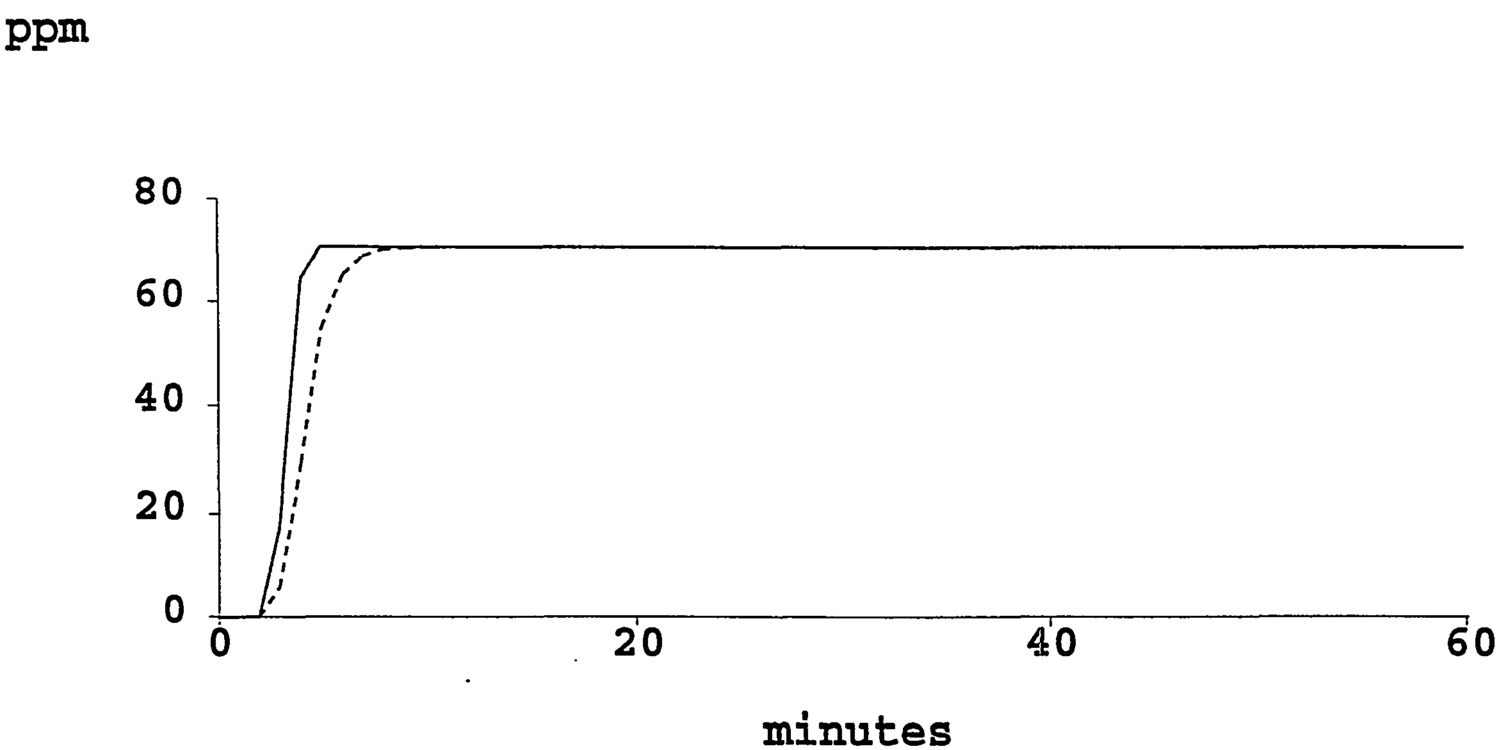
FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: 95 meters
Max Threat Zone for IDLH: 74 meters
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: 95 mete
Max Threat Zone for IDLH: 74 mete
Note: Footprint was not drawn bec
effects of near-field patchine
presentation unreliable for sh

Concentration Window 2883120178

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

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 200 meters
  Off Centerline: 0 meters
  Max Concentration:
    Outdoor: 70.3 ppm
    Indoor: 70.3 ppm
  Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Anhydrous Ammonia

Agricultural Applications

Scenario: The release of 1,000 gallons (3,800 liters) of Anhydrous Ammonia from a furtalizer tank, damaged valve, or a malevolent act. This results in 1,000 gallons of Ammonia being released into the environment, under a Stability Factor of C with a wind speed of 10 mph. (4.5 meters per second).

1,000 Gallon Anhydrous Ammonia Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 40 ppm (meters)	ESHE 300 ppm (meters)	Arrive/Depart KTF/Facility Boundary
Sugar Cane Field	C-76, C-77, C-78, C-79, C-80, C-81, and C-82	1.1 ppm < ERPG-1	660 ft. (200 m.) "Main Complex"	109 ft. (33 m.)	40 ft. (12 m)	Arrives in <1 minutes Departs at <10 minutes

"Low End" Average Meteorological Conditions

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 3 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 217 grams/min
Total Amount Released: 13.0 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

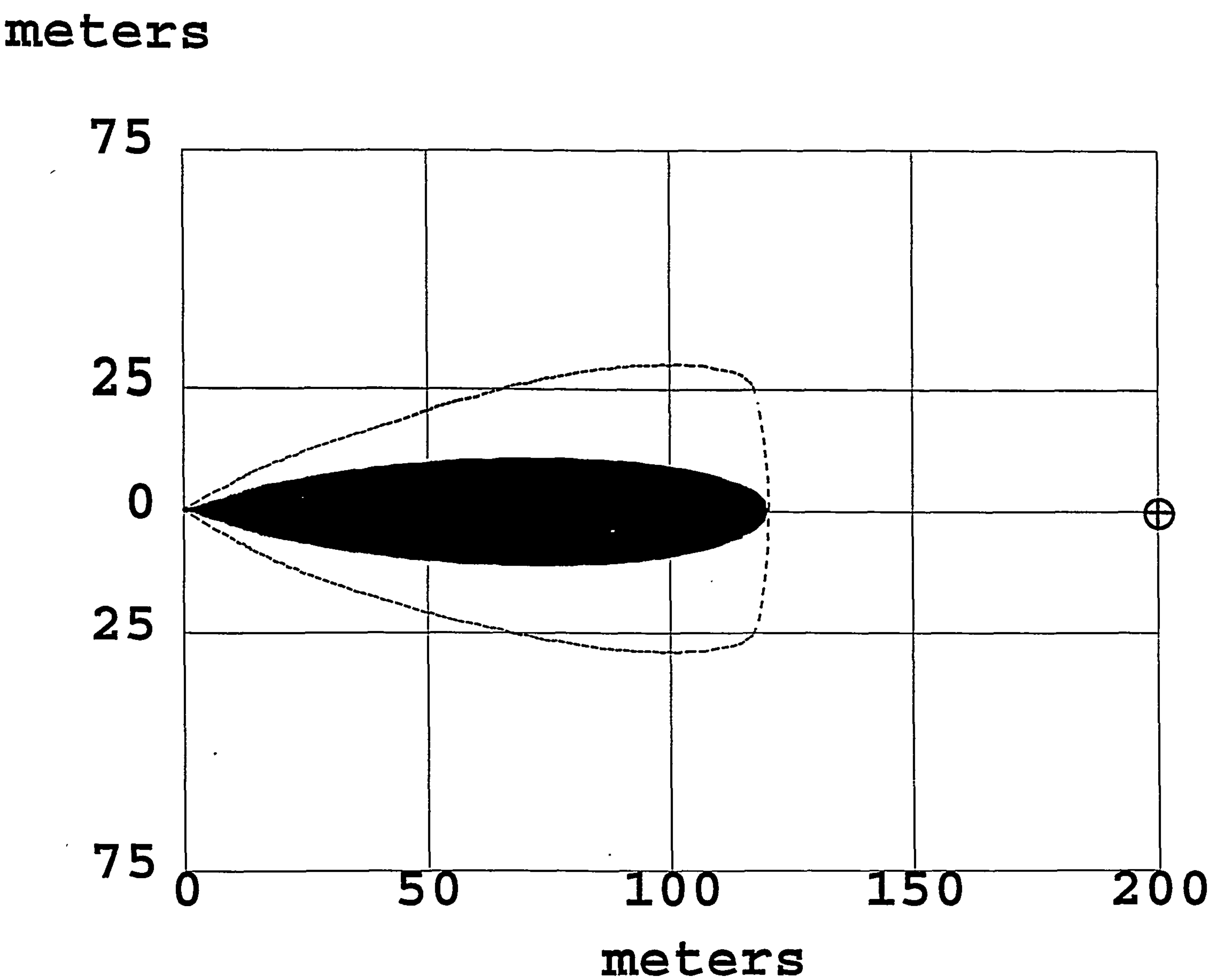
FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 121 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1.1 ppm
Indoor: 1.1 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120106

Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 10 mph from 0° true

FOOTPRINT INFORMATION:
  Dispersion Module: Gaussian
  User specified LOC: 3 ppm
  Max Threat Zone for LOC: 121 meters
  Max Threat Zone for IDLH: less than 10 meters(10.9 yards)



SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 40 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 217 grams/min
Total Amount Released: 13.0 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 40 ppm
Max Threat Zone for LOC: 33 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1.1 ppm
Indoor: 1.1 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120097

```
Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 10 mph from 0° true


FOOTPRINT INFORMATION:
  Dispersion Module: Gaussian
  User specified LOC: 40 ppm
  Max Threat Zone for LOC:  33 meters
  Max Threat Zone for IDLH: less than 10 meters(10.9 yards).
  Note: Footprint was not drawn because
     effects of near-field patchiness make plume
     presentation unreliable for short distances.
```

Dispersion Module: Gaussian
User specified LOC: 40 ppm
Max Threat Zone for LOC: 33 mete
Max Threat Zone for IDLH: less th
Note: Footprint was not drawn bec
effects of near-field patchine
presentation unreliable for sh

Text Summary 2883120086

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 300 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 10 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 217 grams/min
Total Amount Released: 13.0 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: 12 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 1.1 ppm
Indoor: 1.1 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120085

Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 10 mph from 0° true

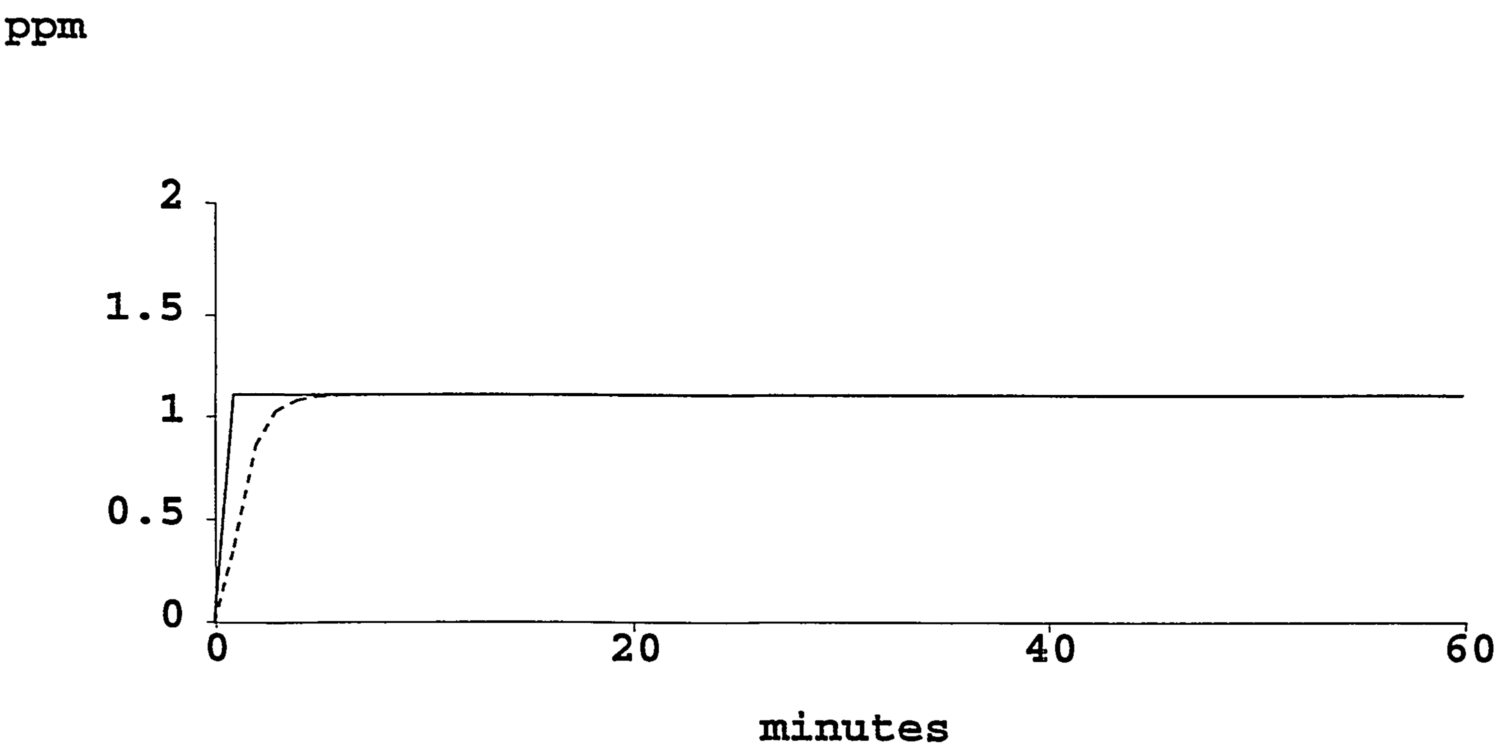
FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: 12 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: 12 mete
Max Threat Zone for IDLH: less th
Note: Footprint was not drawn bec
effects of near-field patchine
presentation unreliable for sh

Concentration Window 2883120085

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

TIME DEPENDENT INFORMATION:
  Concentration Estimates at the point:
  Downwind: 200 meters
  Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 1.1 ppm
     Indoor: 1.1 ppm
  Note: Indoor graph is shown with a dotted line.



Hazards not Owned or Controlled by SNL/KTF

Anhydrous Ammonia

Agricultural Applications

Scenario: The release of 1,000 gallons (3,800 liters) of Anhydrous Ammonia from a furtalizer tank, damaged valve, or a malevolent act. This results in 1,000 gallons of Ammonia being released into the environment, under a Stability Factor of C with a wind speed of 20 mph. (9 meters per second).

1,000 Gallon Anhydrous Ammonia Release

Respective Consequences		Concentrations at the nearest KTF Boundary	Distance to the nearest KTF Boundary	Distance to		Time Till Plume
By Building	Found On Pages			ERPG-2 40 ppm (meters)	ESHE 300 ppm (meters)	Arrive/Depart KTF/Facility Boundary
Sugar Cane Field	C-84, C-85, C-86, C-87, C-88, C-89, and C-90	0.55 ppm < ERPG-1	660 ft. (200 m.) "Main Complex"	76 ft. (23 m.)	<33 ft. (<10 m)	Arrives in <1 minutes Departs at <10 minutes

"High End" Average Meteorological Conditions

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 3 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 217 grams/min
Total Amount Released: 13.0 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 85 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.55 ppm
Indoor: 0.55 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120128

Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 85 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 3 ppm
Max Threat Zone for LOC: 85 mete
Max Threat Zone for IDLH: less th
Note: Footprint was not drawn bec
effects of near-field patchine
presentation unreliable for sh

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 40 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 217 grams/min
Total Amount Released: 13.0 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 40 ppm
Max Threat Zone for LOC: 23 meters
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because effects of near-field patchiness make plume presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.55 ppm
Indoor: 0.55 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120137

```
Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 20 mph from 0° true


FOOTPRINT INFORMATION:
  Dispersion Module: Gaussian
  User specified LOC: 40 ppm
  Max Threat Zone for LOC:  23 meters
  Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
  Note: Footprint was not drawn because
     effects of near-field patchiness make plume
     presentation unreliable for short distances.
```


Dispersion Module: Gaussian
User specified LOC: 40 ppm
Max Threat Zone for LOC: 23 mete
Max Threat Zone for IDLH: less th
Note: Footprint was not drawn bec
effects of near-field patchine
presentation unreliable for sh

SITE DATA INFORMATION:
Location: ALBUQUERQUE, NEW MEXICO
Building Air Exchanges Per Hour: 60 (User specified)
Date and Time: Fixed at January 1, 1995 0900 hours

CHEMICAL INFORMATION:
Chemical Name: AMMONIA, ANHYDROUS
Molecular Weight: 17.03 kg/kmol
TLV-TWA: 25.00 ppm IDLH: 500.00 ppm
Footprint Level of Concern: 300 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%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 20 mph from 0° true Inversion Height: 500 feet
Stability Class: C Air Temperature: 85° F
Relative Humidity: 50% Ground Roughness: Open country
Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
Direct Source: 100 gallons/min
Source Height: 0
Source State: Gas
Source Temperature: equal to ambient
Source Pressure: equal to ambient
Release Duration: ALOHA limited the duration to 1 hour
Release Rate: 217 grams/min
Total Amount Released: 13.0 kilograms
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: less than 10 meters(10.9 yards)
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.55 ppm
Indoor: 0.55 ppm
Note: Indoor graph is shown with a dotted line.

Footprint Window 2883120146

Chemical Name: AMMONIA, ANHYDROUS
Model Run: Gaussian
Wind: 20 mph from 0° true

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: less than 10 meters(10.9 yards)
Max Threat Zone for IDLH: less than 10 meters(10.9 yards)
Note: Footprint was not drawn because
effects of near-field patchiness make plume
presentation unreliable for short distances.

Dispersion Module: Gaussian
User specified LOC: 300 ppm
Max Threat Zone for LOC: less th
Max Threat Zone for IDLH: less th
Note: Footprint was not drawn bec
effects of near-field patchine
presentation unreliable for sh

Concentration Window 2883120147

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

TIME DEPENDENT INFORMATION:
Concentration Estimates at the point:
Downwind: 200 meters
Off Centerline: 0 meters
Max Concentration:
Outdoor: 0.55 ppm
Indoor: 0.55 ppm
Note: Indoor graph is shown with a dotted line.