MMSC-SA-94151
UC-707

Safety Assessment for Waste Management

Environmental, Safety and Health

September 22, 1995

LOCKHEED MARTIN

Lockheed Martin Specialty Components is the Management and Operating Contractor for the Pinellas Plant Under U.S. Department of Energy Contract No. DE-AC04-92AL73000.

DISCLAIMER

Title: Safety Assessment for Waste Management

Number: MMSC-SA-94151

Issue Date: September 22, 1995

DOCUMENT CONTROL

This document will be maintained by Records Management in accordance with the site-wide document control procedures. Document control elements include unique issue numbers, document identification, numbered pages, document distribution records, tracking of revisions, a document MASTER filing and retrieval system, and a document archiving system.

The Pinellas Plant
P.O. Box 2908
Largo, Florida 34649-2908

Lockheed Martin Specialty Components is the Management and Operating Contractor for the Pinellas Plant Under U.S. Department of Energy Contract No. DE0AC04-92AL73000.

This page left blank intentionally.

DOCUMENT APPROVALS

Prepared By:

A. DeWeerd — 19APR94
Safety Engineer
Date

K. Relihan — 4/19/94
Safety Engineer
Date

Approved By:

P. Dillard — 4/22/94
Program Manager
Date

J. Fox, Manager — 4/20/94
Emergency Management
Date

S. Mee, Supervisor — 4/22/94
Waste Management
Date

K. Hall, Manager — 4/20/94
Plant Facilities
Date

DOCUMENT APPROVALS (Continued)

4-29-94

J. Jefferson, Manager
Safety, Fire Protection, and Industrial Hygiene
Date

4-28-94

D. Delaneuville, Manager
Waste Management/Minimization
Date

4/28/94

R. Welberry, Manager
Risk and Emergency Management and
Radiation Protection
Date

4/29/94

T. Pharo, Director
Environmental, Safety and Health
Date

4/28/94

Safety Review Committee Chairperson
Date

REVIEWED FOR CLASSIFICATION:

4/22/94

Classification Officer/Analyst/Derivative Classifier
Date

UNCLASSIFIED

Classification Level

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

ILLUSTRATIONS

TABLES

APPENDICES

This page left blank intentionally.

1.0 INTRODUCTION

This Safety Assessment (SA) contains the descriptions and evaluations of the significant environmental, health, and safety issues associated with Waste Management at the Pinellas Plant. It provides the following:

Site and facility descriptions

An overall description of Waste Management and its operations

An evaluation of the hazards associated with processes and operations that take place within Waste Management

Descriptions and analyses of the adequacy of measures taken to eliminate, control, or mitigate identified hazards

Assessment of potential accidents and their associated risks

The objective of this SA is to document the results of an evaluation of safety-related issues associated with Waste Management. This SA is prepared in accordance with the requirements of the Department of Energy (DOE) Order DOE/AL 5481.1B (Ref. 1) to document the safety basis of the facility and to provide information required to determine the need for further safety documentation (i.e., Safety Analysis Report).

This SA contains the results of safety evaluations of Waste Management operations, equipment, and supplied systems. The evaluations include, as appropriate, preliminary hazards listings, qualitative risk assessments, and quantitative risk assessments. An accident assessment was performed for each system or area that was identified in the preliminary hazard screening to contain hazards greater than those routinely encountered and accepted by the public. The accident assessment also includes a quantitative evaluation of the probabilities and consequences of those events that could endanger the public, the environment, or plant workers, if the risks posed are sufficiently high. These accident assessments were developed in detail to provide complete coverage of all safety issues, and utilize to some extent, the methodology and sophistication employed in Safety Analysis Reports, as mandated in DOE/AL 5481.1B.

1.1 General Description of the Facility - Pinellas Plant

The Pinellas Plant is located in Pinellas County, Florida, near the city of St. Petersburg, and is wholly owned by the United States Government (Department of Energy). The prime operating contractor is Martin Marietta Specialty Components, Inc. (Specialty Components).

The manufacturing operations at the Pinellas Plant are categorized as "Metal Finishing," as defined by the U.S. Environmental Protection Agency (EPA). A list of manufacturing processes at the plant includes: electroplating, electroless plating, encapsulation, etching and chemical cleaning, machining, grinding, burnishing, impact deformation, shearing, thermal cutting, brazing, welding, cutting, flame spraying, sand blasting, solvent degreasing, calibration, and testing. This work involves the handling of small quantities of the radioactive gases tritium and krypton-85 (Ref. 2).

1.2 Facility Design and Construction Organizations - Pinellas Plant

The General Electric (GE) Company completed the original construction of the Pinellas Plant in 1956. Under contract, the H.K. Ferguson Company designed and constructed the plant. As plant owner, GE operated the facility until 1958 when the Atomic Energy Commission (AEC) bought the plant. Since its purchase in 1958, the Pinellas Plant has operated continuously as a part of the Nation's Nuclear Weapons Complex. Approximately 35 percent of the site is covered by structures and paved areas. Included in 65 percent of open space are three storm-retention ponds, with a combined surface area of approximately five acres (2 hectares).

From its original 160,920-square-foot, single-structure size, constructors have increased the plant space to its present 715,000-square-feet size, which is contained within 14 separate buildings (Ref. 3).

1.3 Site Activities - Waste Management Facilities

This Safety Assessment addresses the operations and supporting systems associated with the Waste Management facilities (Buildings 1000, 1010, and 1040, the Reactive Metals Treatment Facility, and the Thermal Treatment Facility). Waste Management collects, stores and/or treats hazardous wastes and containerized liquid wastes that cannot be treated as sanitary wastes (and therefore cannot be disposed of in a landfill). Such wastes include radioactively contaminated solid wastes and Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes. These wastes are temporarily stored in the Waste Management facilities until they are picked up and transported off site for approved disposal. The hazardous wastes are permitted for temporary storage in Building 1040 in accordance with EPA Permit Number H052-159339. Wastes containing reactive metals are neutralized with water in the Reactive Metals Treatment Facility. Waste heat powder and other explosive wastes are ignited in the Thermal Treatment Facility in order to negate their explosive characteristics. The thermal treatment of reactive metals, waste heat powder, and other explosive materials is allowed per the State of Florida Air Emissions Permit Number A052-233355.

The Waste Management group is responsible for collection of wastes that are placed at a central collection point outside Building 100 and by request from personnel in other buildings. Process areas are responsible for the proper satellite accumulation (i.e., initial waste packaging). However, some waste streams, such as batteries and lab-packs, are repacked by Waste Management personnel at Building 1040. Wastes are transported to the Waste Management facilities on forklifts or in a transport cart. They are then stacked on pallets in storage awaiting removal.

Waste Management facilities and operations have been selected for Safety Assessment analysis to address the hazard associated with potential releases of toxic chemicals. An additional concern is the possibility that personnel may be exposed to radiation due to accidental exposure from radioactively contaminated wastes. It is the purpose of this Safety Assessment to provide an in-depth analysis of the systems and potential hazards in thc Waste Management facilities.

This page left blank intentionally.

2.0 SUMMARY AND CONCLUSION

Quantitative and qualitative safety analyses were performed on systems and operations within the Waste Management area to assess the hazards and level of risk posed by these hazards on plant workers, the public, and the environment. This chapter summarizes the results of those analyses and includes assessments of the effects of identified accident conditions on Pinellas Plant facilities and operations. This chapter also discusses the basis for the conclusion that the risks associated with Waste Management operations are acceptably low.

2.1 Summary

The most significant hazards associated with the Waste Management area are listed below:

Storage, packing, and transportation of radioactive, toxic, reactive, and flammable waste

Systems identified as crucial to safety for the Waste Management area are:

Wet-pipe sprinkler system

Bulk storage tank concrete containment dikes

Grounding and bonding system

The highest level of risk identified for the area is Low. The narrative risk categories, negligible, low, moderate, and high are shown in a matrix form in Figure 2-1. Risks associated with the operational and initiating events discussed in Chapter 6, Accident Assessment, are summarized in Table 2-1. Only operational events; those not due to natural phenomena, such as internal flooding or earthquake; have been analyzed in detail in Chapter 6. External events and internal events, such as fires, winds, and earthquakes, have been assessed in a detailed manner to evaluate whether secondary hazards, such as the release of toxic materials, could be expected. No internal or external events contribute to a higher level of risk for this area than for any other area in the plant with the exception of fire. Fire was the main initiator of most of the operational events considered in Chapter 6. Facility and programmatic impacts were assessed and are indicated in the summary table based on an evaluation of the potential consequences.

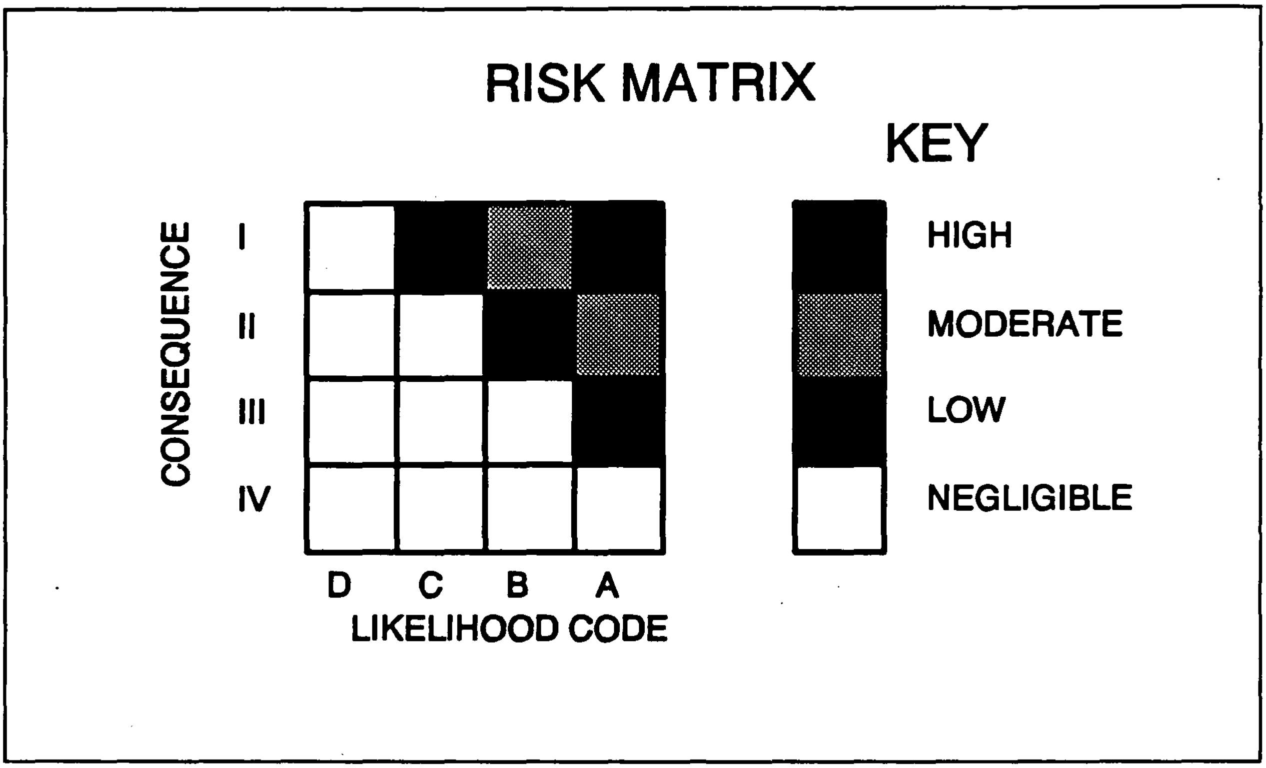


Figure 2-1. Risk Matrix

2.2. Conclusions

This safety assessment concludes that there are adequate controls in place to assure a suitable level of safety for both workers and the environment. There is no more than a low risk to the public associated with operations conducted within the Waste Management area. The level of risk identified for Waste Management is judged to be acceptably low considering the requirements for the operation.

Table 2-1. Summary of Risk Resulting From Postulated Operational Accidents

Accident	Annual Probability of Occurrence	Impact on Members of General Public and Environment	Impact on Operating Personnel	Highest Risk Assignment
Multiple 55-Gallon Drum Rupture of Radioactive Waste Inside Building 1000	Incredible	Negligible	Negligible	Negligible
Multiple 55-Gallon Drum Rupture of Radioactive Waste During Transportation	Incredible	Negligible	Negligible	Negligible
Single Container Release of Radioactive Waste Inside Building 1000	Likely	Negligible	Negligible	Negligible
Multiple 55-Gallon Drum Rupture of Solid Reactive Waste	Unlikely	Negligible	Negligible	Negligible
Rupture of the 5,000-Gallon Bulk Liquid Waste Storage Tank	Extremely Unlikely	Negligible	Marginal	Negligible
Rupture of Four 55-Gallon Drums Inside Building 1040, Bay No. 1	Unlikely	Negligible	Critical	Low
Release of Lab-Pack Waste	Unlikely	Negligible	Critical	Low
Rupture of Hazardous Liquid Waste Transportation Truck	Extremely Unlikely	Critical	Critical	Negligible
Rupture of Four 55-Gallon Drums or the Chemical Transport On Site	Unlikely	Marginal	Marginal	Negligible

This page left blank intentionally.

3.0 SITE DESCRIPTION

This chapter provides a brief summary of environmental and land use characteristics on and in the vicinity of the Pinellas Plant site. Detailed information for selected parameters is presented only as required to support analyses presented.

3.1 Geography and Demography of Site

3.1.1 Location and Site Description

The Pinellas Plant is located on the west coast of Florida in Largo, Pinellas County, as shown in Figure 3-1. The Pinellas Plant occupies 96.85 acres in the center of Pinellas County (Figure 3-2). The plant is bordered on the east by Belcher Road, on the south by Bryan Dairy Road, and on the west by the CSX railroad. The nearest physical boundary to the north is 118th Street. Partially developed commercial property totalling approximately 61 acres is located along the northern property line (Ref. 3).

3.1.2 Population

Pinellas County is presently the most densely populated county in Florida with a current estimated population of 882,982 (Ref. 4). The Pinellas Plant utilizes a work force of approximately 1,000 employees.

3.2 Nearby Facilities

The only facilities near the Pinellas Plant that may pose any above normal risk to the plant are the Eckerd drugstore light industrial facility and Air Products, Inc. Potential risk at the light industrial facility lies only in the handling or storage of consumer drugstore supplies and pharmaceuticals which may constitute an initiating source for a fire. This facility is approximately 1,000 feet from the plant site property line. Potential risks at Air Products result from the presence of a hydrogen dewar and the potential handling of other flammable gases which could constitute an initiating source for a fire. This operation takes place on land adjacent to the north of the Pinellas Plant site boundary.

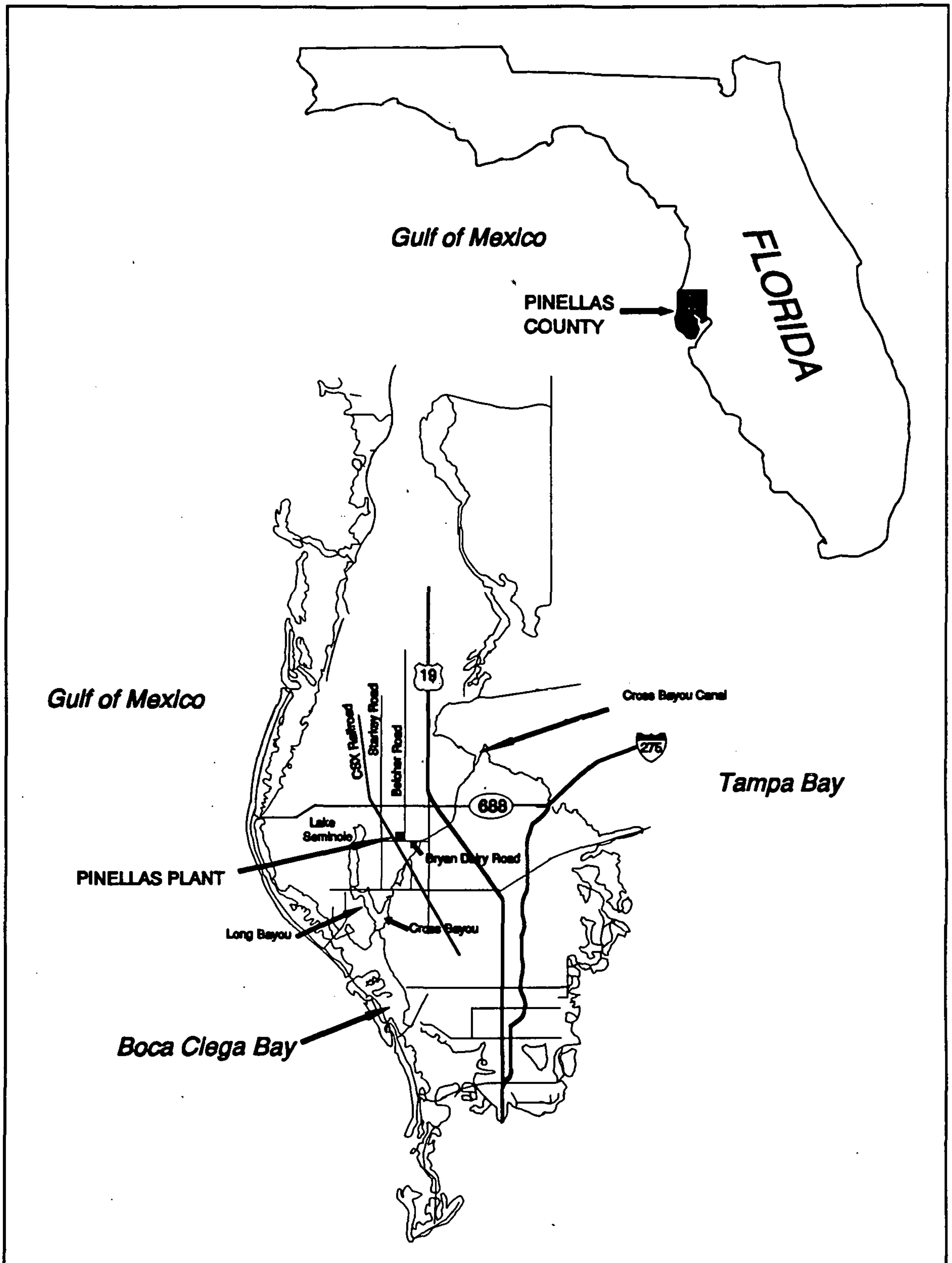


Figure 3-1. Pinellas Plant Location

L:\PUBS\SA\94151

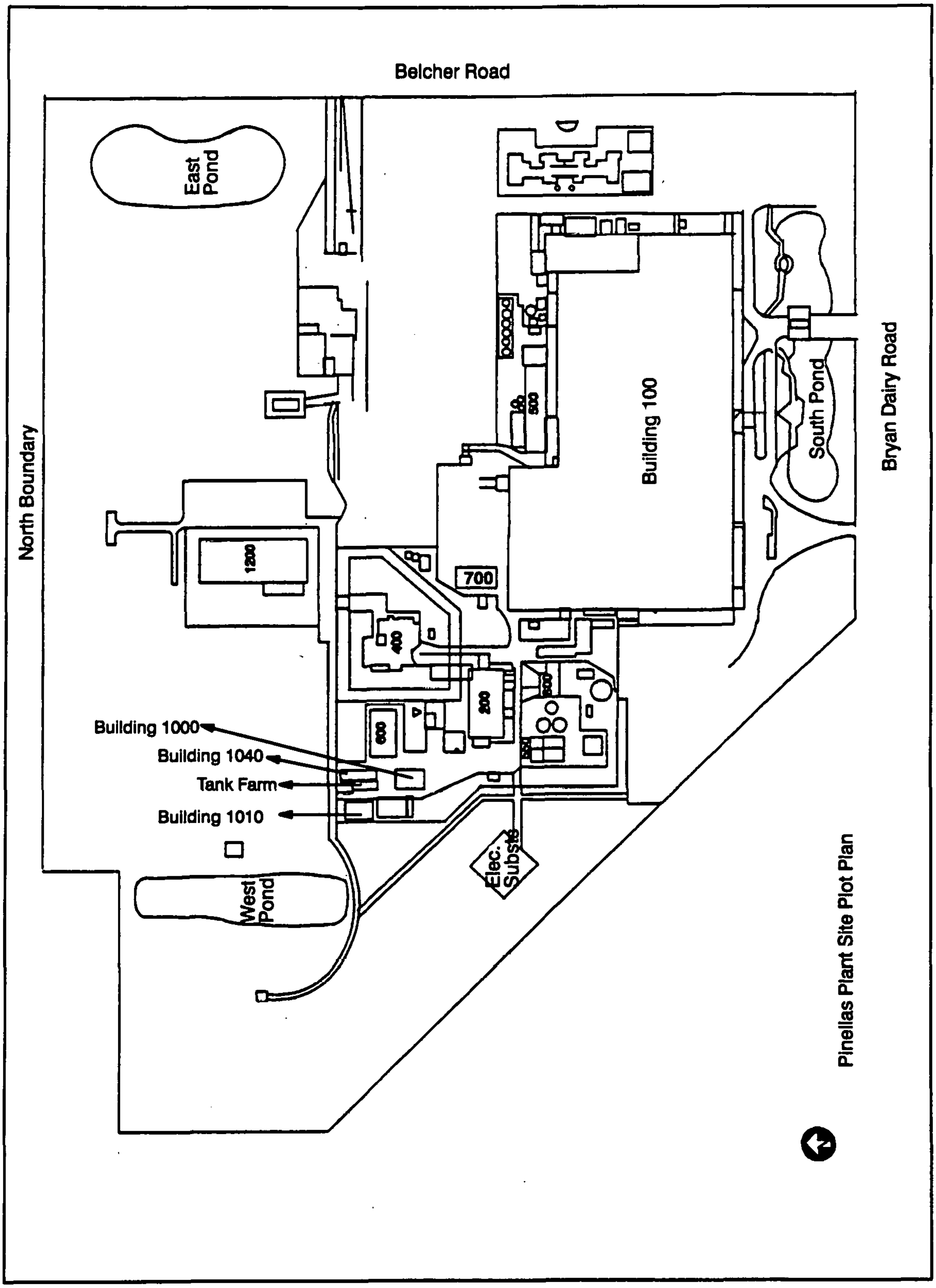


Figure 3-2. Existing Pinellas Plant Site Layout

3.3 Meteorology

Pinellas County has a subtropical climate with four seasons: a cool and dry winter, a spring transition, a long hot and humid summer, and a dry autumn. Rainfall is abundant, particularly during the summer months. A potential exists for hurricanes and tornados.

The mean of average daily temperatures recorded from 1961-1990 at Tampa International Airport is 72.3 degrees Fahrenheit.

The average annual precipitation for the Pinellas Plant region is about 47 inches. Precipitation is unevenly distributed throughout the year with the summer months of June through September accounting for approximately half of the annual total.

The semi-permanent Bermuda high pressure system moving north causes easterly trade wind circulation, which brings warm and humid maritime tropical air into Florida. The moist layer associated with this air is very deep and, as a result, convective thunderstorms form almost daily with an average of 80 to 100 thunderstorms per year. This frequency of thunderstorms exceeds that of any other region in the United States. Thunderstorms occur on almost 75 percent of the days from June through September, and most occur in the late afternoon hours. Sudden temperature drops from about 90 degrees Fahrenheit to 70 degrees Fahrenheit occur as a result of the thunderstorms.

Prevailing winds are from the north and northeast during the winter months and are predominantly from the east and south during the summer months. Distributions of wind directions are fairly uniform. A summary of 10-year hourly observations at the National Oceanic and Atmospheric Administration Tampa International Airport weather station is illustrated in Figure 3-3 with a wind rose showing percentage wind frequency and speed (Ref. 5). Strong sustained winds are associated with thunderstorms, tornados, and tropical cyclones (i.e., tropical storms and hurricanes).

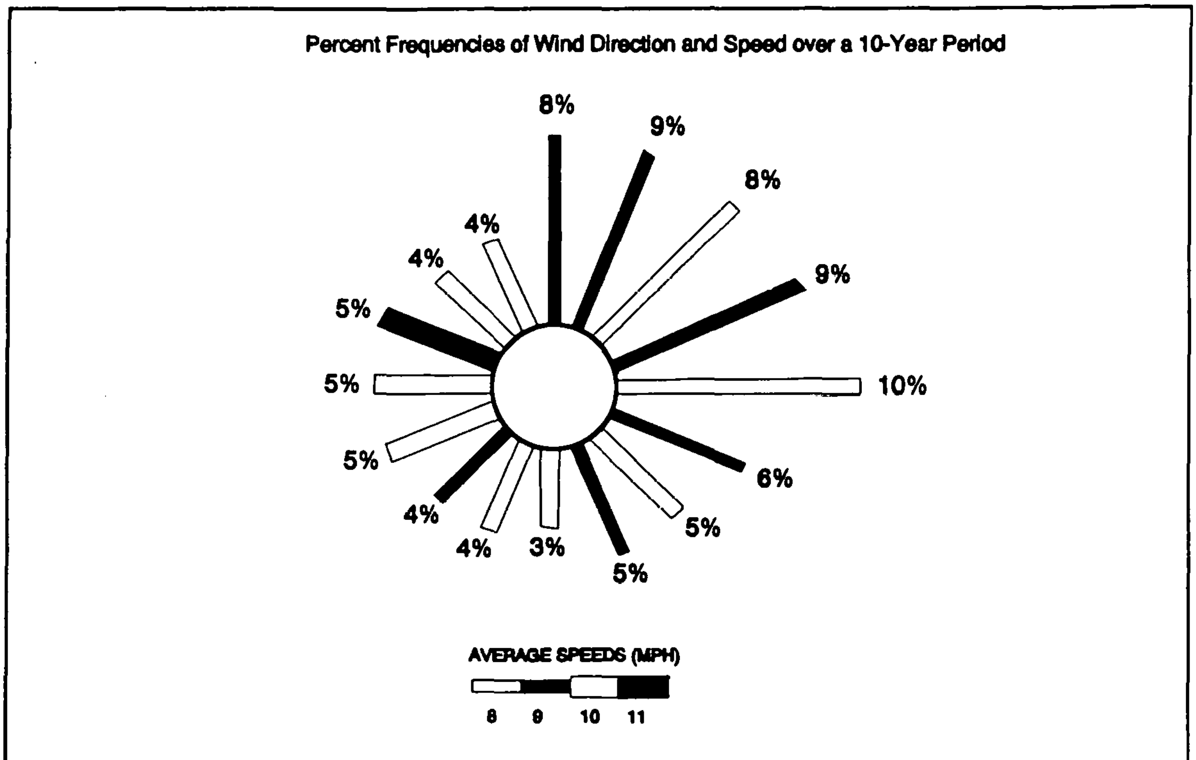


Figure 3-3. Ten-Year Summary of Hourly Wind Observations, Tampa, Florida

Warm-season tornados are caused by the local land/sea breeze effect or by local air mass thunderstorms. Cool-season tornados form most frequently in Florida along the Gulf Coast. Cool-season tornados are sometimes very destructive, accounting for a disproportionately large share of the tornado damage in Florida. They are most common from October to April and are usually associated with large scale weather disturbances. Tornados sometimes occur in groups along fast moving squall lines.

The tornados associated with tropical storms are most frequent in September and October, when the incidence of tropical storms is greatest. Tornados usually occur around the perimeter of the leading edge of the storm, and they sometimes occur in outbreaks of several tornados.

Historical information regarding tornado incidence in Pinellas County for the 31-year period from 1950 through 1980 was obtained from the National Severe Storms Forecast Center. During this period 50 events occurred. Thirty-seven were classed as tornados and 13 as waterspouts moving ashore. They caused seven deaths and 214 injuries and occurred during every month of the year.

Since 1951, 72 tornados were recorded in Pinellas County. The classification of these tornados based on severity is provided in Table 3-1.

Table 3-1. Tornado Classification

QUANTITY	SCALE	WIND SPEED (mph)	DAMAGE
3	-	Less than 40	-
32	0	40 - 72	Light
24	1	73 - 112	Moderate
10	2	113 - 157	Considerable
1	3	158 - 206	Severe
2	4	207 - 260	Devastating
0	5	261 - 318	Incredible

As a result of Florida's geographic location, it is exposed to tropical cyclones. Tropical cyclones are low pressure areas with associated counterclockwise rotary sustained winds of at least 39 miles per hour (mph). Tropical storms threaten the area on a few occasions during most years, with the greatest risk of hurricanes during the months of June and October. Cyclones with sustained winds between 39 and 74 mph are classified tropical storms; those with sustained winds above 74 mph are classified as hurricanes.

From 1886-1990, 55 tropical cyclones passed within 75 nautical miles of the Pinellas Plant, an event occurrence of one every 1.8 years. Of these, 21 were hurricanes with the remaining 34 classified as tropical storms. The most severe tropical cyclone within 75 nautical miles of the site was in September 1985 when a hurricane with 115 mph sustained winds, passed within 64 nautical miles. The closest point of approach for a hurricane to the site was in September 1950 when a hurricane with sustained winds of 127 mph, passed within four nautical miles.

A large part of the generally flat and sandy land near the coast has a less than 15 feet above sea level elevation, which makes the area vulnerable to tidal surges. The design basis hurricane postulated by the U.S. Corps of Engineers shows tide heights ranging from about 10 feet near the southern part of Tampa Bay to more than 14 feet at the northern end of the Bay. The Pinellas Plant is located about 6.3 miles from the Gulf of Mexico and 4.4 miles from Tampa Bay with a minimum floor height of 18.5 feet above mean sea level. No plant damage is expected from hurricane storm surge or tidal flooding.

3.4 Hydrology/Geology

3.4.1 Subsurface Geology

A generalized geologic cross-section in the vicinity of the Pinellas Plant is depicted in Figure 3-4 (Ref. 6). The groundwater system in Pinellas County is composed of three primary units: the upper unit, designated the surficial aquifer; the Hawthorn Formation; and the lower unit, the Floridan aquifer.

The surficial aquifer is thin, unconfined, close to the surface and of poor quality. The thickness of the surficial aquifer below the site ranges from 25 to 35 feet (Ref. 7) and is primarily composed of silty sand. Sediments in the aquifer consist predominantly of fine to medium grained sands with a low clay content. United States Geological Survey (USGS) and Southwest Florida Water Management District (SWFWMD) background data for the surficial aquifer in the area of the Pinellas Plant identify high levels of total dissolved solids (400-1,200 parts per billion); iron concentrations above Florida Department of Environmental Protection (FDEP) drinking water standards; and cadmium, chromium, and lead concentrations that approach FDEP standards. Infiltration, due to precipitation, to the surficial aquifer in Pinellas County is estimated to be 22 inches per year with a porosity of approximately 30 percent. The surficial aquifer is highly susceptible to contamination.

The direction of groundwater flow in the surficial aquifer varies greatly and generally flows in response to local topography. Current information for the plant site indicates that groundwater flow in the vicinity can vary depending on the rate of recharge from rainfall and surface waters (Ref. 8). This aquifer is characterized by low hydraulic conductivity (Ref. 9).

3.4.2 Hydrologic Description

Surface water occurs in rivers, creeks, canals, lakes, and many swampy areas in Pinellas County. Although natural surface waters do not exist on the Pinellas Plant property, three man-made ponds have been excavated for stormwater retention or as borrow pits. The East and West Ponds were excavated primarily as borrow pits and are designated as wetlands by the U.S. Department of the Interior (Ref. 10). The South Pond is for storm water retention, surrounded by a concrete wall; therefore, offering no natural habitat. The South Pond has not been designated a wetlands area.

Topography at the Pinellas Plant is flat, having a total elevation difference over the site of approximately two feet. Surface drainage in the vicinity of the Pinellas Plant flows in three directions: 1) to the northwest into the Starkey Road Subbasin and then into the Long Bayou, 2) to the southwest into the southwest ditch, and 3) into the Cross Bayou Drainage Basin then into the Cross Bayou Canal. Both the Long Bayou and the Cross Bayou flow into Boca Ciega Bay and eventually the Gulf of Mexico.

3.4.3 Floods

The Pinellas Plant is not within the tidal flood-prone area defined by the USGS. The tidal flood elevation, the altitude that tidal flooding is expected to reach once in 100 years, is 11 feet above sea level. The average elevation of the plant is approximately seven feet above this elevation, or 18 feet.

The typical 100-year, 24-hour storm releases 12.5 inches of rainfall. Because the soils at the plant are poorly drained and the topography is flat, a storm of this magnitude could result in some local flooding.

3.4.4 Seismology

Southern Florida is designated as an area where no damage is expected as a result of earthquake activity. Northern Florida is designated as an area where only minor damage to structures from distant earthquakes, with an intensity of V or greater on the Modified Mercalli scale, is likely. The Modified Mercalli scale is a measure of an

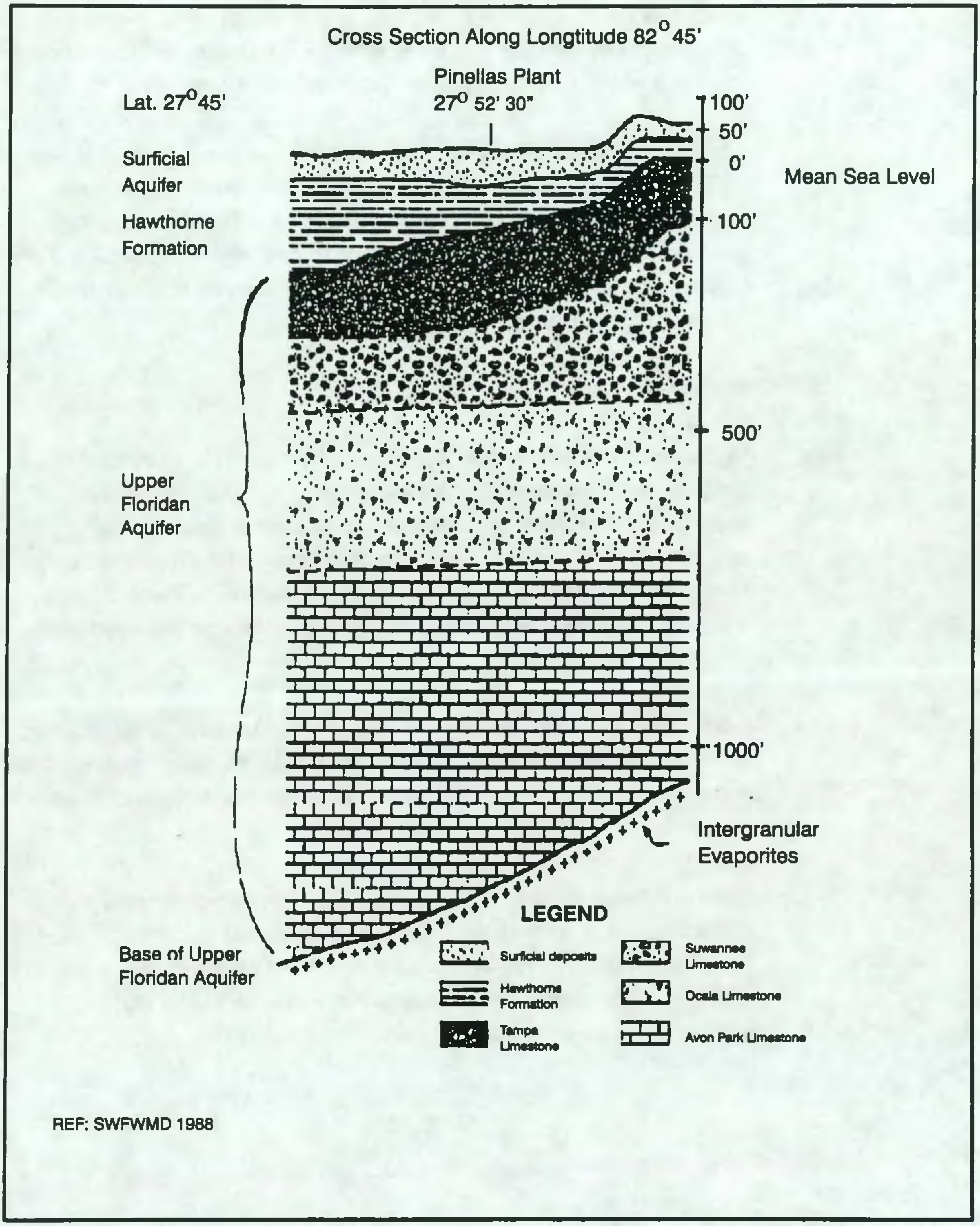


Figure 3-4 - Geologic Section at Pinellas Plant

earthquake's effects in a given area and is based on human observation of damage and other effects. On this scale, the maximum intensity of XII would produce total destruction (Ref. 11).

Local earthquakes of any consequence are a rarity in Florida. As of 1979, Florida residents had only experienced about two dozen earthquakes in the past 200 years. Three of these events had epicenters within a 100-mile radius of the plant site. However, none had an intensity of over IV on the Modified Mercalli scale at the earthquakes' approximate epicenters.

3.4.5 Sinkholes

In the Pinellas County area, the Tampa Formation is described by geologists as the geologic type most prone for the development of sinkholes. Aerial photographs and topographic maps indicate sinkholes are primarily found in the northern one third of the county (Ref. 12). This pattern is caused by the Tampa Limestone dipping to the south and becoming deeper in the subsurface in the southern portion of the county.

Numerous small circular depressions, characteristic of sinkholes, are identified in the vicinity of the plant (Ref. 13). Although sinkholes and numerous circular depressions occur near the plant, no such features are noted on plant property.

The hydrogeologic data indicates that the Hawthorn Formation confining unit is of sufficient depth and thickness such that significant potential for sinkhole development and collapse is unlikely (Ref. 14). The probability of sinkhole occurrence at the plant is calculated to be once every 1,340 years (Ref. 15).

4.0 DESCRIPTION OF FACILITY

4.1 Summary Description of Facility Design

The on-site facilities that support waste management activities consist of storage facilities and treatment facilities. The storage facilities are indicated in Figure 4-1. These storage facilities, including Building 1000, Building 1010, Building 1040, and the storage tank farm, were constructed and equipped to comply with the EPA hazardous waste storage requirements as promulgated in Code of Federal Regulations (CFR) 40, Parts 264, 265 and 270. In addition, there is a storage area for scrap electronic equipment located between Buildings 1000 and 1040. This area consists of a fenced-in area that is used to store non-hazardous scrap electronic equipment prior to shipment offsite. Detailed discussion of this area will not be included in this Safety Assessment.

Waste Management treatment facilities include the Reactive Metals Treatment Facility and the Thermal Treatment Facility, which are maintained and located to comply with the EPA hazardous waste treatment requirements. The Reactive Metals Treatment Facility and the Thermal Treatment Facility are the subject of this SA.

There is also an area in Building 700 used by Waste Management personnel for shredding classified papers. Shredded nonhazardous material is discharged from the shredder to a dumpster located on the north exterior of Building 700.

4.1.1 Building 1000

Building 1000 is a structure of 8 inch reinforced concrete blocks situated on a reinforced concrete foundation. Figure 4-2 illustrates the layout of Building 1000. In addition, the roll-up doors are fitted with bottom seals to prevent wind from driving water under them. The building is approximately 1632 ft^2 and is separated into three bays by concrete-block walls of two-hour fire-rated construction. An area on the west exterior of the building is used for storage of compressed gas cylinders. The wall between the waste and gas cylinder storage areas is also of two-hour fire-rated construction. The bays are equipped with the following common features:

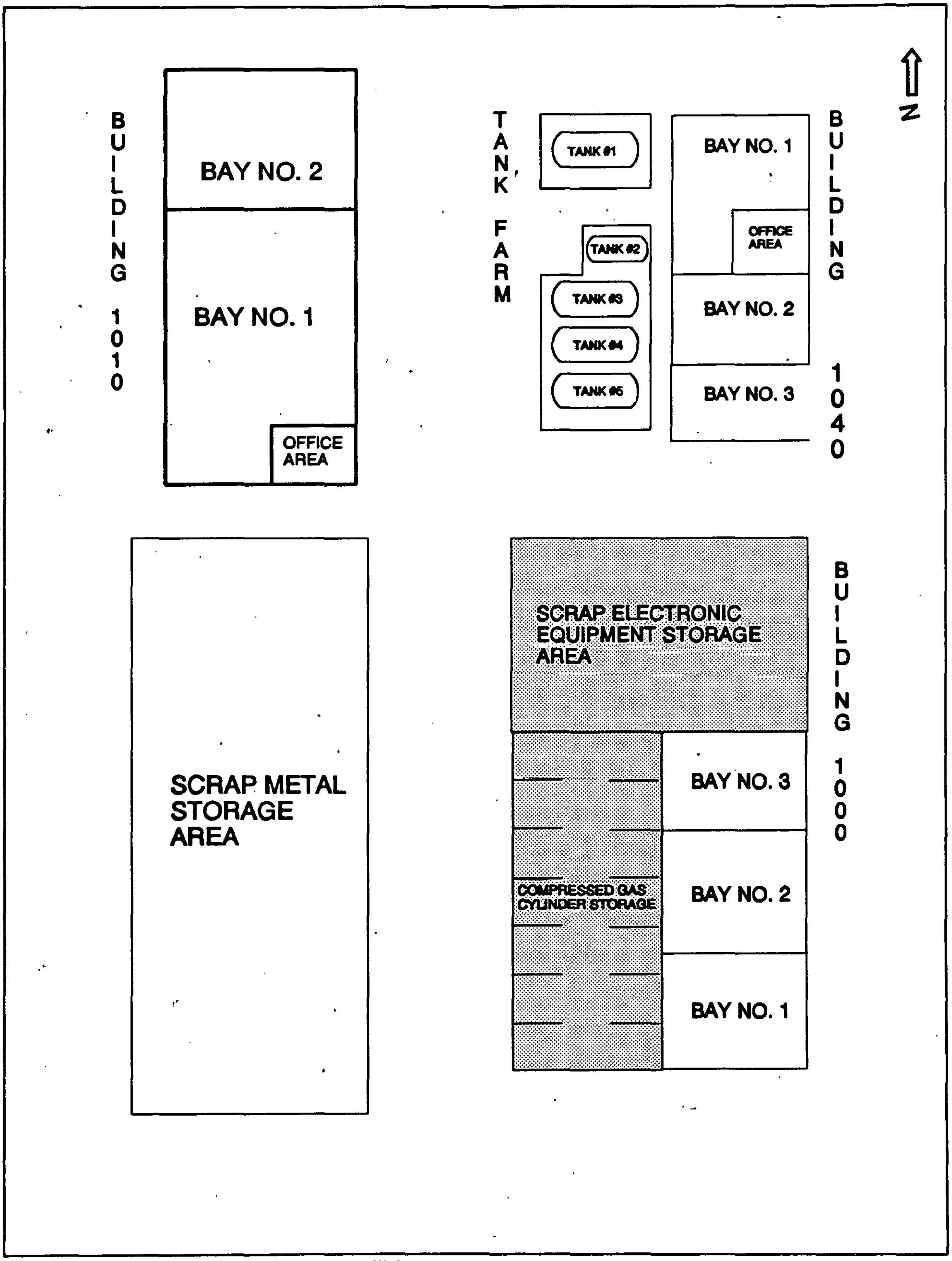


Figure 4-1. Waste Management Facilities

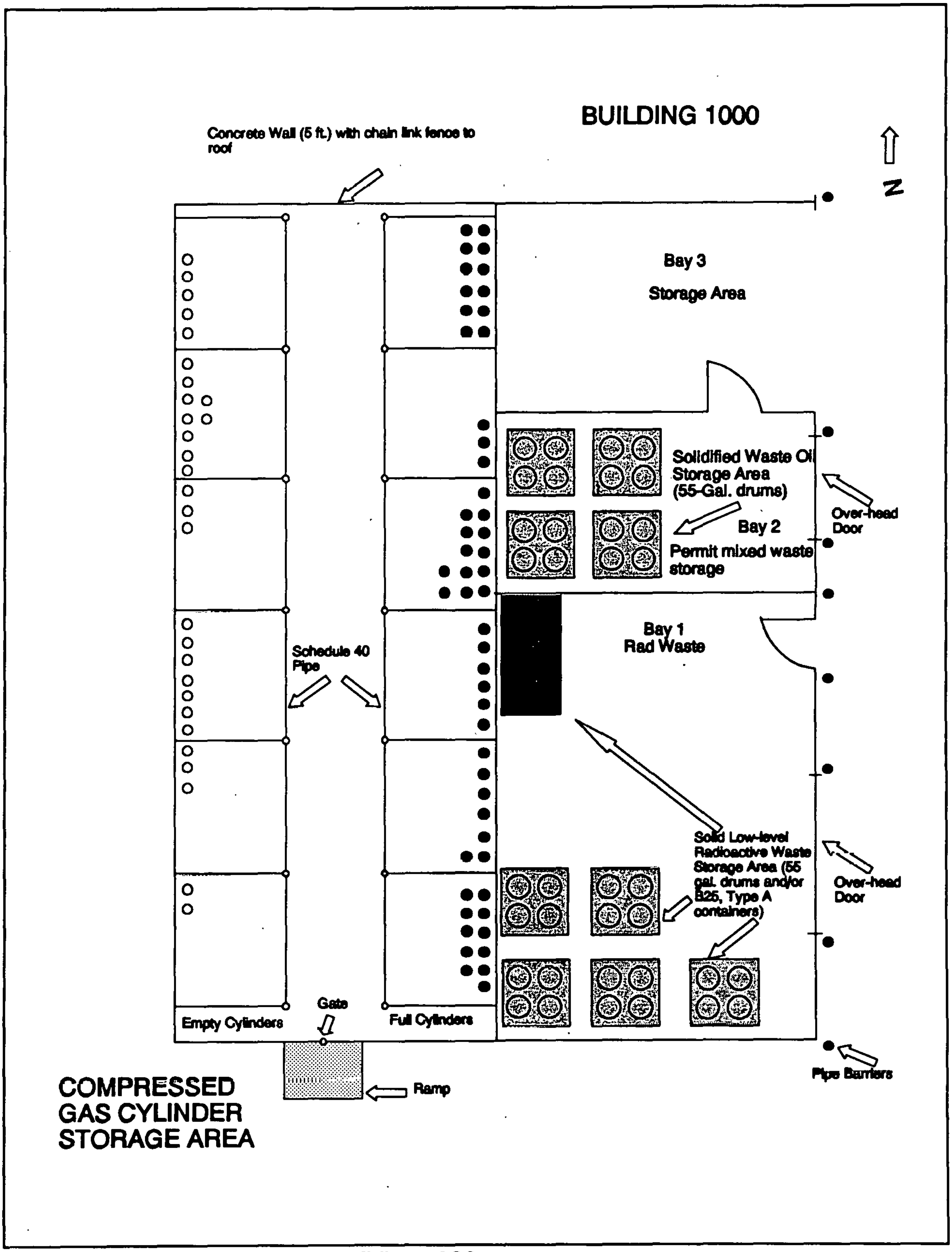


Figure 4-2. Waste Management Building 1000

1. Access to the bays is provided through personnel doors and large metal rollup doors. These doors are protected from vehicle traffic by pipe barriers.

2. Skylights and exhaust fans are located on the roof. Exhaust fans support Bay 1 and 2 at a rate of 930 and 550 cubic feet per minute (CFM) respectively.

Bay No. 1 is approximately 715 ft^2 and is used for storage of low-level solid radioactive waste. The radioactive waste is in a solid inert form and is stored in sealed containers (Type A, 1000 curie maximum) in the bay, which has controlled access. Controlled access currently consists of alarmed door contacts monitored in the Security Building (Building 1200). Also, Bay No. 1 is equipped with monitored motion detectors that cover the entire bay.

Bay No. 2 is approximately 443 ft^2 and is currently used for storage of solidified waste oil. Storage for 55-gallon drums containing non-liquid waste is provided in this bay. A louver is located on the east wall of the bay.

Bay No. 3 is approximately 474 ft^2 and is used for equipment storage.

A 1632 ft^2 reinforced concrete foundation area surrounded by a five-foot concrete block wall is located on the west side of Building 1000. This area is used for storage of compressed gas cylinders, both empty and full. The General Stock and Warehouse Group is responsible for this area. The area is separated into six cells on the east side and six cells on the west side with an aisle separating the two sides. The cells are formed by schedule 40 pipe railings. A chain link fence is installed between the top of the five-foot concrete wall and the roof.

Building 1000 and the area over the compressed gas cylinder storage area are covered by a steel framed roof with corrugated steel roof panels.

Bonded Stock Area

The bonded stock area is a covered fenced-in area situated on a reinforced concrete foundation. This area located east of Building 1000 provides storage space for empty non-contaminated B-25, Type A containers.

Also, the bonded stock area is a controlled access area that is kept locked at all times.

4.1.2 Building 1010

Building 1010 is a concrete block structure situated on a reinforced concrete foundation. Building 1010 is divided into two bays, which are separated by concrete block fire partitions extending from floor to ceiling. Figure 4-3 illustrates the layout of Building 1010. The bays are equipped with the following common features:

1. Access to the bays is provided through personnel doors and large metal overhead doors. These doors are protected from vehicle traffic by pipe barriers.

2. Exhaust fans are located on the west walls of the respective bays.

Bay No. 1 provides additional storage space for radioactive waste (B-25, Type A containers). Also, empty non-contaminated 55-gallon drums and B 25, Type A containers are stored within this bay, in addition to other materials used by waste management personnel for their various operations. An office area is located in the southeast corner of this bay.

Bay No. 2 has been designated as a contingency storage facility for waste streams which are not covered under the Florida Hazardous Waste Operating Permit. Wastes that are stored in Bay No. 2 are subject to the 90-day storage requirements and must be shipped in accordance with 40 CFR Part 263. The non-regulated waste is stored in 55-gallon drums in this bay. The bay has a concrete floor that slopes to a collection trench drain and sump.

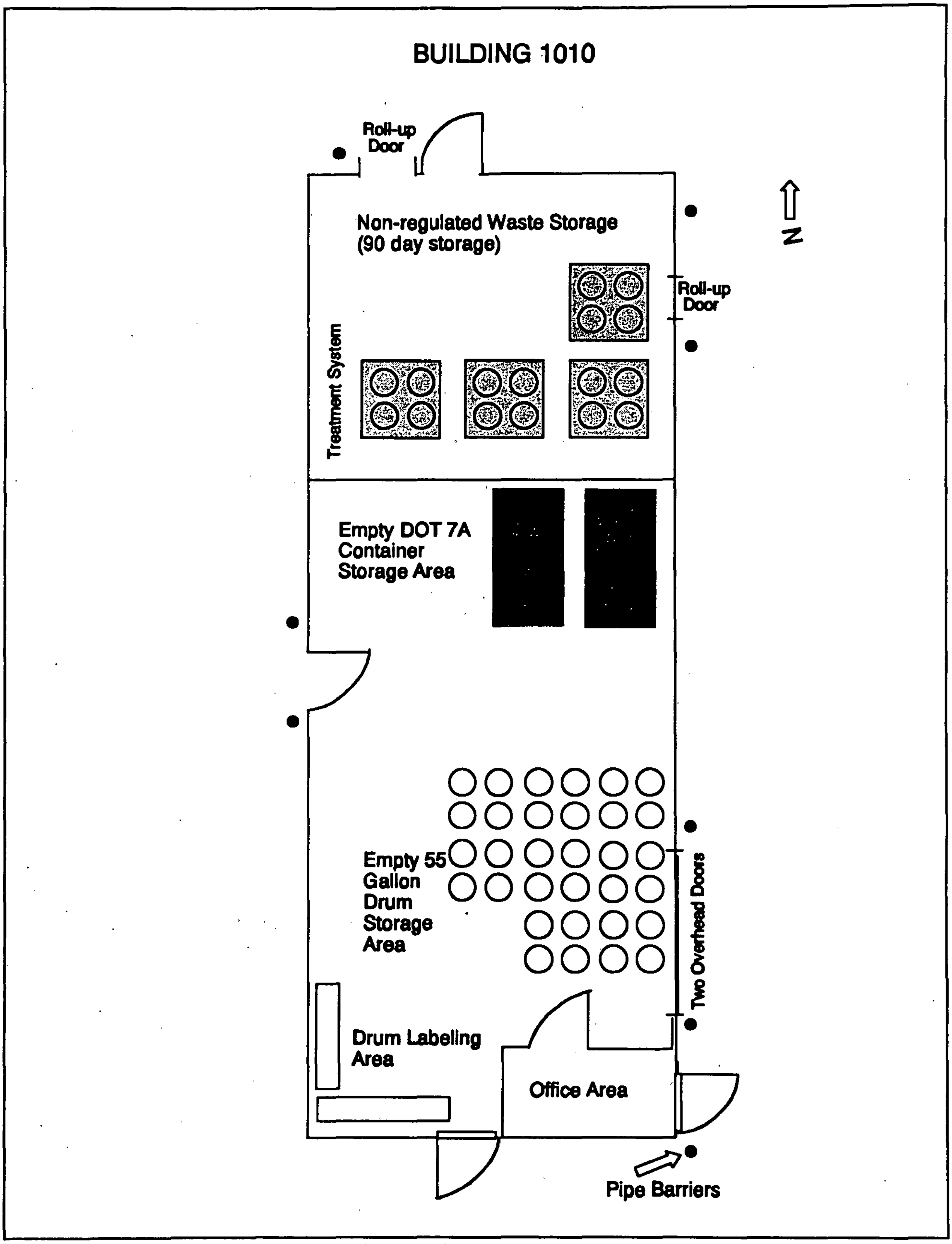


Figure 4-3. Waste Management Building 1010

4.1.3 Building 1040

Building 1040 is a structure of 8 inch reinforced concrete block situated on a reinforced concrete foundation. The floor slab in each storage bay slopes to a collection trench drain and sump. These sumps are closed collection systems, which must be pumped out to empty. The trench drains are precast polymer concrete channels. Figure 4-4 illustrates the layout of Building 1040. The building is approximately 2104 ft^2 and is divided into three bays separated by concrete block walls. A small office is located between the reactive and liquid storage bays. A mezzanine is provided in Bay No. 1, above the office area, for miscellaneous storage. All interior and exterior walls are of two-hour fire-rated construction. Fire doors having a 1-1/2-hour rating are provided in the west wall facing the tank storage and between the office and the reactive storage bay. The liquid waste tank storage farm is located on the west exterior of the building. A concrete apron is provided between the building and the tank storage. The bays are equipped with the following common features:

1. Access to the bays is provided through personnel doors and large metal overhead doors. These doors are protected from vehicle traffic by pipe barriers.

2. Exhaust air is provided at floor level at a rate of 780 CFM in all bays.

3. Skylights and exhaust fans are located on the roof. These exhaust fans support Bay 1 and Bay 2 and 3 (same exhaust rate) at a rate of 2108 and 695 CFM respectively.

Bay No. 1 is approximately 1287 ft^2 and contains predominately liquid drummed wastes. Maximum storage allowed in Bay No. 1 under the permit is forty 55-gallon drums and 24 lab-pack drums. No reactive waste is stored in this bay. There are three Wilden brand air-driven, explosion proof, positive displacement pumps located on the west wall of Bay No. 1. These pumps are used for pumping liquid waste to either the flammable liquids, waste oil, or halogenated hydrocarbon waste storage tanks located on the exterior (west side) of Building 1040. Concrete pedestals and piping for pumps are in place for the two standby waste storage tanks. No pumps are installed on these

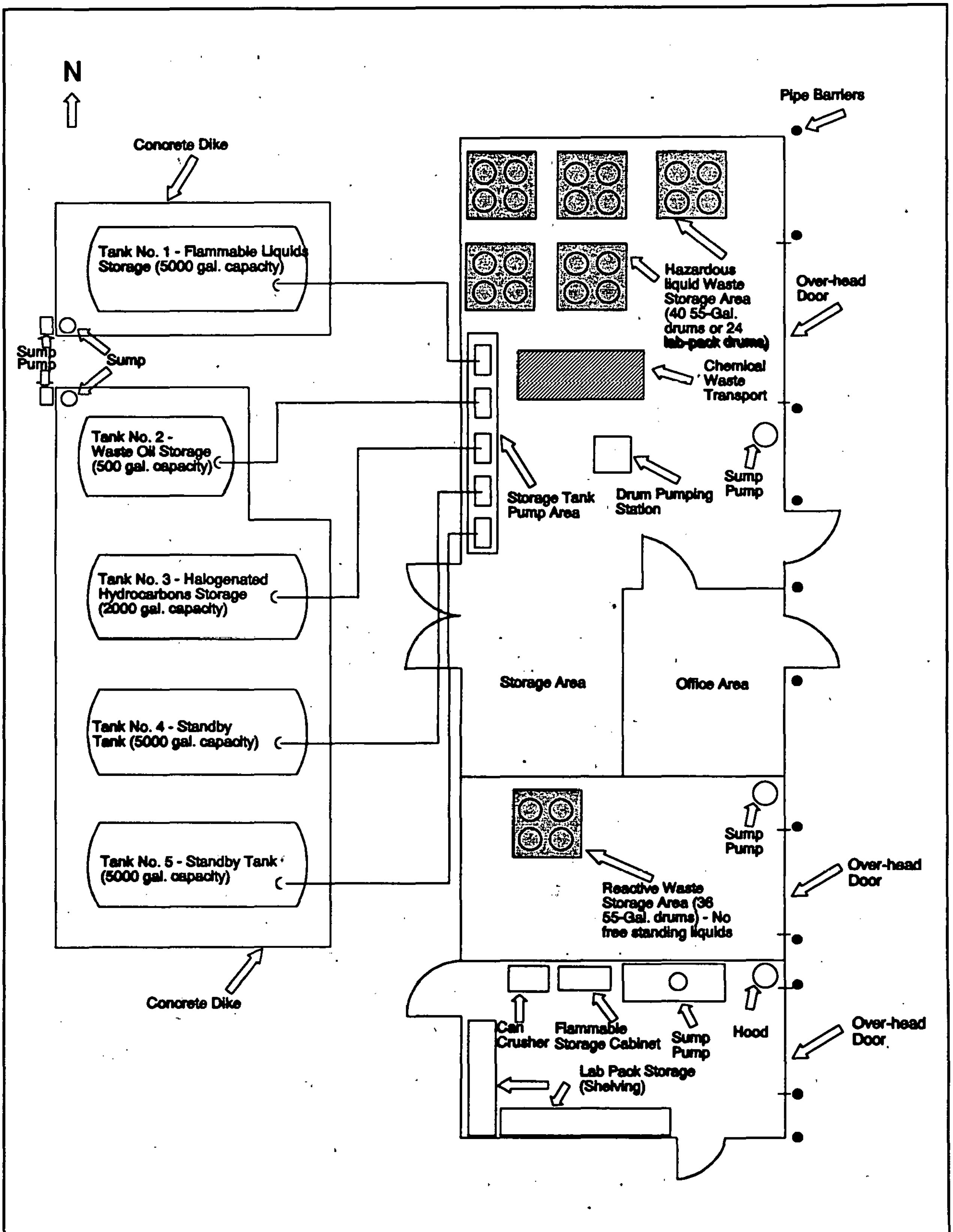


Figure 4-4. Waste Management Building 1040

pedestals. A portable air-driven, explosion proof, positive displacement pump is located in the bay that is used for pumping the liquid waste into 55-gallon drums. The chemical waste transport is stored within the bay. Two portable electric drum pumps are located in this bay. These pumps are not used with flammable liquids. A storage area exists in the northwest corner of the bay for storing tools and equipment. A scale, level with the floor, is located in the southeast corner of the bay and is used to weigh drums.

Bay No. 2 is approximately 385 ft^2 and contains reactive waste. Bay No. 2 has a maximum storage capacity, specified by permit, of fifty-four 55-gallon drums. No free liquids are stored in Bay No. 2.

Bay No. 3 is approximately 431 ft^2 and contains five gallons or less of miscellaneous laboratory chemicals. These chemicals are placed in tote trays and stored on steel storage shelves that are attached to the north and west walls. A hood with an exhaust to the building exterior is located on the south side of the bay but is no longer in service. A flammable storage cabinet is located on the south side of the bay and is used to store alcohol. A can crusher is also located on the south side of the bay. This mechanical device is used to crush one-to-five-gallon metal cans for waste volume reduction.

Storage Tank Farm

The tank storage area consists of five tanks containing ignitable liquids, waste halogenated solvents, and waste lubricating oils. These tanks are connected to 1-inch carbon steel pipes from air operated pumps in Bay No. 1 of Building 1040. Also, the 1-inch lines are contained within 3-inch lines from Building 1040 to the containment dike. The tanks are connected to the lightning protection system and are equipped with flame arrestors on the vent lines. The tank farm is illustrated in
Figure 4-4.

The flammable liquids storage tank (No. 1) is a 5,000-gallon tank installed in a containment dike. A sump is located in the dike with an air-driven, explosion proof pump located on the exterior of the dike.

The other four tanks are installed in a common concrete containment dike that is sized to contain the contents of all four tanks plus 10 percent. The dike has a sump with an air-driven, explosion proof pump on the exterior of the dike.

The waste oil tank (Tank No. 2) is a 500-gallon tank that is available for storage of waste oil, if necessary. The halogenated hydrocarbons storage tank (No. 3) is a 2,000-gallon stainless steel tank. There is one 5,000-gallon permitted standby tank (Tank No. 5), which can contain any hazardous waste that is compatible with the waste stored in the less-than-90-day area.

4.1.4 Treatment Facilities

The Reactive Metals Treatment Facility and the Thermal Treatment Facility are located in a fenced-in area north of Building 700 and illustrated in Figure 4-5. The treatment facilities are surrounded by a chain link fence with a gate on the south side of the facility.

Reactive Metals Treatment Facility

The Reactive Metals Treatment Facility is a concrete pool with sides raised above grade. The Reactive Metals Treatment Facility provides water submergence for calcium metal and calcium bimetal and material contaminated with lithium to render them nonhazardous.

The concrete pool is approximately 16.5 feet in length, 15.2 feet in width, and 3.0 feet in depth. The pool is constructed with 8-inch thick concrete sides and bottom. The pool is open to the atmosphere with no roof. Inside the basin are two reaction vessels for calcium metal and two for calcium bimetal, and one reaction vessel for lithium contaminated solids. The reaction vessels consist of 55-gallon steel drums with no covers and perforations in the sides near the bottom.

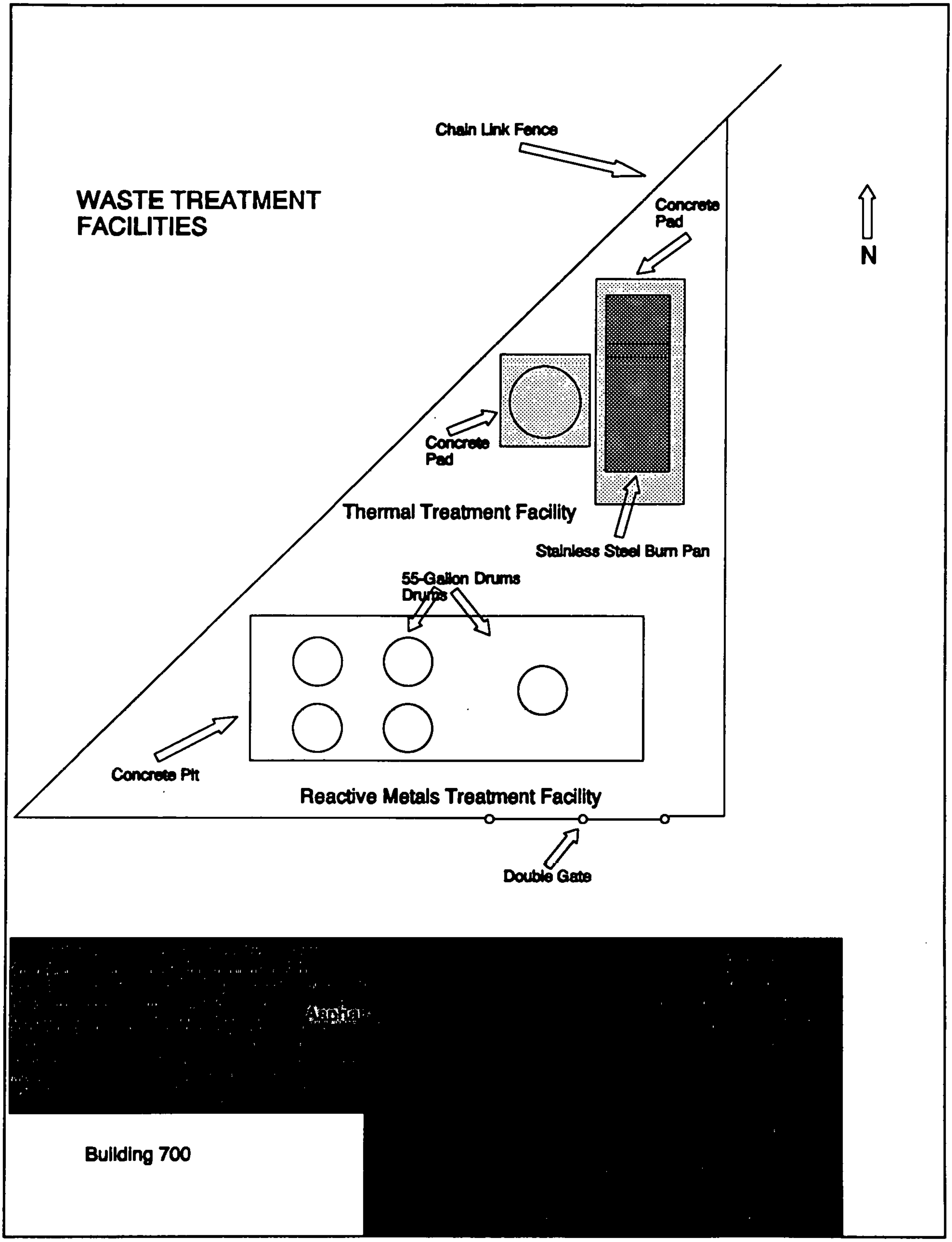


Figure 4-5. Treatment Facilities

Thermal Treatment Facility

The Thermal Treatment Facility is used to treat waste heat paper (metallic zirconium and barium chromate), heat powder (iron shavings and potassium perchlorate), primer squibs, and detonators. Heat paper and heat powder are treated in a shallow steel burn pan approximately 6 feet long, 2 feet wide, and 6 inches deep. Squibs and detonators are treated in a metal reaction vessel. The reaction vessel is a cast iron housing that has demonstrated adequate structural strength to contain these detonations. The reaction vessel and burn pan are located on a concrete pad, which has a berm along the sides to contain any rainwater.

4.2 Structural and Mechanical Safety Criteria

Buildings 1000 and 1040 were built in 1982 and 1989 respectively in compliance with the Southern Building Code and consistent with safety requirements applicable during the construction period. Due consideration was given to the hazardous nature of operations within Buildings 1000 and 1040. This consideration was supported by the use of a fire suppression system, fire rated concrete-block walls, and exhaust fans.

4.3 Facility Service and Utility Systems

The plant utilities that support the waste management activities are described below for each facility.

4.3.1 Heating, Ventilation, Air Conditioning (HVAC)

Buildings 1010 and 1040 have dedicated heat pumps for the HVAC requirements of the office area located within the respective buildings.

4.3.2 Electrical Power

Electrical service is supplied to Buildings 1000 and 1010 using standard 480 volt, 3-phase and 110 volt, single-phase distribution and connections.

Electrical service is provided to Building 1040 through a 15 kVA, 60 Hz, 480V primary, 120/240V secondary, wall mounted transformer located on the east exterior wall of the office area. The transformer supplies power to several panel boards. The panel boards then distribute the power to the mixers on the liquid waste storage tanks, lighting in the building, heat pump for the office area, exhaust fans in the building, motors on the three overhead doors, and office receptacles. Emergency power is not supplied to the Waste Management areas discussed in this SA.

4.3.3 Compressed Air and Other Gas Supply and Distribution Systems

Compressed air is supplied to Building 1040 and the liquid waste storage tank area from the utility operations compressed air system. This system is discussed in detail in the Utility Operations SA. The compressed air is used for the air-driven pumps located inside Bay No. 1 of Building 1040 and the two air-driven pumps located by the liquid waste storage tanks. A connection on the compressed air line, both inside and outside Building 1040, exists for connecting any air-operated equipment that may be necessary.

4.3.4 Domestic Water Supply

Domestic cold water is supplied to Building 1040 for the three safety shower eyewash stations located both inside (one in Bay No. 1) and outside (two on the east side) the building. Domestic cold water also supplies several hose bibbs both inside and outside the building. Also, domestic cold water is supplied to Building 1010 and the treatment facilities.

4.3.5 Cooling Water Systems

There are no cooling water systems used in the waste management areas discussed in this SA.

4.3.6 Sewage and Treatment Systems

Building 1040 has a closed sump that requires a pump to empty its contents. A specific pump is not installed in this sump. Liquid waste spills are collected in the sump and pumped into 55-gallon drums.

The trench drains located throughout Building 1040 all feed into a closed sump system located in each of the three bays in the building. There is an air-operated pump in each sump that is manually actuated and is capable of pumping the collected liquid to a chemical drain where it flows to the Industrial Wastewater Neutralization Facility (IWNF) for processing.

4.3.7 Safety Communication and Alarms

Emergency telephones are provided at various locations in the waste management storage areas and treatment areas. The telephones are used to contact the Communications Control Center.

4.4 Environmental, Safety and Health (ES&H) Protection Systems

4.4.1 Lightning Protection System

The lightning protection system for Buildings 1040, 1000, and 1010 consists of roof mounted air terminals spaced approximately every 15 feet. The lightning protection cables are copper and connect the air terminals to the grounding loop cable. The grounding loop cable is attached to four 3/4 inch x 20 feet (5/8 inch x 10 feet for Building 1010) long copper ground rods that are driven in the ground at all four exterior corners of the buildings. The copper cables of Building 1040 are attached to the roof mounted exhaust fans; security bars on the skylights; steel roof trusses; air conditioner housing; electrical panel housings; overhead doors; personnel door frames (doors bonded to the frames); wall exhaust fan frames; metal ladder in Bay No. 1; domestic water main line; storage Tanks No. 1, 2, 3, and 5; and gutters and downspout. Buildings 1000 and 1010 do not require the grounding/bonding of doors, gutters, etc. due to the nature of the hazards present. The Waste Management Facilities' lightning protection systems are approved by Underwriters Laboratories.

4.4.2 Fire Protection Systems

Building 1000 is protected by a wet pipe sprinkler system hydraulically designed as Extra Hazard Group 1, providing 0.35 gpm/ft^2 over the entire storage area. This system is arranged to provide protection to the inside face of the overhead door in Bay No. 1 as well. The alarm valve is located in Bay No. 1, and the local alarm is provided in the form of a water motor gong. The system also has a pressure switch that automatically alarms to the Communication Center in Building 1200 upon system activation. The sprinkler heads are of the Intermediate (175 - 225°F) type. Heads are installed such that protection is maintained with the overhead doors in either the closed or open position. No fire department connections are provided for this building. However, in the event of a loss of the building fire water supply, the sprinkler main drains are provided with a single 2.5 inch hose connection, which would allow the responding County fire units to supply water to the sprinkler system to maintain at least a partial supply to the building sprinkler system. This arrangement is common to all sprinkler systems at Pinellas Plant. Portable fire extinguishers are provided at the facility in accordance with the National Fire Protection Association (NFPA) 10.

A fire hydrant is located approximately 150 feet east of the facility. In addition, a pre-connected hose reel with 150 feet of hose is provided at the southeast corner of the building. The sprinkler, hydrant, and hose reel systems for all buildings are fed from the plant fire water system.

Building 1010 is protected by a wet pipe sprinkler system. A 0.5 inch hose reel is located on the east side of the building. As in Building 1000, local alarm is provided by a water motor gong while system activation is signaled to the Communication Center by a pressure switch. A fire hydrant is located within 250 feet of the building, in the fenced-off area to the north.

Portable fire extinguishers are provided in accordance with NFPA 10.

Building 1040 is provided with a wet pipe sprinkler hydraulically designed as Extra Hazard except for the office area, which was designed as Ordinary Hazard. The sprinkler systems for the storage areas are designed to provide 0.35 gpm/ft^2 using Intermediate heads. The system piping is arranged to maintain sprinkler coverage with the overhead doors open or closed. Local alarm is provided by a water motor gong, and the system pressure switch provides an automatic actuation signal to the central alarm station in the Communication Center. Portable fire extinguishers are provided in the building in accordance with NFPA 10.

A fire hydrant located 250 feet to the north, inside a fenced off area, serves the facility . A pre-connected hose reel with 150 feet of 1-1/2 inch hose is located at the southeast corner of the building.

The Pinellas site, including Buildings 1000, 1010, and 1040 are served by the plant designated employee program. All designated employees are trained in use of fire extinguishers. Due to the small size of the site, designated employees response times are within three minutes, based on 29 Code of Federal Regulations (CFR) 1910 and NFPA standards. A written agreement has been established with the County fire authorities.

4.5 Comparison to Criteria

Table 4-1 presents a comparison to the major safety related features of Waste Management to the governing criteria set forth in DOE Order 6430.1A, "General Design Criteria" (Ref. 16). Many of the sections of the DOE Order reference other government and industry standards. For example, Section 0110-6.1 of DOE Order 6430.1A states that all facilities shall comply with DOE Order 5480.4, DOE Order 5480.7A, 29 CFR 1910, 29 CFR 1926, and NFPA 101," Life Safety Code." By direct reference, DOE Orders require compliance with various standards, including all of the NFPA standards published in the

National Fire Codes, the Underwriters Laboratories (UL) Product Directory, and the Factory Mutual Approval Guide.

Twenty two criteria were examined for compliance with DOE Order 6430.1A. All were determined to be in compliance except the criteria for Section 0110-6.1 and 1530-99.19. Section 0110-6.1 requires compliance with DOE Order 5480.7A. The buildings do not comply with DOE Order 5480.7A because they do not have an approved fire alarm system. Compliance will be achieved as funds become available.

Compliance with the criteria in Section 1530-99.19 which requires that provisions be available for handling fire protection water contaminated with tritium is not necessary. Accident analysis in Chapter 6 demonstrated that a fire in the radioactive waste storage facility (Building 1000) is an incredible event. The amount of combustibles present in the building is insufficient for the ignition and propagation of a fire. In addition, fire water inadvertently released would not become contaminated with tritium because the metal drums and boxes stored in the building are sealed and meet the DOT requirements for Type A containers.

Table 4-1. Evaluation of Waste Management With Respect to DOE General Design Criteria

DOE Order 6430.1A Section	Criteria	Conform (Y/N)	Comments
0110-6.1	Compliance with DOE Order 5480.7A	N	Buildings do not have an approved fire alarm system.
DOE Order 5480.7A	Section 9.b of DOE Order 5480.7A establishes acceptable limits on the duration of any program delays that may result from the maximum credible fire. This is further required in Section 1530-2.34 of DOE Order 6430.1A.	Y	Based on the conclusions of the fire analysis in Chapter 6, programmatic impacts would be less than 6 months.
DOE Order 5480.7A	Section 9.c of DOE Order 5480.7A sets specific limits on the acceptable value exposed to property loss due to the maximum possible fire. This is further required in sections 0110-99.0.7 and 1530-2.3 of DOE Order 6430.1A.	Y	Based on the conclusions of the fire analysis in Chapter 6, maximum possible fire loss is within the limits set by DOE Order 5480.7A.
NFPA 101	Chapter 28 NFPA 101, Industrial Occupancies, states that Emergency Lighting is not required if another power source for lighting is available within 10 seconds, or structure is occupied only during daylight hours with skylights or windows to provide required level of illumination on all portions of the means of egress during these hours.	Y	Waste Management Facilities are provided with skylights and are only operated during daylight hours.
NFPA 10	NFPA 10 requires that portable fire extinguishers be provided for protection of the facility and contents.	Y	Fire extinguishers are provided for all of the waste management buildings, treatment facilities, and chemical waste transports.
NFPA 30	Flammable tanks shall be equipped with venting devices that are normally closed except those with listed flame arrestors.	Y	Storage tanks are equipped with flame arrestors on the vent line.
0110-6.2	A "special" and "general" fire protection design analysis is required for all facilities.	Y	A fire analysis has been performed to support accident analysis in Chapter 6.

Table 4-1. Evaluation of Waste Management With respect to DOE Design Criteria (Continued)

DOE Order 6430.1A Section	Criteria	Conform (Y/N)	Comments
0110-6.3	The fire resistance ratings of the facility construction features must be established by testing or approval by UL, Factory Mutual (FM), or another nationally recognized testing and approval agency.	Y	Waste Management Facilities construction features are UL approved.
0110-99.04	The design of the facility shall include controlled access to areas of potential hazards within the facility.	Y	The buildings in the waste management area have controlled access to limit personnel from areas of potential hazards. Bay No. 1 of Building 1000 is alarmed and monitored by security personnel.
	At least two exits shall be provided in rooms where hazardous materials are handled.	Y	All the bays in the waste management buildings that could contain hazardous material are equipped with at least two doors.
	Layout of the facility shall provide specific control and isolation, if possible, of quantities of flammable, toxic, and explosive gases, chemicals, and other hazardous materials admitted to the facility.	Y	The layout of the waste management buildings is such that flammable and toxic chemicals and other hazardous materials are segregated and isolated from each other in separate storage bays, drums, or tanks.
0110-99.06	The fire resistance of fire-rated enclosures is required to withstand the effects of a design basis fire (DBF). Penetrations in the fire resistive enclosure must be protected from the DBF. This is further required in Sections 0110-99.92 and 0727 of DOE Order 6430.1A.	Y	The fire analysis demonstrated fire-rated enclosures can withstand the effects of a DBF.

Table 4-1. Evaluation of Waste Management With respect to DOE Design Criteria (Continued)

DOE Order 6430.1A Section	Criteria	Conform (Y/N)	Comments
1300-8.2	Hazardous waste requirements appear in the directive in DOE 5480.1B, Chapter 2. Additionally, the RCRA, as amended, 40 CFR 264 and 40 CFR 265, contain specific design and operating requirements and standards for owners and operators of hazardous waste treatment and storage disposal (TSD) facilities.	Y	The operating requirements for the Waste Management Facilities are in accordance with applicable codes.
1300-8.3	Radioactive mixed waste, i.e., waste containing radioactive materials and other hazardous waste, shall be avoided where practicable. Mixed waste shall be segregated and handled separately from other types of waste in accordance with DOE 5400.3.	Y	There are currently no mixed wastes generated at the Pinellas Plant. However, mixed waste could be generated in the future. Specialty Components has a permit to store mixed waste (metals only) in Bay 2 of Building 1000.
1300-8.4	Facility design shall provide for the segregation of hazardous wastes into compatible groups for storage in accordance with the DOE 5400 series and DOE 5480 series. Suggested compatibility groups are acids, caustics, flammable materials, and organic materials.	Y	The hazardous wastes are segregated and stored in compatible groups in specific bays.
1300-8.5	Spill prevention and control shall be considered in the design stage of the facility to minimize the possibility of accidentally releasing hazardous waste to the environment.	Y	The bays that store liquid waste are equipped with trench drains and internal sumps.
1300-12.4.5	Personnel who work in a hazardous environment or who may be temporarily exposed to such hazards shall have convenient access to protective equipment, including emergency showers and eyewashes, and any other protective equipment necessary for the successful and safe completion of their work.	Y	Emergency showers, eyewashes and protective equipment are conveniently located for easy access.

Table 4-1. Evaluation of Waste Management With respect to DOE Design Criteria (Continued)

DOE Order 6430.1A Section	Criteria	Conform (Y/N)	Comments
1530-6	Installation of standpipe systems shall comply with NFPA 14.	Y	The system was installed in accordance with NFPA 14.
1530-7	Portable fire extinguishers shall comply with NFPA 10.	Y	Extinguishers comply with NFPA 10.
1530-99.0	Because of flammable or potentially flammable atmospheres, electrical installations in hazardous process locations shall be designed to preclude the introduction of any ignition source by the electrical equipment.	Y	The electrical installations are in accordance with the National Electrical Code (Class I, Division 2).
1530-99.19	Provisions shall be available for handling fire protection water contaminated with tritium.	N	Only undrained sumps are present. However, accident analysis in Chapter 6 demonstrated that a fire in the radioactive waste storage facility (Building 1000) is an incredible event.
1550-1.5.1	The ventilation-exhaust system shall be designed for the effective removal of noxious odors, hazardous gases, vapors, fumes, dusts, mists, and excessive heat and for the provision of fresh air to occupants.	Y	The facilities are equipped with exhaust fans. The CFM from these fans exceeds ASHRAE recommendations.
1630-5	Lightning protection systems shall comply with NFPA 78.	Y	Lightning protection is provided in accordance NFPA 78.
1660-99.4.3	Positive steps shall be taken to control or eliminate static electricity in areas where materials that are ignitable by static spark discharge are processed or handled. This includes spark sensitive explosives, propellants, and pyrotechnics as well as solvent vapors and flammable gases.	Y	Bays are equipped with grounding systems.

This page left blank intentionally.

5.0 DESCRIPTION OF OPERATIONS

This chapter describes operations in the Waste Management Facilities. These operations include removal, transportation, transfer, storage, treatment, and shipping of radioactive and hazardous wastes. These operations are discussed separately in the following subsections. Waste Management has detailed procedures for all of these operations (Ref. 17).

Unless stated otherwise, for each operation, four aspects are discussed:

Operation description (including equipment description)
Operation hazards
Physical barriers
Administrative controls

Also presented in this chapter is a summary discussion of the quantities of wastes generated and a description of the area-wide physical and administrative controls. Appendix A lists high level administrative controls known as safe operating restrictions which define the safe operating envelope for Waste Management.

5.1 Waste Removal (55-gallon drums)

5.1.1 Operation Description

Managers of process areas which generate liquid or solid waste are responsible for requesting removal of accumulated waste. Waste Management personnel, upon receiving the request, prepare a drum by labeling the drum with the appropriate EPA pre-printed label or a "Non-Hazardous" label, and deliver the drum to the requestor's area. Waste Management has a specific procedure (Ref. 17) for drum preparation and labeling.

Waste Management personnel inspect drums prior to removing them from a process area to ensure there is no damage and then secure lids and locking rings on 17H 55-gallon drums, and secure the bung plugs on 17E 55-gallon drums. All drums that are in areas which have the potential for tritium contamination must be surveyed for radioactive contamination, per the Site Radiation Control Manual, by ES&H Health Physics prior to removal. Drums are transported to the storage area using a fork lift. There are times when B-25 boxes are loaded with low-level contaminated waste in Building 1000.

Drums are inspected for proper labeling and weighed on a drum scale located in Bay No. 1 in Building 1040. The drums are then stored on pallets in the proper storage locations as required by their contents.

Chemical Waste Removal

Waste Management personnel pick up small quantities of waste material generated throughout the Pinellas Plant at a central pickup site located outdoors, adjacent to the receiving area on the north side of Building 100.

Process Area personnel transport small containers of liquid and solid waste to the central pickup area at a designated daily time. Personnel must bring a completed Waste Disposal Log along with the waste material, and each container must be properly marked before it is accepted by Waste Management personnel.

Waste Management personnel inspect the chemical waste transport prior to use. Valves and funnel lids on the transport vehicle are closed and pipelines are capped. The chemical waste transport vehicle is then towed from Building 1040 to Building 100 (Receiving) through the use of a cart with a gasoline-powered engine. Once the chemical waste transport reaches the pickup area, it is grounded by the use of a flexible cable to the grounding rod located at the pickup area. A "No Smoking" sign is placed on the chemical waste transport. All personnel handling the chemical waste wear protective clothing.

The Waste Management operator determines final disposition requirements for each chemical waste. All steel containers are bonded to the chemical waste transport. Chemical waste is then poured into the appropriate tank on the chemical waste transport. Containers of off-specification materials (such as solvents rejected because of impurity) as well as empty containers used for acutely hazardous chemicals (as defined in 40 CFR 261) are loaded into the tote tray on the chemical waste transport. Empty containers other than those that were used for acutely hazardous chemicals are considered non-RCRA waste.

Once chemical waste pickup is completed, the flexible grounding cable is removed from the grounding rod and the chemical waste trailer is towed to Building 1040. Non-RCRA waste, off-specification hazardous waste and empty containers from acutely hazardous waste are stored in Bay No. 3. The chemical waste transport is manually backed into Bay No. 1 of Building 1040. The chemical waste transport is bonded to the pump at the 5,000-gallon flammable liquid storage tank through use of the pump's conductive hose. Contents of the chemical waste transport tanks, except flammable liquids, are pumped into the appropriate drums in Bay No. 1. Flammable liquids are then pumped from the chemical waste transport to the 5,000-gallon flammable liquid storage tank or into 55-gallon drums.

Waste Management operators respond to the process area to pick up chemical waste in Department of Transportation (DOT) approved drums at the request of the process area manager. Drums are inspected for proper labeling and proper sealing. Drums are then removed through the use of a hand dolly to pallets outside Building 100, where the drums are strapped to a forklift and transported to Building 1040 for storage.

Waste Zinc and Aluminum Removal

Area 139, Resin Casting, generates rinse water and sludge from a flame spray booth operation. This rinse water and sludge contain waste zinc and aluminum. Waste Management provides the appropriate drums for collecting this waste and also picks up full drums.

Waste Management personnel label a Specification 34, 55-gallon polyethylene drum and deliver it to Area 139. The drum plug is removed and a vented drum plug installed. The vent plug is verified to be operational by both visual and mechanical inspection. Waste Management personnel return to Area 139 on the same day to pick up the filled drum and any 5-gallon buckets of sludge and debris. Vented and the nonvented plugs are secured on the 55-gallon drum, and lids are placed on the 5-gallon buckets. The 55-gallon drum of waste water and 5-gallon buckets of sludge and debris are prohibited from being stored overnight in Building 100. The 55-gallon drum and 5-gallon buckets are transported to the Waste Management facilities.

The 5-gallon buckets are stored in Bay No. 3 of Building 1040 and the 55-gallon drum is stored in the 90 day storage area of Building 1010.

Waste Calcium Chromate Solids Removal

Waste calcium chromate solids are generated from the Battery Development Area and are removed by Waste Management personnel. A 17C or 17H drum with locking ring and closure is properly labeled, and a 60-mil drum liner is installed. The drum is transported to the waste generating area, and calcium chromate solid waste is transferred to the drum. The drum is then sealed and transported to Building 1040, Bay No. 2.

Waste Asbestos Removal

Drums filled with waste asbestos are removed by Waste Management personnel from areas in the plant after maintenance has packed them. These 17H drums are equipped with a locking ring and closure bolt. The drums are properly labeled and a drum liner installed before transporting to a specific area where asbestos is transferred into the drum and picked up. The drum is then sealed and transported to the 90 day storage area in Building 1010.

Waste Gold Cyanide

Waste gold cyanide is picked up at the daily waste pickup location (Building 100 Receiving area) by Waste Management personnel. Waste gold cyanide is also picked up at specific areas by Waste Management personnel upon request. Approved containers (Specification 34) are transported to Building 1040, Bay No. 3 storage and are stored in the cyanide waste cabinet. This cabinet is inspected on a daily basis by Waste Management personnel. Gold cyanide waste containers are labeled and their accumulation dates are indicated. Once the quantity of gold cyanide in the cabinet reaches 30 gallons or the age of the oldest container is approaching one year, the gold cyanide is prepared for shipment. A 30 or 55-gallon DOT-approved drum is used for shipment of gold cyanide waste. Gold cyanide is transferred from temporary storage containers to a drum. Several samples are taken to determine gold content. Waste is then shipped for gold recovery and waste disposal.

Scrap Battery Removal

Scrap lithium silicon, sulfur dioxide and calcium chromate batteries are collected in 17H drums in Battery Production Areas and are removed and stored by Waste Management personnel. Drums are prepared, labeled and transported by Waste Management to the battery areas. Once scrap batteries have been collected in the drums, Waste Management is notified to remove the drums from the areas. Waste Management personnel perform a visual inspection of contents on the top layer of each drum. Waste Management will not remove the drums if anything other than lithium batteries are present. In the case of the sulfur dioxide batteries, they are prohibited from removing the drums if leads on the batteries have not been cut off or taped down and if cells have not been sealed in nonconductive bags. Scrap calcium chromate drums are prohibited from being removed from the area if anything other than postmortem or destructively tested calcium chromate batteries are present. If the lithium silicon, sulfur dioxide, and calcium chromate drums meet the aforementioned requirements, they are secured with locking rings and closure bolts and are transported to Building 1040, Bay No. 2. At this location the drums are emptied and noncombustible packaging foam is inserted into the drum. Batteries are then placed back in their respective drums with terminals up. Layers of batteries are separated by layers of foam. The drums are then secured and stored in Bay No. 2 of Building 1040.

Liquid Transport Trailer

The Chemical Waste Transport trailer is a four-wheeled steel unpowered wagon with a tow bar. The trailer is separated into two containment basins, one is for flammable liquids and the other is for halogenated hydrocarbons, freon, and methylene chloride. There are four 35-gallon rectangular welded steel tanks on the trailer. The tanks are approximately 1.5 feet x 1.25 feet x 2.5 feet long. One container is for flammable liquids and is mounted inside the flammable liquids containment. The other containment basin contains three 35-gallon containers. One container is for each of the three liquids discussed above. Each tank has a funnel inlet covered with a lid, a 1-inch diameter pipe for a vent with a double elbow to prevent any rain from entering the tank. A quick disconnect is attached to a drain for pumping liquids through the top of the tank while in Building 1040.

The trailer is equipped with a fire extinguisher, grounding cable, and clamp. This grounding cable is used to ground the cart to the grounding rod located at the chemical waste pick-up location outside the Building 100 receiving area. This arrangement is illustrated in Figure 5-1. The cable is also used to ground the trailer when inside Building 1040. The trailer is towed with a gas powered vehicle. This vehicle is mechanically incapable of operating in reverse, and the vehicle is also prohibited from entering Building 1040 with the trailer.

5.1.2 Operation Hazards

The hazards associated with the removal of waste involves hazardous materials whose handling may result in harm to workers. These materials are discussed below:

Tritium contaminated waste represents a radioactive hazard to waste management personnel.

Reactions of gold cyanide solutions with acids, acid salts, chlorates, and nitrates produce the toxic gas, hydrogen cyanide.

Asbestos is a known carcinogen.

Scrap lithium silicon and calcium chromate batteries may contain some unspent hazardous materials. Because of the reactive nature of the materials they are segregated from each other and placed in metal drums.

Spent sulfur dioxide batteries may contain residual amounts of sulfur dioxide.

L:\PUB\CGA\D4151

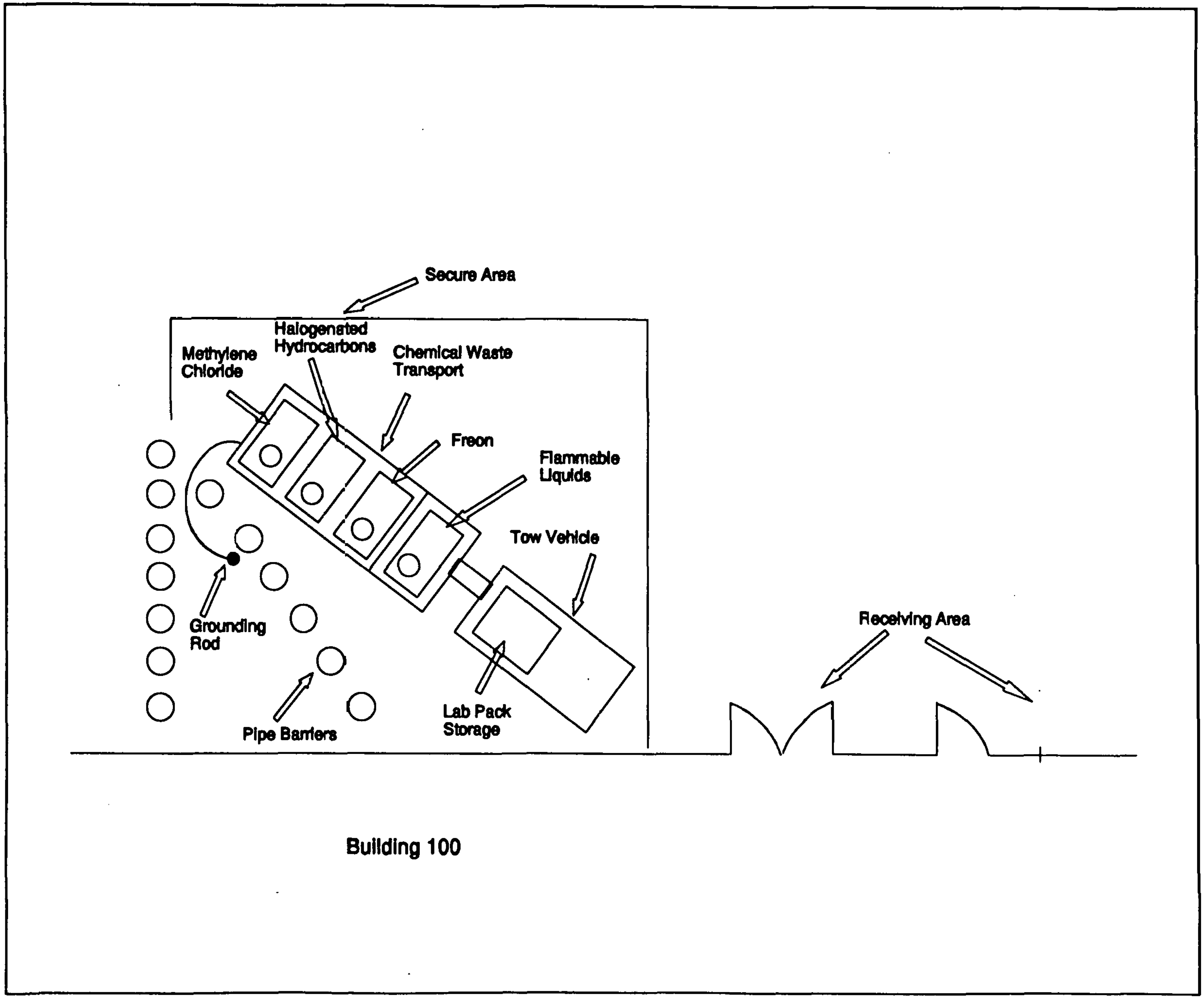


Figure 5-1. Liquid Waste Pick-up Location

5.1.3 Physical Barriers

Physical barriers associated with waste removal operations are discussed below:

- Personnel wear half-face, cartridge-type dust/mist respirators during the gold cyanide and calcium chromate transfer operations.
- Personnel wear full-face, cartridge type high efficiency particulate air (HEPA) respirators when filling the drum with asbestos.

5.1.4 Administrative Controls

Administrative controls direct personnel not to pick up waste if inclement weather (i.e., lightning) is imminent, if someone is smoking, or if an operation involving sparks or open flames is occurring within 25 feet of the chemical waste transport.

5.2 Waste Storage

5.2.1 Operation Description

The Pinellas Plant is regulated in operating a Hazardous Waste Storage and Treatment Facility by Waste Management Operating Permit No. HO52-159339 (Ref. 18) issued by FDEP. This permit restricts the maximum amounts and types of hazardous waste stored on-site. Table 5-1 lists type, quantity, and location of hazardous waste storage permitted at the Pinellas Plant by the Waste Management Operating Permit.

Operations associated with storage of radioactive and hazardous waste are limited to transportation. Fifty-five gallon drums of radioactive waste are placed on a four-drum wooden pallet and moved by forklift into position in Bay No. 1 of Building 1000. Pallets are stacked three high. B-25 boxes of radioactive waste are moved by forklift from Building 1000 to Building 1010. Building 1010 provides additional space for radioactive waste storage.

Fifty-five gallon drums of liquid hazardous waste are placed on four-drum internal containment pallets and moved by a diesel powered fork lift into position in Bay No. 1 of Building 1040. Pallets are prohibited from being stacked more than two high in that bay. The operation is the same for 55-gallon drums stored in Bay No. 2 of Building 1040 with the exception that pallets do not have to be internal containment type since no liquids are stored in this bay.

Table 5-1. Waste Storage Permit Allowances

Location	Capacity	EPA Waste No.	Waste
Building 1040 Bay No 1	40 55-gallon drums 24 lab packs (both may contain free liquids)	F001	Tetrachloroethylene; trichloroethylene; methylene chloride; 1,1,1-trichloroethane; carbon tetrachloride; and chlorinated fluorocarbons
		F002	Tetrachloroethylene; methylene chloride; trichloroethylene; 1,1,1-trichloroethane; chlorobenzene; 1,1,2-trichloro-1,2,2-trifluoroethane; ortho-dichlorobenzene; trichlorofluoromethane; and 1,1,2-trichloroethane
		F003	Xylene, acetone, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol
		F005	Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane
		F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum
		F007	Spent cyanide plating bath solutions from electroplating operations

Table 5-1. Permitted Waste Storage Allowances (Continued)

Location	Capacity	EPA Waste No.	Waste
		F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used
Building 1040 Bay No. 1	40 55-gallon drums 24 lab packs (both may contain free liquids)	F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process
		D001	Hazardous wastes characteristic of ignitability
		D002	Hazardous wastes characteristic of corrosivity
		D004	Arsenic
		D007	Chromium
		D008	Lead
		D009	Mercury
		D011	Silver
		U032	Calcium chromate
		U223	1,3-diisocyanatomethyl; benzene
Building 1040 Bay No. 2	36 55-gallon drums 18 lab-pack drums (Neither may contain free liquids.)	D001	Hazardous wastes characteristic of ignitability
		D002	Hazardous wastes characteristic of corrosivity
		D003	Hazardous wastes characteristic of reactivity
		D004	Arsenic
		D007	Chromium
		D008	Lead
		D009	Mercury
		U032	Calcium chromate

Table 5-1. Permitted Waste Storage Allowances (Continued)

Location	Capacity	EPA Waste No.	Waste
		U223	1,3-diisocyanatomethyl; benzene
Building 1040 Bay No. 3	3 55-gallon drums (Drums may not contain free liquids.)	D002 D004 D008 D009	Corrosive; Arsenic waste; lead; and mercury
Hazardous Waste Storage Tank No. 1	5,000-gallons (standby tank)	F003	Xylene, acetone, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol
		F005	Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane
		D001	Hazardous wastes characteristic of ignitability
Hazardous Waste Storage Tank No. 3 (Halogenated)	2,000-gallons	F001	Tetrachloroethylene; trichloroethylene; methylene chloride; 1,1,1-trichloroethane; Carbon tetrachloride; and chlorinated fluorocarbons
		F002	Tetrachloroethylene; methylene chloride; trichloroethylene; 1,1,1-trichloroethane; chlorobenzene; 1,1,2-trichloro-1,2,2-trifluoroethane; ortho-dichlorobenzene; trichlorofluoromethane; and 1,1,2-trichloroethane
Hazardous Waste Storage Tank No. 5 (standby)	5,000-gallons	F001	Tetrachloroethylene; trichloroethylene; methylene chloride; 1,1,1-trichloroethane; carbon tetrachloride; and chlorinated fluorocarbons
		F002	Tetrachloroethylene; methylene chloride; trichloroethylene; 1,1,1-trichloroethane; chlorobenzene; 1,1,2-trichloro-1,2,2-trifluoroethane; ortho-dichlorobenzene; trichlorofluoromethane; and 1,1,2-trichloroethane

Table 5-1. Permitted Waste Storage Allowances (Continued)

Location	Capacity	EPA Waste No.	Waste
Hazardous Waste Storage Tank. No. 5 (standby)	5,000-gallons	F003	Xylene, acetone, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol
		F005	Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane
		D001	Hazardous wastes characteristic of ignitability

5.2.2 Operation Hazards

Operation hazards associated with the waste storage operations are the hazardous waste and the radioactive waste being stored. A list of the hazardous and radioactive waste is presented in Section 5.5.

5.2.3 Physical Barriers

Physical barriers present in waste storage are the different types of containment used to stored hazardous and radioactive waste. There are several types of storage containers used to store waste at the Pinellas Plant. Two types of containers are used for the low-level solid radioactive waste generated, a DOT specification 17C 55-gallon drum and a DOT specification B-25 Box, Type A. Hazardous waste is stored in DOT specification 17E, 17H, and 34 55-gallon drums.

The 17C 55-gallon drums used for storing low-level solid radioactive waste are steel open-top drums with locking rings. The B-25 Boxes, Type A, are steel with removable steel lids. The 17H drums are steel open-top drums with locking rings. The 17E drums are steel closed-top drums with bung holes. The specification 34 drums are polyethylene drums with or without bung holes.

The 17H drums are used for solid waste and liquid/sludge mixtures which cannot be pumped. Flammable liquids, corrosives, and aqueous solutions are not stored in 17H drums. The 17E drums are used for storing liquids. Solids and corrosives are not stored in 17E drums. Specification 34 drums ("poly drums") are used for corrosives and aqueous sludge mixtures and solutions. The specifications for all the containers used by waste management are discussed in Title 49 CFR, Parts 172 and 173.

The 17C, 17E, and 17H drums are required to be tested by the drum manufacturer as specified in Title 49 CFR, Part 178. This section requires that random samples of drums be taken at the start of production and repeated every four months. The tests that are performed consist of filling the drum to 98% capacity with water and dropping from a height of 4 feet onto solid concrete so as to strike diagonally on chime or, when without chime seam, to strike on another circumferential seam. Additional drop testing is performed on other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime and rolling hoops must be capable of withstanding this drop test. A hydrostatic pressure test of 40 psi is performed on a drum. The drum must withstand this pressure for 5 minutes. A drum with a full removable head must sustain 20 psi for 5 minutes. A drum is also tested with seams under water or covered with soapsuds or heavy oil by interior air pressure of at least 15 psi for 17C drums and 7 psi for 17E and 17H drums.

5.2.4 Administrative Controls

Waste Management personnel perform daily inspections of radioactive storage and hazardous waste storage areas of Building 1000, Building 1040, Building 1010, and storage tanks. Inspections are performed to detect any equipment malfunctions and/or deterioration, operator errors, and discharges which may lead to release of hazardous materials that could threaten personnel and the environment. In addition, the inspection program ensures compliance with provisions of the Hazardous Waste Facility Operating Permit. Daily inspections are documented and a file maintained within the Waste Management area. In addition to daily inspections, a bi-weekly inspection is conducted in the areas described above and involves a more detailed assessment. This inspection form is also filed within the Waste Management area.

A monthly inspection of Waste Management areas is conducted by a waste specialist to ensure compliance with requirements of FDEP Operating Permit No. H052-159339 (Ref. 18), and CFR Titles 40 and 49.

A quarterly non-destructive test is performed on the flammable liquids storage tank and halogenated hydrocarbons storage tank. The test is performed to determine rate of corrosion or erosion in the tanks. The inspection ensures that a minimum tank shell thickness of 0.227 inches is maintained.

5.3 Waste Treatment

5.3.1 Reactive Metals Treatment Facility

Operation Description

Waste is treated at the Pinellas Plant in compliance with provisions of the Hazardous Waste Operating Permit. Facility hazardous waste treatment operations consist of thermal and reactive treatment units. Reactive Metals Treatment operations treat calcium metal, calcium bimetal, and lithium contaminated wastes designated EPA Hazardous Waste Number D003.

Calcium metal and calcium bimetal are removed from the waste generator area after a request has been received by Waste Management. Calcium metal is only accepted by Waste Management personnel if it is secured in a metal container or plastic bag. Calcium bimetal is only accepted if it is received in a secured plastic bag or in a sealed air-tight foil pack. Sealed containers are secured on the bed of the transport vehicle with straps to prevent shifting. Plastic bags are placed inside the bed of the transport vehicle, but they are not stacked above the vehicle's side boards. Calcium metal and/or calcium bimetal are then transported to the Reactive Metals Treatment Facility. Calcium metal is placed in a 55-gallon drum labeled "Waste Calcium Metal," and calcium bimetal is placed in a 55-gallon drum labeled "Waste Bimetal." Plastic bags and foil packs are also disposed of in the trash compactor after the calcium metal or calcium bimetal is removed.

A hose, connected to the domestic water supply located near the concrete reaction pit, fills the reaction vessel (55-gallon drum) with water to a depth of 18 to 20 inches. The procedure contains a warning that hydrogen, heat, and steam are vigorously generated in the reaction vessel during treatment. The calcium metal and calcium bimetal are immersed for 48 hours and then checked to see if the reaction is complete. If the reaction is not complete, calcium metal and bi-metal are submerged in water for an additional 24 hours. Water is then siphoned from the concrete pit through use of a siphoning system pump. Water is pumped into the IWNF. Reaction vessels are inspected in the concrete pit.

Lithium waste is transported to the Reactive Metals Treatment Facility. Lithium-contaminated waste is immersed in water for a minimum of 12 hours, and then water is siphoned from the concrete pit in the same way as for calcium metal and bi-metal, and pumped to the IWNF.

Operation Hazards

Operation hazards associated with reactive metals treatment operations are the generation of hydrogen and heat during the treatment process.

Physical Barriers

Physical barriers present in the reactive metals treatment are the reaction vessels treatment facility (fenced in concrete pit).

Administrative Controls

The procedure for treatment of lithium contaminated waste specifies that the waste should be transported through the shortest practical route when it is removed from inside the plant. Calcium metal, calcium bi-metal and lithium-contaminated waste is removed for treatment on a request basis only and is not transported when it is raining or if rain is imminent.

5.3.2 Thermal Treatment System

Operation Description

The purpose of thermal treatment of listed materials is to convert the materials completely to nonexplosive, nonflammable material by open burning. Thermal treatment must be performed by at least two Waste Management operators. Security personnel are notified prior to thermal treatment. Treated materials are not stored by Waste Management; they are picked up from the process area on the day and at the time thermal treatment is scheduled. The amount of material that can be picked up is limited to the quantity that can be treated in one shift (2 pounds per burn).

The burn pan is visually inspected prior to initiating thermal treatment. The pan is checked for deterioration and for material present in the pan. One operator obtains a quart of gasoline, which is stored in Building 700, and transports it to the burn pan. The operators prepare the material for thermal treatment. Material to be treated [heat powder (Class 1.3 explosive) and/or heat paper] is placed in the burn pan, and a thin layer of gasoline is spread on and around the material and is trailed off to one end of the burn pan. Operators stand upwind of the material and use a pipe ignitor torch to light the gasoline at one end of the pan. Residue from burning is inspected to ensure combustion is complete, and if not, the burn procedure is repeated. There is no collectible residue after thermal treatment of heat power waste. Heat paper burn residue is placed in a metal can labeled "Heat Paper Burn Residue" and stored in Bay No. 3 of Building 1040. The amount of material treated is recorded by the Waste Management operator.

Explosive squibs and primers (Class 1.4 explosive) are treated in the cast iron reaction vessel. Two Waste Management operators perform this treatment process. Security personnel are notified prior to performing treatment, and the fire engine is manned and located near the reaction vessel.

The reaction vessel is visually inspected for signs of deterioration prior to initiating treatment. Approximately one gallon of heating oil or diesel fuel is obtained by Waste Management from Building 700. Approximately one gallon of heating oil or diesel fuel is poured into the vessel. A holding tray is placed into the vessel, and wire mesh screens are secured to the top of the vessel. A propane torch is then used to ignite the fuel in the vessel through a port located on the south side of the vessel. Squibs or primers are then remotely placed into the holding tray and are allowed to detonate. Residue is disposed of as nonhazardous waste approximately 12 hours later. The quantity of material treated is recorded by the Waste Management operator.

Operation Hazards

Hazards associated with thermal treatment operations are the exposure to explosive and flammable solids.

Physical Barriers

Physical barriers associated with thermal treatment operations are the burning pan and the reaction vessel. Safety glasses and rubber gloves are required during material preparation for treatment.

Administrative Controls

Thermal treatment is restricted when it is raining or if rain is imminent. Treatment of Class 1.3 and 1.4 explosives requires a Florida Blaster Permit. Waste Management personnel are currently testing for this permit. No permit for the treatment of explosives exists as of the date of issue of this document, and treatments have been postponed until the permit is issued.

5.4 Waste Shipment

5.4.1 Operation Description

Waste storage areas are inspected on a daily basis by Waste Management personnel. If a drum storage area is nearing capacity, a drum waste shipment is initiated. If a storage tank reaches approximately 70 percent capacity, a bulk waste shipment is initiated. Waste is sampled and analyzed if the Waste Management operator deems it necessary to determine composition of the waste. Hazardous waste and nonclassified radioactive waste are shipped by commercial carriers. Classified radioactive waste is shipped through use of safe secure transports (SST). The disposal facility provides the carrier for shipment. Drums are inspected to ensure they are labeled properly, and the following documents are prepared: Hazardous Waste Manifest; Land Disposal Restriction (LDR) form; Hazardous Waste Shipment Checklist; Emergency Response Guidelines; and Security Notification form.

The manifest is reviewed, and drum labeling, marking, and packaging are inspected by Traffic Assurance Specialists prior to releasing waste for shipment. Prior to bulk waste shipments, a Waste Management operator agitates the storage tank to mix in any sediment from the bottom of the tank. Trucks used for waste shipments are inspected by a Waste Management operator prior to releasing waste. If the truck fails inspection, deficiencies are noted by the Waste Management operator, and the truck is not loaded. Drums are transferred from storage areas to the truck through use of a fork lift. Truck tires are chocked prior to loading any waste on the truck. Contents of the storage tanks are pumped into the truck, with a five-gallon bucket placed under the truck fitting to contain any spillage. The Waste Management operator ensures trucks used for waste shipments are properly placarded (i.e., flammable, corrosive, oxidizer, etc.).

5.4.2 Operation Hazards

Operation hazards associated with waste shipment are the hazardous and radioactive waste being shipped.

5.4.3 Physical Barriers

Physical barriers present with waste shipment are the shipping containers and transportation vehicles.

5.5 Waste Quantities

Operation hazards associated with waste operations are the hazardous materials present in Waste Management facilities. These materials are hazardous waste and radioactive waste. Hazardous waste stored at the Pinellas Plant is identified with the characteristics of ignitability, corrosivity, reactivity, or toxicity.

Table 5-2 lists hazardous and radioactive wastes which were generated and stored at the Pinellas Plant during the years 1992 and 1993 (Ref. 4).

Table 5-2. Pinellas Plant Waste Quantities, 1992 and 1993

Waste	EPA ID No. (per 40 CFR 261)	Quantity (M^3) 1992	Quantity (M^3) 1993
Calcium Chromate (Solid)	D007, U032	0.94	0.00
Iron Disulfide and Residue	D003	0.00	0.00
Calcium Chromate Batteries	D003	0.83	0.00
Lithium Silicon Batteries	D003	0.00	0.00
Lithium Silicon	D003	0.00	0.21
Titanium Metal Powder	D003	0.00	0.00
Flammable Liquids	F003, F005, D001	14.70	11.30
Halogenated Hydrocarbons	F001, F002	4.60	2.84
Waste Epoxy Resin	D001	0.83	0.00
Methylene Chloride Resin	F001, F002	2.28	0.00
Laboratory Wastes	---	36.40	9.38
Waste Cyanide	D002, D003, F007	0.42	0.28
Waste Asbestos	---	0.00	2.10
Radioactive Waste (Solid)	---	29.42	28.46
Thermal Treatment Materials		0.004	0.0004

Hazards associated with wastes that have been stored in the past and wastes that are permitted to be stored are specific for each individual waste. Some wastes present more of a hazard to the environment than humans while others pose a greater hazard to humans. Specific hazards associated with Pinellas Plant permitted wastes are discussed and analyzed as necessary in Chapter 6 of this SA.

5.6 Physical and Administrative Controls

Physical Controls and Area Maintenance

Physical controls of Waste Management Facilities are provided by fences, containment dikes and limited access to buildings, where appropriate. Building access is controlled at all times; control is maintained by key locking doors and allowing only Waste Management and Security personnel to keep sets of keys.

Preventive and corrective maintenance operations are performed periodically in Waste Management Facilities. Corrective maintenance is coordinated through the Facilities Maintenance group. Any request for corrective maintenance must be accompanied by the appropriate paperwork and, in some cases, may require approval by the Pinellas Plant ES&H and Environmental Management groups. Preventive maintenance is coordinated with the Maintenance Programs group, and an appropriate schedule is agreed upon. Maintenance Programs assigns a specific maintenance unit to perform the work. As with corrective maintenance, paperwork associated with the preventive maintenance request requires approval by ES&H and Environmental Management groups.

Administrative Controls

Waste Management operations are conducted in compliance with all applicable Pinellas Plant General Operating Policies, Standard Operating Procedures, Waste Management Operating Procedures Manual (Ref. 17) and the Environmental, Safety and Health Manual (Ref. 20). These standards address management and personnel responsibilities in performing waste management operations. Also, they address safety requirements needed to control hazards associated with those operations. Physical limits imposed on the site regarding maximum quantities of hazardous waste that can be stored are delineated in the Hazardous Waste Operating Permit (Ref. 18).

6.0 ACCIDENT ASSESSMENT

Chapter 6 presents the accident assessment for Waste Management. It discusses both operational failures and nonoperational accident initiators. Operational events are assessed using the descriptions of the facility and the operations presented in Chapters 4 and 5 to prepare a Failure Modes and Effects Analysis (FMEA). Events such as internal flooding are not initiated in a specific operation and are, therefore, classified as nonoperational events.

Following a discussion of the FMEA process and the screening process, each accident initiator or event is analyzed to the level necessary to assess the degree of risk posed by the event. The level of analysis, whether quantitative or qualitative, is determined based on three factors: 1) severity of the potential outcome, or consequence, of the event, 2) complexity of the accident scenario, and 3) nature of the safety systems and features associated with the event.

The four primary objectives of this assessment are to:

- Identify the level of risk posed to workers, the environment, and the public;
- Assess features, such as safety systems and administrative controls which have been installed or implemented with the intent to reduce the likelihood of these accident initiating events or to reduce the severity or consequence if an accident does occur;
- Help identify the equipment, controls, or restrictions required to maintain the level of safety identified in this analysis; and
- Define the accident scenario with sufficient fidelity to aid in the evaluation of proposed changes to the facility or process and to help identify the presence of Unreviewed Safety Questions (USQ).

The general approach applied in the accident analysis process is summarized below:

1. Identify potential initiating events and operational failures that could adversely affect the area, personnel within the area, the public, or the environment;

2. Estimate (quantitatively or qualitatively), using a graded approach, the potential consequences of all credible accident sequences (i.e., sequences with an estimated annual probability of occurrence of greater than 1.0E-6); and

3. Categorize the credible sequences according to the risk they pose using a broadly defined categorization scheme.

The process of identifying potential initiating events and operational failures involved examining prior safety analysis reports, other risk assessments, generic compilations of initiating events, and site-specific reviews as well as obtaining DOE guidance. The site-specific reviews of potential initiators included: Pinellas-specific safety and environmental assessments, the current guidance for DOE hazards assessments (Ref. 1, 16 and 21), risk and safety analysis of similar DOE facilities (Ref. 22 and 23), and the Nuclear Regulatory Commission Guide specifying initiating events (Ref. 24) that are considered in nuclear power plant risk assessments. Design Basis Accidents (DBAs) were also considered. DOE Order 6430.1A, "General Design Criteria," specifies the type and magnitude of natural phenomena DBAs (e.g., tornado, earthquake) that DOE facilities are required to withstand (Ref. 16). Potential nonoperational accidents (i.e., those initiated by events other than operational failures) assessed in this chapter are: chemical/toxic gas release, external explosion, internal fire, internal flooding, lightning strike, power outage, and tornado/hurricane. The identification and screening process for potential operational accidents is discussed in detail in Section 6.2.

Throughout this chapter, a graded approach is applied to the accident analysis. In other words, where a qualitative discussion or a conservative deterministic analysis is adequate to bound the risk of a relatively simple event and the risks are acceptable (i.e., within the general guidelines of risk acceptance), no more detailed analysis is performed to generate complex fault tree or event tree information. Likewise, when a situation is more complex but still has an accompanying acceptably low risk, bounding statements are posed that simplify the situation; these are considered adequate for this analysis.

6.1 Nonoperational Accidents

Accident initiators of an internal nature that are commonly addressed in DOE facility Safety Assessments are discussed in this section.

These accident analyses are developed based on the methodology in DOE/AL Order 5481.1B. This methodology includes definition of accident sequences, development of event trees, determination of event likelihood and consequence, and comparison with risk criteria. The methodology is comparable to that applied to operational accidents (see Sections 6.2.5 - 6.2.10), but is more qualitative and does not use the FMEA to screen accident initiators.

6.1.1 Chemical/Toxic Gas Release

Chemical releases are possible in the Waste Management facilities because liquid chemicals are stored in these facilities in drums and may potentially be stored in tanks. In addition, Waste Management operations involve the transport of hazardous wastes from various plant locations to the Waste Management facilities. The types of chemicals available for release from these operations include any of the liquid RCRA-regulated wastes used and disposed during Pinellas Plant operations. These releases are discussed as operational events in this chapter (see Section 6.5).

6.1.2 External Explosions

External explosions are addressed in this SA because of the close proximity of pressurized gas cylinders to the facility. There may be up to 120 compressed gas cylinders in the storage area immediately to the west of Building 1000. These are stored upright in cells comprised of Schedule 40 pipe. This storage area is separated from the remainder of Building 1000 by an 8-inch thick reinforced wall that reaches to the ceiling. The remaining walls of the storage area are 5-feet-high, also 8-inches-thick, with a chain link fence that connects to the ceiling. The following types of gases are stored in the facility (in order of abundance): helium, argon, acetylene, fluoriform (Freon 23), hydrogen, nitrogen, oxygen, lazergas, and xenon. The largest cylinders stored in this facility contain 130 to 291 scf volume of gas. Of the types of gases stored, a cylinder pressurized to 1,300 psig containing 291 scf of hydrogen gas is considered to be the most hazardous item stored in the facility. Hydrogen is stored under high pressure and is the most explosive of the stored gases (Ref. 25). Therefore, this analysis considers an accident involving a cylinder of hydrogen to represent the bounding accident.

Likelihood Assessment

According to Reference 25, the most common failure modes associated with portable gas cylinders are those associated with handling and transport of the cylinders. In the gas cylinder storage area adjacent to Building 1000, the most likely accident scenario involving hydrogen gas and having serious consequences would be dropping the cylinder and rupturing the valve. Such an accident has the potential for the cylinder to become an explosive-driven missile.

This accident requires the following two failures:

- The operator handling the cylinder drops it while the protective valve cap is off.
- The valve ruptures, resulting in the forceful release of pressurized gases.

This incident is judged to be Extremely Unlikely, based on the historical data from plant cylinder storage operations and because it requires multiple failures. Also, operators are trained in handling cylinders using two computer-based training programs. Operating procedures indicate that cylinders shall not be handled unless the protective valve cap is in place; if an operator is observed violating those procedures, a minimum of three days suspension is the result. There have been no instances of gas cylinders at the Pinellas Plant being generated as missiles due to improper handling. Even if the average failure rate for either dropping the cylinder or valve rupture is 0.01 events per year, the combined probability is in the Extremely Unlikely range (1E-4 events per year to 1E-6 events per year).

Consequence and Risk Assessment

This analysis bounds the energy released from a ruptured gas cylinder (overpressure) as the amount of energy released from dropping the cylinder and rupturing the valve. The energy released from a gas cylinder pressurized at 1300 psig containing 291 scf of hydrogen can be determined by the isothermal expansion of a compressed gas.

This energy is calculated using the following equation (from Ref. 26):

$$W = 1.4x10^{-6} V \left[\frac{P_1}{P_0}\right]\left[\frac{T_0}{T_1}\right] R T_1 Log_e \left[\frac{P_1}{P_2}\right]$$

Where:

W = equivalent mass of TNT,(lbm)
P1 = initial pressure, (1314.7 psia)
V = volume of stored energy, (291 ft^3, volume of gas)
P_2 = final pressure of expanded gas, (14.7 psia)
P0 = standard pressure, (14.7 psia)
T_1 = temperature of compressed gas, (530 °R)
T_0 = standard temperature, (492 °R)
R = gas constant, (1.987 Btu per lb. mole-°R)

The blast energy associated with a ruptured cylinder is 160 lbs of TNT. The peak overpressure generated from a ruptured gas cylinder can be determined by calculating the scaled distance (Z). The scaled distance can be determined using the following equation from (Ref. 27):

$$Z = \frac{R}{W^{1/3}}$$

Where:

Z = scaled distance, (ft/lbm$^{1/3}$)
W = TNT mass, (160 lbs)
R = radial distance from the explosion, (24 ft, assumes the cylinder is located on the west wall of the storage area which is approximately 24 feet from Building 1000.)

The scaled distance is 4.42 feet. The blast wave parameters (peak overpressure) are plotted as a function of the scaled distance (Ref. 27). This distance corresponds to a overpressure of 50 psi. The structure damage effects associated with a explosion of that magnitude can be estimated using a probability unit (probit) model Pr. The probit model equation for structure damage is shown as:

$$Pr = -23.8 + 2.92 Log_e P_s$$

Where:

P_s = peak overpressure, (344,550 N/m^2)

The probit value is 13.4 which indicates there will be a 100% chance of structural damage given this event (Ref. 28).

The initial velocity of the projectile can then be determined using the following formula (Ref. 28):

$$V_m = 2.05\left(\frac{P_v D_f}{W_f}\right)^{0.5}$$

Where:

V_m = initial velocity, (feet per second)
P_v = rupture pressure of the cylinder, (1300 psig)
W_f = projectile weight, (weight of the cylinder 150 lbs)
D_f = diameter of the fragment, (6 inches)

The velocity of a (150 lb) cylinder is 89 feet per second. The minimum concrete block thickness that can withstand the velocity of a cylinder is determined using the modified Petry formula (Ref. 29).

$$T = K\frac{W}{A} Log_{10}(1 + \frac{V^2}{215000})$$

Where:

T = Shield thickness (in)
K = Material constant (wall) 110 in^3/lb (Ref. 29)
W = Weight of projectile, (150 lb)
A = Cross-sectional area of cylinder (28.3 in^2)
V = Velocity of projectile (89 feet per second)

The minimum wall thickness needed to provide adequate shielding is 9 inches. Given this event, a penetration of Building 1000 west wall is expected and injury to personnel from falling waste containers could result. The consequences of a cylinder rupture to Building 1000 are marginal to critical. The overall risk to the facility and personnel is negligible.

6.1.3 External Fires

External fires present a serious threat to the Waste Management facilities since a fire of sufficient heat and duration can conceivably cause the release of radioactive or toxic materials. The facility is physically separated from other buildings at the plant; however, it is not sufficiently isolated from other structures to preclude the possibility of a fire propagating to the Waste Management facilities. For example, Building 600 is located approximately 40 feet from Building 1040. Also, a transportation incident could occur at any point on the plant roads near Buildings 1000, 1010, and 1040. Factors that may limit the effects of such a fire on the Waste Management facilities include: 1) buildings equipped with automatic fire suppression systems, and 2) limited quantities of combustible materials located in and around the Waste Management facilities. The main threat of an external fire is that it may initiate an internal fire; internal fires are addressed subsequently in this chapter.

6.1.4 Internal Explosions

Internal explosions are not expected to occur in the Waste Management facilities due to the absence of pressurized or explosive materials. That is, in the absence of a fire, there are no materials in the facility which act as initiators for an explosion. During a fire, waste containers, such as plugged drums, are susceptible to the increase in heat, and accompanying increase in internal pressure. During very high heat conditions, these containers may fail, resulting in an explosion. Also during a fire, high concentrations of explosive gases may be generated from the various toxic or flammable materials stored in the facility. These concentrations are then likely to be ignited by the heat of the fire, resulting in an explosion. Explosions are not considered to be the primary effects of an internal fire, but are subsumed to the other effects produced by a fire. Therefore, all internal explosion accidents are considered to be subsumed by internal fire accidents and are addressed in Section 6.1.5, "Internal Fires."

6.1.5 Internal Fires

Internal fires in the Waste Management facilities pose a serious hazard to on-site personnel and possibly to the off-site public. A fire of sufficient heat and duration may result in the release of toxic or radioactive materials. Significant inventories of flammable materials are stored in the Waste Management facilities, which, if released, could exacerbate a fire. Appendix B provides an analysis of internal fires.

The frequency of a fire initiating in Waste Management is evaluated by reviewing the plant history (Ref. 30). The history indicates that, in Waste Management (past and present), there have been no reported fires in 13 years of available data. No fire events in 13 years yields a conservative frequency of 3.8E-02 per year. This rate is computed from the initiating event frequency of (2N + 1)/2T, where N is the number of events and T is the time period over which data has been gathered (Ref. 24). The likelihood that the fire suppression fails to operate is 1.5E-4 per challenge (Ref. 31). The joint probability of a fire and no sprinkler function is 1.5E-4 * 3.8E-2, or 5.7E-6 which is Extremely Unlikely.

Results of the analysis indicate that the fire suppression system in Building 101 is adequate to control credible fires without the assistance of the first-shift fire brigade. The analysis also indicates that the fire suppression system in Building 1040 (Bay No. 1) is dependent on the first-shift fire brigade response (within 2 minutes) to aid in controlling credible fires. In the event of a second- or third-shift fire (as described in Appendix B), Bay 1 of Building 1040 would probably be lost due to the slower response of the municipal fire departments. Design of Waste Management facilities are adequate to prevent spread of fire from the bay of origin. The consequences of a fire in Waste Management are marginal to critical. The associated risk to plant personnel, facilities and the public is negligible.

6.1.6 Internal Floods

Internal floods are possible in the Waste Management facilities because Buildings 1000, 1010, and 1040 are provided with water systems for both fire protection and domestic supply. These facilities may be inadvertently flooded with water due to three primary events: 1) inadvertent actuation of one or more overhead sprinklers, 2) rupture of the water distribution line for the suppression system, and 3) rupture of the domestic water supply line. The likelihood and consequences of these internal flooding events are addressed below.

Likelihood Assessment

Based on information provided in DOE Fire Protection Data (Ref. 32), the probability of inadvertent actuation of a single sprinkler head is 9.8E-6 per year. In the Waste Management facilities, there are no more than 100 sprinkler heads available for actuation. Therefore, the probability of inadvertent actuation of a sprinkler head in the Waste Management facilities is 9.8E-4 per year (100 * 9.8E-6 per year), which is an Unlikely event.

The likelihood of rupture of the fire suppression wet-pipe sprinkler system is expected to be comparable to inadvertent actuation of a sprinkler head. A failure rate of 1E-9 per hour is used for individual sections of three inch diameter (or less) pipe (Ref. 33). It is conservatively judged that there are 200 sections of pipe in the fire suppression system, and they have water supplied to them 8,760 hours per year. The probability of a rupture in the sprinkler system lines is then determined to be 1.7E-3 events per year (200 * 8760 * 1E-9), or Unlikely.

Using the same failure rate, the likelihood of a rupture of the domestic water supply lines is estimated to be 9E-4 events per year. This estimate is based on the conservative assumption that there are 100 sections of pipe, and they are used 8,760 hours per year. The likelihood category for this event is also Unlikely.

The only situation that would complicate the expected effects of the flood (i.e., facility damage) would be an internal flood event that involves the reactive wastes stored in Bay No. 2, Building 1040. Such wastes may react with water to produce a fire. These wastes are stored in plastic bags inside drums. In order for these materials to be affected by the flood, the materials would have to be released from the drums. Therefore, an event involving a drum breach would have to occur at approximately the same time as the internal flood event. Combining the likelihood of a drum breach, which is shown in Section 6.5.3.3 to be 7.5E-02 per year, with the most likely flood initiator (rupture of the wet-pipe sprinkler lines) is expected to result in a likelihood of (7.5E-02) * (1.7E-03) or 1.3E-04, which is an Unlikely event.

Equipment and facility damage are the most serious consequences of an internal flood. Even if the internal flood were to be accompanied by a reactive materials fire, the result would be a localized fire that would be extinguished by the inadvertently supplied water once the reactive metals-water reaction was complete. In fact, controlled flooding is the means by which reactive wastes are intentionally neutralized in the Reactive Metals Treatment Facility. Material damage and clean up costs caused by the flood event are considered to be a Marginal consequence.

The overall risk of an internal flood event in the Waste Management facilities is Negligible.

6.1.7 Lightning Strikes

The Pinellas Plant is located in an area that has one of the highest frequencies of lightning occurrence in the world. Therefore, the risk to the Waste Management facilities that is associated with lightning strikes is examined here. Waste Management, like all of the plant areas, is protected by industrial-quality lightning arrestors. The arrestors have proven themselves to be effective.

Consequence Assessment

The potential direct effects of a lightning strike on Waste Management include injury to personnel, damage to equipment, and initiation of a fire. The most severe consequence to personnel would involve ignition of flammable and combustible liquid waste by a lightning strike during handling operations. The fire analysis in Appendix B demonstrates that the most severe consequences to personnel from a fire in Waste Management (Building 1040) are critical. Those operations which may not be conducted during conditions of lightning or rain are described in the Waste Management Operating Procedures for Environmental Management (Ref. 34). As a bounding case, the likelihood of lightning strike during flammable material handling (Building 1040) is evaluated.

Likelihood Assessment

Data tabulated by the National Weather Service indicate that thunderstorms occur in the area of the Pinellas Plant on the average of 90 days out of 365 days. The frequency of lightning strikes to an area that is the size of Building

1040 is calculated by determining the flash density and the attractive area of the structure. The annual number of flashes expected to strike the Building 1040 during a year is equal to the product of the flash density (σ_{yg}) and the attractive area (A_a) of the structure.

The flash density is equal to the number of lightning strikes that strike the ground per square kilometer per year and is represented as the following equation (from Ref. 35):

$$\sigma_{yg} = p * \sigma_y$$

In this equation, p is the proportion of lightning discharges that go to the ground in relation to the geographical latitude, and is the number of flashes per square kilometer. The proportion of lightning discharging to the ground at the latitude of Pinellas Plant is 18.7% and is determined by using the following equation:

$$p = 0.1[1 + (A/30)^2]$$

The value for A is 28, representing the degrees of latitude (north) of the Pinellas Plant location. The value for flashes per square kilometer, σ_y, is 56.7 flashes/km^2/year and is represented in the following equation:

$$\sigma_y = 0.007T_y^2$$

The total number of flashes to which a structure is exposed is related to the frequency of local thunderstorms. The value for T_y is the number of thunderstorm days per year (90 days) at the given location. By substituting in the equations given above, the flash density (σ_{yg}) in the Pinellas Plant area calculated to be 10.6 flashes/km^2/year.

The attractive area of Building 1040 is calculated by determining the area of the roof and the area represented by the height of the sides of the building; the attractive area includes those areas contributed by the four corners of the building (circle of radius r_a). Both ends of the building (dimension w) contribute to the area $2wr_a$; the sides contribute $2lr_a$. Therefore, the attractive area (A) is equal to the sum of the roof area (l*w), the corners (πr_a^2), the ends ($2wr_a$), and the sides ($2lr_a$). The attractive area is defined in the following equation (from Ref. 35):

$$A_a = w * l + \pi r_a^2 + 2r_a(w + l)$$

The attractive area is calculated as 0.0002 km^2, based on the values given below:

l = length of the roof (0.026km)
w = width of the roof (0.007km)
r_a = $80\sqrt{h}\,(e^{-0.02h} - e^{-0.05h}) + 400(1-e^{-0.0001h^2}) = 0.00058$km
h = height of the building (0.0004km)

With an attractive area of 0.0002km^2 and a flash density of 10.6 flashes/km^2/year, the total number of flashes expected to strike the Building 1040 is 0.002 strikes per year. Therefore, the likelihood of a lightning strike is considered an Unlikely event.

The likelihood that personnel will be handling flammable materials at time of the strike and the likelihood that the lightning protection system will fail must also be considered. The likelihood of flammable materials handling operations is conservatively assumed to be 1. The estimated failure rate of the lightning protection system is 1E-2. The overall likelihood of a damaging lightning strike occurring during handling operations is the product of the occurrence of the lightning strike, the probability that personnel are present and performing flammable materials operations, and the probability of failure of the lighting protection system (0.002 x 1 x 1E-2, or 2E-5). This likelihood is Extremely Unlikely.

The consequences of a lightning strike during handling operations are expected to be serious injury to personnel and damage to equipment (critical consequence). This conservative analysis indicates that risk to personnel is negligible, based on the potentially Critical consequence and the Extremely Unlikely probability.

6.1.8 Loss of Off-site Power

The potential effects of the loss of off-site power on the Waste Management facilities are discussed in this section.

The plant emergency electrical power system does not supply electrical power to any of the Waste Management facilities. The facilities contain no safety systems that require emergency electrical power. Therefore, the temporary loss of off-site electrical power would result in no increased risk to the facility.

6.1.9 Tornados and Hurricanes

The Pinellas Plant is located in an area which has a history of tornado and hurricane activity. Therefore, the buildings which comprise the Waste Management facilities were designed in accordance with the following codes and criteria:

DOE Manual 6430.1A, General Design Criteria
UCRL-15910, Design and Evaluation Guidelines for DOE Facilities Subjected to Natural Phenomena Hazards
Standard Building Code
Guide for Calculations of Design Wind Pressures

The buildings are capable of withstanding a 100-year mean recurrence level wind velocity of 93 mph. The joists, walls, roof, and all welding was in accordance with requirements pertaining to the above codes (and others). Sustained wind velocities in excess of 93 mph are then assumed to cause structural damage to the buildings and to allow radioactive-waste containers to be drawn/blow out of the building. These containers are Department of Transportation (DOT) Type A 55-gallon drums and B-25 boxes, both capable of sustaining significant impacts without breaching. Due to the low frequency of storms of this magnitude and the durability of the containers, the likelihood of release of radioactive materials due to winds is considered Extremely Unlikely.

All radioactive wastes in the Waste Management facilities are solid. The only feasible release mechanism by which the contaminated solids could release their radioactive content (in a short time) is by fire. Therefore, in the event that solid radioactive material is released outside the building, there is no concern of significant exposures to plant personnel, the public, or the environment. The consequences of this event are considered Negligible. The associated risk to plant personnel, facilities, the public, and the environment is Negligible.

6.2 Operational Accident Events Identification and Screening

Operational accident events are identified in a multistep process. This process includes:

1. Identifying systems and operations that may present a physical or operational hazard. This information is derived from the descriptions in Chapters 4 and 5 and the hazards analysis presented in this section.

2. Screening of the systems and operations previously defined to identify hazard levels warranting additional investigation.

3. Developing a FMEA to better define the potential outcome (consequence) of failure conditions and to identify systems that mitigate these potential outcomes.

4. Using the results of the FMEA to identify accident scenarios that allow an assessment of the risks associated with the facility and its operations.

6.2.1 Preliminary Hazards Analysis

This section summarizes the hazards identified in the Waste Management area and analyzes their potential to cause damage or harm.

The Waste Management facilities were initially assessed in order to determine the hazards present. This assessment did not constitute a formal analysis but was performed as a prelude to the Safety Assessment process. A summary of the key hazards is presented in Table 6-1. This table considers the information presented in Chapters 4 and 5 in identifying those systems and areas where specific hazards are present. The key hazard table identifies each hazard and the nature of the hazard that could present a threat to workers, the facility, the public, or the environment. Hazards identified in this assessment are incorporated into the FMEA along with the systems, equipment, and operations identified in Chapters 4 and 5 of this SA.

Table 6-1. Key Hazards Listing for the Waste Management Facilities

Hazard Type	Specific Hazard	Location/Use
Chemicals	Hazardous liquid waste (including a variety of toxic or flammable organic liquids), up to forty 55-gallon drums, as well as external bulk tank storage	Bay No. 1, Building 1040 and external bulk tank storage/ Drums are stored on pallets until removed by the waste disposal vendor.
	Reactive waste (actually solid regulated waste that can contain corrosive, toxic, or reactive materials), up to thirty-six 55-gallon drums	Bay No. 2, Building 1040/ Drums are stored on pallets until removed by the waste disposal vendor.
	Lab-pack waste, a variety of chemicals that may be toxic or flammable	Bay No. 3, Building 1040/ Lab-packs are stored until they are packed into drums and removed by the waste disposal vendor.
Chemicals	Reactive metals, in the form of contamination on clothing and other articles	Reactive Metals Treatment Facility/ Water is reacted with contaminants on articles in order to render them nonreactive.
Flammable Materials	Flammable liquids (including alcohol, acetone, etc.)	Drum or external tank storage at Building 1040/ Flammable liquids are stored until shipment to an approved disposal location.
	Gasoline, heating oil, diesel fuel, in metal containers	Thermal Treatment Facility/ Flammable liquid used to ignite materials to be thermally treated.
Radiation	Solid low level radioactive waste, stored in 55-gallon drums and B-25 boxes	Bay No. 1, Building 1000/ Radioactive wastes are stored on pallets until removed by the waste disposal vendor.
	Solidified waste oils in up to thirty-eight 55-gallon drums; with oil being low level radioactive	Bay No. 2, Building 1000/ Radioactive solidified waste oils are stored on pallets awaiting eventual off-site disposal.
Explosives	Explosives, including heat paper, heat powder, squibs, drivers, and detonators	Thermal Treatment Facility/ Explosive items are ignited/detonated in a metal container in order to reduce the material to a nonexplosive, nonflammable state.
Potential Energy	Falling drums or other containers (gravitational potential)	Empty drums and drums of wastes are stored in Buildings 1000, 1010, and 1040.

Table 6-1. Key Hazards Listing for the Waste Management Facilities (Continued)

Hazard Type	Specific Hazard	Location/Use
Kinetic Energy	Moving vehicles, namely electric forklifts, diesel carts, and hand carts	Forklifts and carts are used to transport drums and boxes of waste to the various staging locations.

6.2.2 Screening of Operational Events for the FMEA

The systems, operations, and equipment included in the FMEA are derived from the discussions and functional descriptions contained in Chapters 4 and 5 of this document and from the hazards enumerated in Table 6-1. All the significant systems (or system types) in the Waste Management Area are listed in Table 6-2 and Table 6-3. Table 6-2 includes all elements that are considered in the FMEA and briefly describes their functions and reasons for inclusion in the FMEA. All safety systems are included in the FMEA while operational systems and operations are included depending upon their hazard contribution. Where the hazards of concern are obviously similar, a grouping is established in the Group "Gp" column and an alpha character is assigned (all of the same letter grouped together for assessment). Table 6-3 is included for completeness and identifies those systems, operations, or materials described in Chapters 4 or 5 that are not included in the FMEA. A brief statement is included explaining the reason for exclusion from further consideration in the FMEA.

Table 6-2. Systems, Operations, and Materials Included in the FMEA

Number	Name	Hazard(s) or Concern
1	Fire Protection System	Wet pipe sprinkler system which activates automatically upon detection. Safety system.
2	Low Level Solid Radioactive Waste Storage in Building 1000	Storage of drums or boxes of potentially radioactive solid wastes and solidified waste oil. Inadvertent release of this waste may expose personnel to radioactive contamination.
3	Storage of Reactive Wastes in Building 1040, Bay No. 2	Storage of drums of RCRA regulated solid wastes in Building 1040. Inadvertent release with exposure of this waste to moisture may result in exothermic reactions, producing fire.

Table 6-2. Systems, Operations, and Materials Included in the FMEA (Continued)

Number	Name	Hazard(s) or Concern
4	Storage of Flammable, Toxic, and Corrosive Liquid Waste in Building 1040, Bay No. 1	Storage of drums of hazardous and/or flammable wastes in Building 1040. Inadvertent release of these wastes may expose personnel to toxic materials, contaminate the environment, and/or provide a source of flammable materials.
5	Storage of Waste Asbestos in Building 1040	Storage of drums of asbestos wastes in Building 1000. Inadvertent release of this material may pose a health risk, since inhalation of asbestos can lead to asbestosis.
6	Storage of Lab-pack Wastes in Building 1040	Storage of Lab-pack wastes in Building 1040, in racks in Bay No. 3 and drums in Bays No. 1 and No. 2. Inadvertent release of these wastes may provide a source of toxic or flammable materials.
7	5,000-gallon Flammable Liquids Storage Tank	Storage of flammable wastes in a tank near Building 1040. Inadvertent release of these wastes from the tank may provide a source of flammable materials.
8	2000-gallon Halogenated Hydrocarbons Storage Tank	Storage of hazardous liquid wastes in a tank near Building 1040. Inadvertent release of these wastes from the tank may provide a source of toxic or flammable materials.
9	500-gallon Waste Oil Storage Tank	Storage of waste oil in a tank near Building 1040. Inadvertent release of these wastes from the tank may provide a source of combustible materials.
10	5,000-gallon Standby Storage Tanks	Storage of either flammable wastes or hazardous wastes in two tanks near Building 1040. Inadvertent releases from the tanks may provide a source of toxic or flammable materials.
11	Transportation of Hazardous Waste to the Waste Storage Facilities	Use of forklifts to transfer up to four drums each of hazardous or radioactive waste to Buildings 1000 or 1040. Inadvertent releases of wastes may expose workers or environment to toxic or radioactive materials.
12	Transfer of Hazardous Waste to Drums and/or Tanks	Pumps used to transfer waste from the transport cart to drums or tanks in Bay No. 1, Building 1040. Spill or other release may result in exposure of workers to toxic materials or provide a source of flammable materials.
13	Reactive Metals Treatment	Wastes contaminated with reactive materials that are exposed to water to remove the reactive characteristics of the contaminants. Personnel may be exposed to reactive metals, fire, and high heat.

Table 6-2. Systems, Operations, and Materials Included in the FMEA (Continued)

Number	Name	Hazard(s) or Concern
14	Thermal Treatment	Explosive or heat sensitive wastes ignited with a flammable liquid in order to negate their explosive characteristics. Personnel may be exposed to high heat, fire, or explosively-driven shrapnel.
15	Transportation of Hazardous Waste Off Site	Trucks for drum transport or a bulk chemical truck that removes the wastes from the Buildings 1000 or 1040 for off-site shipment. Inadvertent release of waste may expose workers or the environment to toxic, radioactive, or flammable materials.

Table 6-3 lists those items that were found, based on a preliminary screening, to be such that additional analysis through the FMEA process was not warranted. "Common industrial applications" generally refers to nonspecialized equipment bought and used in the manufacturer's intended configuration. "Standard Industrial Hazard" refers to OSHA controlled hazards.

Table 6-3. Items Not Included in FMEA

Number	Name	Reason for Excluding from FMEA
1	Storage of Empty Drums	Common industrial hazards.
2	Disposal of Shredded Materials	Common industrial hazards.
3	HVAC and Air Filtration Systems	Common industrial applications.
4	Supplied Breathing Air Systems	Common industrial applications.
5	Electrical Power Supply	Common industrial applications.
6	Compressed Air Supply System	Common industrial applications.
7	Domestic Water Supply	No intrinsic hazard.
8	Wastewater System	No intrinsic hazard.
9	Bottled Gases	Common industrial hazard; bottled pressurized gases are not the responsibility of Waste Management.
10	Use of Vehicles (forklifts, cushman carts, and handcarts)	Common industrial applications/hazards.
11	Office Operations	Typical OSHA-regulated office hazards.

Number	Name	Reason for Excluding from FMEA
12	Maintenance Operations	Standard repairs. Common industrial hazard.
13	Transport and Storage of Non-regulated Wastes	Common industrial hazard.

6.2.3 Guidelines and Assumptions in Developing FMEA

The first step in the FMEA process is to identify potential events that could adversely affect each of the system elements. These are failure modes that describe, in general terms, the type of failures that could affect a system element. This section describes the top-level assumptions and other important factors used in developing the FMEA. Two categories of assumptions and other important factors are useful for developing and interpreting the FMEA: general and system specific. The general items are listed first. The specific items and the system to which they apply follow.

General:

1. Waste Management personnel are well-trained and are familiar with the guidelines (procedures and controlling documents, such as Hazardous Waste and Blasters permits) for transport, storage, or treatment of wastes. Safety aspects of these guidelines, such as the use of protective clothing, are conducted as specified. (Faults due to intentional operator failures are not realistic failure modes.)

2. The work force is small and is responsible to a limited chain of authority, allowing more effective supervisory control and limiting the number of people who use the facility.

3. This SA addresses only those failures associated with operations performed by the Waste Management group. In this respect, such operations include collection of waste containers, their transport to Waste Management storage, storage, and preparation (staging) for off-site removal by the disposal vendor. This module does not include failures associated with filling waste containers (such as spills and other accidents), since this is the responsibility of the groups that generate the waste. Waste accumulation activities performed by these groups are addressed in the SAs associated with their other operations.

4. Burns sustained by workers through incidental contact with reactive materials are considered to affect only exposed extremities, such as hands and arms. The burns are not considered permanent or life-threatening.

5. In the FMEA, failures involving fires consider only the consequences of the fires on facilities and equipment. The fire initiators addressed in the FMEA may result in secondary fires which could spread to affect personnel. Secondary fires are discussed in section 6.4.2, "Internal Fires."

Specific:

1. Radioactive Releases:

   a) Tritium is colorless, odorless, and tasteless, and thus it is not detected by the human senses.

   b) Due to the highly dispersive nature of hydrogen and its isotopes, releases of tritium to the work area are quickly dispersed into the air.

   c) A single drum or box (B-25 container) of radioactively contaminated waste may contain up to 1,000 curies of tritium, although the average is generally much less. Inadvertent releases of tritium contaminated waste are considered to be released as tritium oxide.

   d) Tritium oxide is 10,000 to 25,000 times more hazardous to humans than elemental tritium. Pathways into biological systems are through inhalation, ingestion, absorption, and entry through cuts and wounds.

   e) Clean-up costs associated with significant releases are high based on experiences at other DOE plants.

   f) The effects of inadvertent releases of tritium oxide on personnel injury are a function of the quantity of release, the duration of release, and the proximity of personnel. Quantity of release has the same effect on the environment and systems without respect to duration of the release.

2. Asbestos and Calcium Chromate Releases: The toxic effects of these materials are important in terms of chronic (long duration) exposure but are much less significant for acute (single, short duration) events.

   a) Asbestos is a fibrous, odorless solid that is typically white, greenish-blue, or gray-green in color.

   b) Asbestos fibers can be inhaled or ingested; they can be imbedded in the lungs. Asbestos is a known carcinogen; after prolonged exposure to asbestos fibers, a condition called asbestosis can develop and may be fatal.

   c) Calcium chromate is an oxidizer and a suspected carcinogen. It is believed to cause fibrosis in the lungs and chronic exposure may be fatal.

3. Zinc-Plating Solution and Toxic Solids Releases (such as lead): Releases of solid toxic materials, such as zinc or lead contaminated wastes, are not considered to pose an immediate health threat to workers. These materials are regulated as hazardous because their release to the environment can cause a serious human health concern resulting from chronic exposure. These materials are not readily mobilized in accident situations; but they are ingested slowly through such means as drinking contaminated groundwater.

4. Reactive Materials Releases: Ambient moisture in the Waste Management facilities is assumed to be sufficient to cause an exothermic reaction with reactive metals. Therefore, releases of these materials may result in a fire.

5. Cyanide Releases: Reactions of cyanide or gold cyanide solutions with acids, acid salts, chlorates, or nitrates produce the toxic gas, hydrogen cyanide.

   a) Hydrogen cyanide is a colorless or blue liquid or gas (above 78° F) with a bitter, almond-like odor.

b) Hydrogen cyanide can cause immediate asphyxiation and death, via inhalation by a single breath, to persons exposed to levels above 2,300 ppm. The IDLH (Immediately Dangerous to Life and Health) for this material is 50 ppm; exposure to this concentration without a respirator is expected to cause death within 30 minutes. Exposure of personnel to lower levels, between 5 and 50 ppm, can cause weakness, confusion, nausea, and changes in the depth and rate of respiration.

6. Toxic Materials Releases: Releases of toxic gases or liquids other than hydrogen cyanide (such as sulfur dioxide or methylene chloride) may achieve concentrations at worker locations in excess of the IDLH levels. The effects of toxic material releases are dependent upon the quantity of materials released, the proximity of the worker, and the volatility of the material. Such effects are assumed to result in consequences that range from Negligible to Catastrophic. However, releases of toxic gases from thermal batteries are known to result in Negligible consequences (Ref. 41). Releases of toxic materials from lab-packs, due to their wide variety of chemical types (but generally smaller quantities), are assumed to present a hazard comparable to releases of hazardous liquid chemicals.

7. Flammable Liquids Releases: Depending upon the situation, releases of flammable materials may also involve a source of ignition, such as sparks or high heat. Such releases of flammable materials are considered to result in fire. Conversely, those failures that only involve combustible materials, such as oils, are not expected to result in fires. Cleanup of these releases is expected to prevent the prolonged exposure of these materials to an ignition source that is required for these materials to become involved in a fire.

6.2.4 FMEA Results

The FMEA is included as Appendix C. Guidelines for both likelihood and consequence categorization are provided by DOE/AL 5481.1B. These guidelines are shown in Table 6-4 and Table 6-5. The results of the FMEA are summarized in Table 6-6. A qualitative likelihood assessment is provided for all Category III consequence events to further screen this consequence class. If a likelihood of "Likely" is assessed, then the Category III event is carried forward to the Operational Accidents section for further analysis to better substantiate the category and its likelihood. All category I and II consequence events are examined. Prior to analysis, many of these events are observed to be of a "kind" where further grouping is worthwhile because of process of analysis, commonality of consequence, or other characteristic. Results of this grouping step are provided in the Operational Accidents section, Section 6.4.

Table 6-4. Qualitative Likelihood Categories

Category	Estimated Occurrence Rate (Per Year)	Description
Category A - Likely	$> 10^{-2}$	The event is likely to occur (possibly several times) during the lifetime of the facility.
Category B - Unlikely	10^{-2} to 10^{-4}	The event is unlikely, but may reasonably be expected to occur during the lifetime of the facility.
Category C - Extremely Unlikely	10^{-4} to 10^{-6}	The event is extremely unlikely and is not expected to occur during the lifetime of the facility.
Category D - Incredible	$< 10^{-6}$	The event is so unlikely that it is not credible.

Table 6-5. Qualitative Consequence Categories

Consequence Magnitude and Type	
Category	Description
Magnitude	
I Catastrophic	A failure that may cause deaths, the total loss of the facility or process, or severe damage to the environment
II Critical	A failure that may cause severe injuries or occupational illnesses, major damage to the facility or process, or major damage to the environment
III Marginal	A failure that may cause minor injuries or occupational illnesses, minor damage to the facility or process, or minor damage to the environment
IV Negligible	A failure that most likely will not result in injuries or occupational illness, damage to the facility or process, or damage to the environment
Type	
a	Hazardous material released to the environment
b	Hazardous material released within the building
c	Personnel exposed to hazardous material
d	Personnel exposed to safety hazards other than hazardous material
e	Loss of processing capability
f	Loss of system components

Table 6-6. Qualitative Likelihood Assessment

System/Event	Comments	Likelihood (Consequence)
Low Level Solid Radioactive Waste Storage/Rupture of multiple 55-gallon drums	Drums of low level radioactive solid waste are breached, the waste is released to the area, and personnel are exposed to tritiated water.	(II)
Low Level Solid Radioactive Waste Storage/Single Container Release	Container containing low level radioactive waste released tritium to the area.	(II)
Low Level Solid Radioactive Waste Storage/Rupture of multiple 55-gallon drums of solidified oil	Drums of low level radioactive solid waste oil are breached, the waste is released to the area, and personnel are exposed to tritiated water.	(II)
Reactive Solid Waste Storage/Rupture of multiple 55-gallon drums	Drums of reactive wastes are breached, the waste reacts with a reagent and toxic gases are released.	(II)
Flammable, Toxic, and Corrosive Liquid Waste Storage/Rupture of four 55-gallon drums	Four 55-gallon drums are ruptured from a fork lift, and hazardous liquid waste is released.	A Likely (III)
Flammable, Toxic, and Corrosive Liquid Waste Storage/Rupture of multiple 55-gallon drums	Drums of hazardous liquid wastes are breached and the waste is released.	(I)
Storage of Liquid Lab-Pack Waste/Rupture of multiple containers	Multiple containers of lab-pack hazardous liquid waste are breached, and the waste is released.	(I)
Bulk Flammable Liquid Waste Storage/Rupture of the 5,000 gallon storage tank	Failure of tank to contain its flammable materials contents results in a release of these wastes. Exposure to an ignition source results in a fire in the tank area.	(I)
Bulk Halogenated Hydrocarbon Liquid Waste Storage/Rupture of the 2,000 gallon storage tank	Failure of tank to contain its halogenated hydrocarbon contents results in a release of these wastes. Exposure to an ignition source results in a fire in the tank area.	(I)
On site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of four 55-gallon drums	Four 55-gallon drums are breached while in transport on site with hazardous liquid wastes released.	(II)

Table 6-6. Qualitative Likelihood Assessment (Continued)

System/Event	Comments	Likelihood (Consequence)
On site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of the Chemical Transport	The Chemical Transport is breached while in transport on site with hazardous liquid wastes released.	(II)
On site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of the bulk tank truck	The bulk tank truck ruptures while in transport on site with hazardous liquid wastes released.	(I)
On site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of the transfer hose	While transferring the hazardous liquid waste from the bulk storage tank to the tank truck, the transfer hose ruptures releasing hazardous liquid waste.	(I)
On site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of multiple 55-gallon drums on truck	Multiple 55-gallon drums rupture on site while being transported in the truck and release hazardous liquid waste.	(I)
On site Transportation of Radioactive Solid Waste/Rupture of multiple 55-gallon drums on truck	Multiple 55-gallon drums rupture on site while being transported in the truck and release tritium.	(I)

6.2.4 Define Accident Sequences

In this portion of the analysis, accident sequences are defined for those initiating events with a likelihood greater than 1.0E-6 per year and for those components of system operational failures identified in the FMEA as having potentially critical or catastrophic consequences. This definition process takes into account the response and mitigation functions available or required to deal with incidents or accidents.

6.2.5 Develop Event Trees

Event Trees may be required to define the relationships of the hazard, the systems designed to control or mitigate the hazard, and the outcomes of combinations of successes and failures of those systems and events. The development of sequence event trees begins with the identification of the systems (safety or normal process systems) available to fulfill the response and mitigation functions defined in Chapters 4 or 5. For this purpose, systems are broadly defined and may include passive features, such as containment or confinement walls. Once the systems are identified, the nature and temporal order of their response are established. From this information, accident sequence event trees can be constructed that (1) are combinations of system successes and failures (given some initiating event or operational failure), and (2) can result in a set of significant consequences. The event tree structure reflects the interrelationships between systems as well as those physical aspects of the accident itself that can affect individual system success.

6.2.6 Determine Accident Sequence Likelihoods

The sequence of performing this step or the step described in Section 6.2.7 may be reversed depending upon the system characteristics.

Accident sequence probabilities may be either quantitatively or qualitatively obtained. The method of development of an accident sequence probability is influenced by a number of factors including the estimated or assessed consequence of failure, the complexity of the system, and the desire to assess the importance or characteristics of identified safety systems or procedures. In general, if the consequence of an event is marginal (Category III or lower), a qualitative assessment of likelihood is all that is required. A qualitative or quantitative assessment of likelihood for events of consequence code I or II may or may not be required depending upon the characteristics of the system.

The first step in the determination process establishes the response/mitigation system characteristics and develops estimates of their failure (or success) probabilities. Where systems are the same or very similar to those used in other applications, system failure rates may be available from the literature or experience at the facility. Operational experience may be used to estimate the failure rates, particularly where there is significant operational experience. Otherwise, it may be necessary to develop a system fault tree and to generate estimates of the system failure rates by "solving" the fault tree. Once the system failure rates have been determined, the sequence outlined by the event tree can be quantified. The final step in the quantification process is a comparison to the 1.0E-6 per year probability criterion. If the sequence probability is less than 1.0E-6 per year, the sequence is documented and eliminated from further consideration. If all of the identified sequence probabilities fall below the threshold, the accident analysis is concluded. The information about the systems that are employed in response and mitigation to achieve the low sequence probability is noted for use in defining systems critical to safety and their associated operational safety requirements. Those sequences with probabilities are also documented and retained for later consideration.

6.2.7 Quantify Accident Consequences

The next step in the accident analysis process is to define the potential consequences for the retained accident sequences (or for any specific situations for which consequence estimates are desired regardless of likelihood). The consequences may include, but are not limited to, radiation exposure, toxic chemical exposure, and exposure to blast effects. After the consequences are identified, they are quantified on a conditional basis. That is, the radiation dose (population or individual), toxic exposure level, blast strength, or whatever consequence is of concern, is quantified assuming that the accident has occurred.

6.2.8 Estimate the Risk From Accidents

The results of the analyses described in Section 6.2.7 are combined to generate an estimate of the risk for each retained sequence. The risk is the product of the sequence probability and conditional consequence, and is expressed as a consequence per year. For example, a radiation exposure could be expressed as the expected population dose (rem per year) due to accidents at the facility. Similar relationships are developed for other consequences.

In addition, the risk level associated with each event is tabulated using a broadly defined categorization scheme. Table 6-4 and Table 6-5 describe the quantitative categories used to characterize the likelihood and consequences of each event. These categories are based on the qualitative likelihood and consequence descriptors outlined in Reference 1. The two categories, when combined, provide a measure of the accident risk at the plant. Category combinations are shown diagrammatically in Figure 6-1. These categories are used in Chapter 2 as a means to summarize each event.

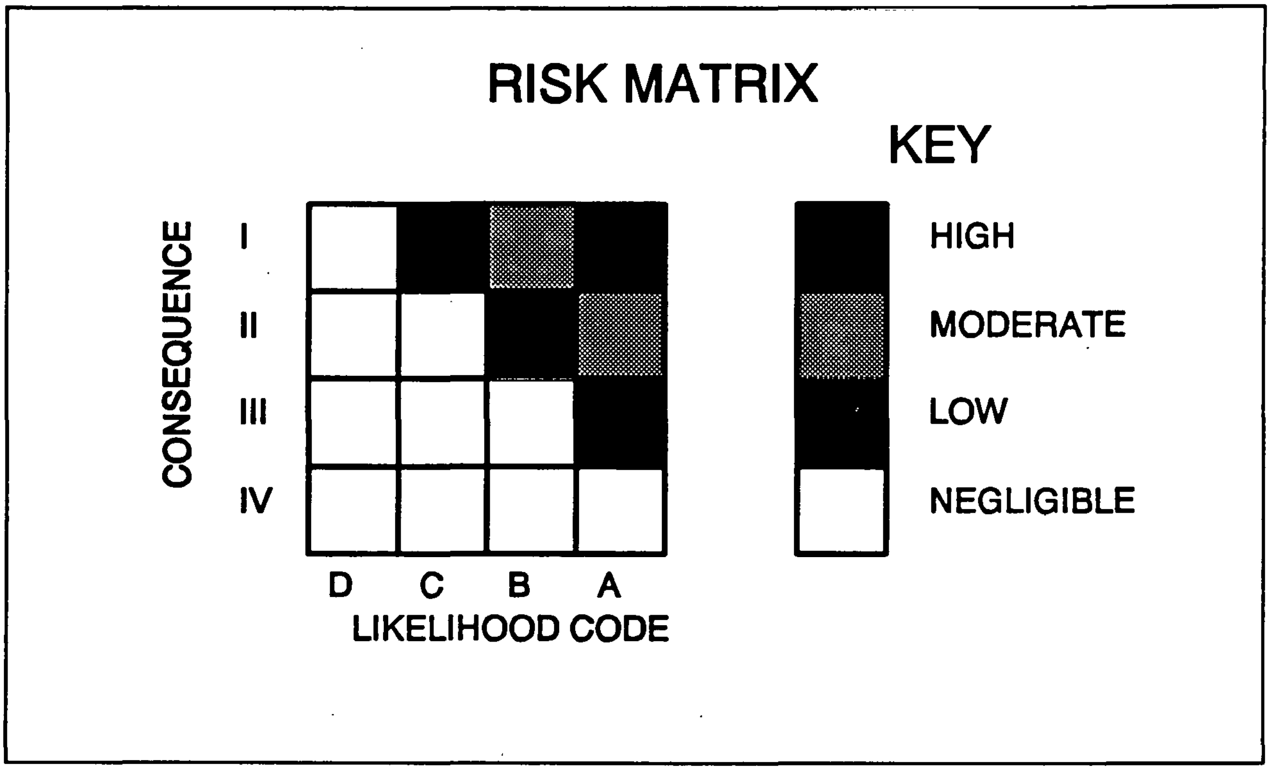


Figure 6-1. Risk Matrix

6.2.9 Compare with Criteria

The estimated risks are then compared with established criteria, when such criteria exists, for the type of facility being studied. Radiation doses should be within the limits defined in DOE Order 6430.1A and DOE 5480.11 to be acceptable. Similarly, exposures due to toxic chemicals should be within accepted threshold limit values (TLV) for the material in question. The risks that are acceptable or negligible on the basis of comparison with criteria are documented and summarized. This summary is often presented in a narrative description in addition to the tabular form required by DOE/AL Order 5481.1B. The remaining risks are also summarized and documented. In this latter case, insights gained from the accident analysis may be "fed back" to the facility management for the possible implementation of measures to reduce the predicted risk. Information about all systems that serve to reduce or mitigate the consequences of an accident is included to aid in identifying systems critical to safety and in subsequently defining administratively controlled operational safety requirements or safety restrictions, when necessary to ensure the identified level of risk is not exceeded.

6.3 Operational Accidents

Operational accidents are postulated based upon the results of the FMEA discussed in Section 6.2. FMEA events with Category I or II consequences, and Category III consequences whose qualitative likelihood is assessed to be "Likely," are considered for analysis in this section. Those events that meet the above criteria are shown in Table 6-7 and described in Table 6-8.

Table 6-7. Operational Events for Analysis

SYSTEM/EVENT	ANALYSIS EVENT
Low Level Solid Radioactive Waste Storage/Rupture of multiple 55-gallon drums	Event 1
Low Level Solid Radioactive Waste Storage/Single Container Release	Event 1
Low Level Solid Radioactive Waste Storage/Rupture of multiple 55-gallon drums of solidified oil	Event 1
Reactive Solid Waste Storage/Rupture of multiple 55-gallon drums	Event 2
Flammable, Toxic, and Corrosive Liquid Waste Storage/Rupture of four 55-gallon drums	Event 3
Flammable, Toxic, and Corrosive Liquid Waste Storage/Rupture of multiple 55-gallon drums	Event 3
Storage of Liquid Lab-Pack Waste/Rupture of multiple containers	Event 4
Bulk Flammable Liquid Waste Storage/Rupture of the 5,000-gallon storage tank	Event 3
Bulk Halogenated Hydrocarbon Liquid Waste Storage/Rupture of the 2000-gallon storage tank	Event 3
On-Site Transportation of Flammable, Toxic, and Corrosive Waste/Chemical Transport Cart	Event 5
On-Site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of the chemical transport	Event 5
On-Site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of the bulk tank truck	Event 5

Table 6-7. Operational Events for Analysis (Continued)

SYSTEM/EVENT	ANALYSIS EVENT
On-Site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of the transfer hose	Event 5
On-Site Transportation of Flammable, Toxic, and Corrosive Waste/Rupture of multiple 55-gallon drums on truck	Event 5
On-Site Transportation of Radioactive Solid Waste/Rupture of multiple 55-gallon drums on truck	Event 1

Table 6-8. Analysis Events

Event Number	Event Description
1	Multiple 55-Gallon Drum Rupture/Single Container Release of Low Level Solid Radioactive Waste: Analysis to examine the likelihood of an event leading to the rupture and release of multiple 55-gallon drums of solid low level radioactive waste inside Building 1000 and on-site during transportation off site. If required, the analysis examines the effects of the multiple drum rupture.
2	Multiple 55-Gallon Drum Rupture of Solid Reactive Waste: Analysis to examine the likelihood of an event leading to the rupture and release of multiple 55-gallon drums of solid reactive waste inside Building 1040, Bay No. 2. If required, the analysis examines the effects of the multiple drum rupture.
3	Release of Flammable, Toxic, and Corrosive Liquid Waste: Analysis to examine the likelihood of an event leading to either the rupture of multiple 55-gallon drums of flammable, toxic, and corrosive liquid waste inside Building 1040, Bay No. 1, or the rupture of the bulk storage tanks outside Building 1040. If required, the analysis examines the effects of the release of flammable, toxic, and corrosive liquid waste.
4	Release of Lab-Pack Liquid Waste: Analysis to examine the likelihood of a multiple container rupture of liquid lab-pack waste inside Building 1040, Bay No. 3. If required, the analysis examines the effects of the release of the liquid lab-pack waste.
5	On-site Hazardous Waste Transportation Accident: Analysis to examine the likelihood of an event leading to the release of bulk quantities of flammable, toxic, and corrosive liquid waste on-site during transportation. If required, the analysis examines the effects of the release of flammable, toxic, and corrosive liquid waste on site.

6.3.1 Event Number 1 -- Multiple 55-Gallon Drum Rupture/Single container release of Solid Low Level Radioactive Waste

This event postulates that the entire inventory of low level solid radioactive waste is released from an accident initiator. The radioactive waste is stored in 55-gallon drums. The curie content of each drum is assumed to be the maximum permitted or 1000 Ci. The accident initiator for a multiple drum release is a fire. The scenarios assumed for this event are multiple drum rupture as a result of a fire inside Building 1000 and multiple drum rupture as a result of a transportation accident on site with a subsequent fire. A fire is the key initiator in both scenarios since without a fire the solid radioactive waste will pose a marginal consequence. This assumption is due to the insignificant quantity of tritium oxide that is expected to be present in gaseous form in a 55-gallon drum.

Multiple 55-Gallon Drum Rupture Inside Building 1000

The initiation of a fire in Building 1000 was considered for this event. In order to estimate the frequency of a major fire in Building 1000, a record of structure fires was obtained and evaluated (Ref. 36). Reference 36 indicates that 76,500 structure fires have occurred in the United States in 1987. These structures consider industry, utility, and defense structures and storage in structures. This data is an estimate of all fires both minor and major. Reference 37 indicates that there was a total of 5,937,000 establishments in the United States for all industries in 1987. It is conservatively assumed that there are at least two structures per establishment. This translates into a total of 11,874,000 industrial structures in the United States in 1987. The frequency of a fire initiating in an industry structure in the United States in 1987 is then (76,500 structure fires per year)/(11,874,000 structures), or 6.4E-03 fires per year.

The frequency of fire initiating in Building 1000 was further evaluated by reviewing the plant history (Ref. 30). The history indicates that for the Waste Management structures (past and present) there have been no reported fires in 13 years of available data. No fire events in 13 years yields a conservative frequency of 3.8E-02 per year. This rate is computed from the initiating event frequency formula (2N + 1)/2T, where N is the number of events and T is the time period over which data has been gathered (Ref. 24). This frequency is for any fire as is the previously calculated frequency. In order to modify the overall fire frequency estimates to include only major fires, a factor of 0.3 was employed as was used in Reference 24. In that reference it was determined from a comprehensive study of nuclear power plant fires that 30% of all reported fires could be classified as major. Therefore the frequency of a major fire in Building 1000 is estimated to be (3.8E-02 fires per year) * (0.3 major fires/fire) or 1.1E-02 per year. Using the same factor for the previous estimate yields a frequency of (6.4E-03) * (0.3 major fires/fire) or 1.9E-03 per year. The analysis in Reference 38 indicates the frequency of fire in a similar type of structure as 4E-03 per year. The conservative value of 1.1E-02 per year was used for this event.

The likelihood of a major fire initiating in Building 1000 was then used with the probability of failure of the wet pipe sprinkler system to determine the likelihood of this event. The fire protection system reliability data reported by the Electric Power Research Institute estimate that the failure probability for wet-pipe sprinkler systems similar to the sprinklers in Building 1000 is 1.5E-04 failures per demand (Ref. 31). The frequency of a major fire in Building 1000 and a failure of the wet-pipe sprinkler system to actuate is (1.1E-02) * (1.5E-04) or 1.65E-06 per year. The likelihood of a multiple 55-gallon drum rupture inside Building 1000 is conservatively assumed to be incredible and is not considered any further.

Multiple 55-Gallon Drum Rupture During Transportation On Site

This event postulates a traffic accident on site involving the radiological waste transportation truck. As a result of the accident a fire initiated rupturing multiple 55-gallon drums. The traffic control on site is much more restrictive than the public roadways. There is limited traffic on the plant site at any given time. Data obtained from Reference 39 indicates that 1.31 Hazardous Material (HAZMAT) transportation accidents occur per million miles driven. The quantity of radioactive waste shipped off site is limited. It is conservatively estimated that there are six shipments of radioactive waste off site every year. A truck traveling one mile on site with a full load for each shipment translates to six miles per year on site for a truck with multiple 55-gallon drums of radioactive waste. Using the reference data, the probability of a traffic accident on site involving a truck loaded with multiple 55-gallon drums of radioactive waste is (1.31E-06 accidents/mile traveled) * (6 miles per year) or 7.86E-06 per year. The fact that an accident occurs does not imply that a fire is initiated. There have been no traffic accident fires reported in 25 years of available data. The probability of a fire initiating is conservatively computed from the initiating event frequency formula (2N +

1)/2T, where N is the number of events and T is the time period over which data has been gathered. No fire events in 25 years yields a conservative frequency, of 2E-02 per year. The frequency of a traffic accident on-site involving a truck transporting multiple 55-gallon drums of radioactive waste and a fire initiating is (7.86E-06) * (2E-02) or 1.57E-07 per year. The likelihood of a multiple 55-gallon drum rupture of radioactive waste on-site is conservatively assumed to be incredible and is not considered any further.

The postulated scenarios of multiple 55-gallon drum rupture of solid low level radioactive waste are shown to be incredible events. These events pose a negligible risk to personnel and the environment.

Single Container Release inside Building 1000

Single container release of low level radioactive waste represents an accident situation which can occur inside Building 1000. The plant has experienced at least one instance where tritium was released from a waste container in Building 1000. The consequences of this situation were negligible, but it demonstrates that release accidents are possible.

The maximum curie content permitted in a container is 1000 ci. However, historical data indicates the average curie content measured in a container is 101 ci. The effects of a 1000 ci release are analyzed in Appendix F. The analysis shows that the dose received by a worker is very time dependent, with only minimal doses being received during the first few minutes of the release. When the release is modeled without ventilation, lack of ventilation serves to increase the dose received by the worker substantially after the first few minutes of the release. The dose received by workers within thirty minutes of the release with and without the exhaust fan operating is 8.61 rem and 15.1 rem, respectively. This dose does not exceed the conservative DOE criteria for lifetime exposure (see Area 108 Safety Assessment) and is considered to represent a negligible consequence.

The single container release is a Likely event, but the consequences as a result of the release is negligible. This event poses a negligible risk to personnel and the environment.

6.3.2 Event Number 2 -- Multiple 55-Gallon Drum Rupture of Solid Reactive Waste

This event postulates that the entire inventory of solid reactive waste in Building 1040 comes in contact with a reagent (i.e., water) and subsequently releases the by-products of the reaction. The reactive waste is stored in 55-gallon drums with a maximum permitted quantity in the bay of twenty-four 55-gallon drums. The accident initiator for a multiple drum rupture is a fire. The fire is the mechanism for breaching the drums, and the subsequent initiation of the fire suppression system is the source of the reagent. The fire suppression system is the only credible source of water in Building 1040, Bay No. 2. The water would react with the waste and a violent exothermic reaction could result. This reaction could result in the production of toxic gases.

An inventory of the type of reactive wastes stored in Bay No. 2 of Building 1040 indicates that the most significant potential toxic gas generated would be sulfur dioxide (SO_2). Sulfur dioxide was then used in the air dispersion model as a bounding chemical. The analysis in Appendix D conservatively assumes that the twenty-four 55-gallon drums contain 6000 cells (250 cells per drum). A single cell contains about 0.022 grams of sulfur dioxide at the end of its useful life. This corresponds to a quantity of 132 grams available during the event. The analysis in Appendix D consisted of performing air dispersion modeling for the assumed quantities of SO_2 for generating a bounding toxic gas release during a fire in Bay No. 2 of Building 1040. The model calculated the concentrations of SO_2 at various distances from the release point. These values were then compared to the National Institute of Occupational Safety and Health (NIOSH) Immediately Dangerous to Life and Health (IDLH) concentration of 100 parts per million (ppm) and the Time Weighted Average (TWA) concentration of 2 ppm for SO_2. The analysis assumes that a fire is initiated inside the bay, the sprinkler system actuates and all twenty-four 55-gallon drums rupture exposing the reactive material to water.

The analysis in Appendix D indicates that 132 grams of sulfur dioxide at an elevated temperature (expected in a fire) would result in a maximum airborne concentration of 0.0013 ppm at a distance of 100 meters. This is below the TWA and IDLH values for SO_2. It can be concluded that this concentration would cause negligible effects to personnel who are exposed. The site boundary is approximately 200 meters from the release point, where the concentration is 0.0010 ppm.

The likelihood for this event is conservatively assumed to be the probability of a fire initiating in Bay No. 2 of Building 1040. The probability of a fire for the subject bay is the same as the probability of a major fire in Building 1000 and is 6E-03 per year. The activation of the sprinkler system is conservatively assumed to have a probability of 1 since the water reacts with waste to generate possible toxic gases. The probability of a fire initiating in Bay No. 2 of Building 1040 and the fire suppression system actuating is (6E-03) * (1) = 6E-03 per year, or Unlikely.

The risk to personnel from a solid reactive waste release is negligible.

The analysis of the postulated accident associated with the release of 132 grams of SO_2 indicates that there would be a negligible health effect to the public. The environmental effects could be marginal due to the effect of the SO_2 on plants. The fire in Bay No. 2 of Building 1040 as it relates to public exposure and the environment is categorized as a marginal consequence and Unlikely likelihood. This combination of consequence-likelihood categories represent a negligible risk to the public and the environment.

6.3.3 Event Number 3 -- Release of Flammable, Toxic, and Corrosive Liquid Waste

The events discussed in this section all involve the release of a toxic substance from Bay No. 1 of Building 1040 and the bulk liquid waste storage tanks. An inventory of the types of waste permitted for storage in the bay was performed. Methylene chloride was chosen as the bounding chemical since it was one of the chemicals with concentrations approaching the IDLH for the quantities of liquid screened and it is a common liquid waste stored in Building 1040. The quantity of methylene chloride modeled in the following analysis is conservatively greater than the quantities that are typically stored in the bay. In all cases the chemical is assumed to be pure methylene chloride in order to avoid the complicated modeling of several chemicals. This modeling is considered to be conservative and represent the bounding case.

Rupture of Four 55-Gallon Drums Inside Building 1040, Bay No. 1

This event postulates the rupture of four 55-gallon drums inside Bay No. 1 of Building 1040. This event is initiated by an operator error while operating a fork lift with the subsequent rupture of four 55-gallon drums. The entire contents of all four drums are assumed to spill on the bay floor. The surface area occupied by the spill would be limited and its total contribution to the vapor concentration would be the area of the trench drains and sump plus the area occupied by the spill before flowing into the trench drains and sump. The analysis assumed a surface area of 50 m^2 (50% of the bay surface area). No credit is taken for the containment basin of the pallets. The drums are assumed to contain methylene chloride for the purposes of this analysis.

The analysis in Appendix E indicates that a 220 gallon spill of methylene chloride over a surface area of 50 m^2 would have an evaporation rate of 111 gallons per second of liquid. This release rate was then input into a gas clearing model using an exponential clearing rate and a ramp input. The analysis indicates that the methylene chloride concentration inside the bay reaches an equilibrium level of 39,000 ppm at approximately 25 minutes after the spill. This level is well above the IDLH value of 5,000 ppm for methylene chloride. The IDLH is exceeded in approximately 70 seconds after the spill. Acute contact consequences as a result of a spill accident are minor if prompt care is given. Ingestion is not expected. Exposure via inhalation is not expected to be lethal because of the comparatively long time (several minutes to greatly exceed the IDLH) for a hazardous level to spread throughout the facility, giving the workers ample opportunity to evacuate if physically able. Prolonged exposure (more than a few minutes) to levels well above the IDLH can be expected to result in serious injury and death, but this is not considered realistic since workers are expected to evacuate. The consequence to workers due to a large spill is therefore no greater than critical (severe occupational illness).

The likelihood of puncturing a drum was calculated to be 7.5E-02 per year for the DOE Rocky Flats Building 664 Safety Analysis Report (Ref. 40). The fork lift operations that take place at Building 664 at Rocky Flats are comparable with the operations in Bay No. 1 of Building 1040 at the Pinellas Plant. There have been no reports of a drum rupture in Bay No. 1 of Building 1040 in the history of the plant. It is conservatively assumed that 1% of all drum handling involves four-drums. Therefore, the likelihood of a four-drum puncture in Bay No. 1 of Building 1040 is 7.5E-04 per year.

The consequence of four 55-gallon drum rupture would be critical and the likelihood would be Unlikely. Events that fall into these combinations of consequence-likelihood categories represent a low risk to personnel.
The spill of four 55-gallon drums of hazardous liquid waste inside Bay No. 1 of Building 1040, as it relates to public exposure and the environment would be categorized as Negligible consequence and Unlikely. These combinations of consequence-likelihood categories represent a negligible risk to the public and the environment.

Rupture of the 5,000-Gallon Bulk Liquid Waste Storage Tank

This event postulates that the entire inventory of liquid waste in the bulk liquid waste storage tank is released. The liquid waste is stored in a 5,000-gallon storage tank that is surrounded by a concrete dike. The accident initiator for a tank rupture is assumed to be a wind or explosion generated missile strike or a traffic accident. There is no significant potential missile generating equipment near the bulk liquid waste storage tank. The location of the bulk liquid waste storage tank is away from a high density vehicle traffic area and the concrete containment dike surrounding the tank precludes a direct vehicle impact with the tank. A crane could conceivably swing its boom out over the containment dike and strike the tank. The historical data available at the plant indicates that there has not been a liquid waste storage tank rupture on site. In addition, the tanks are tested quarterly by the Non Destruction Evaluation Lab to determine the rate of corrosion or erosion of the tanks. Based on this the rupture of the bulk liquid waste storage tank due to impact from other than wind generated missiles is judged to be Incredible to Extremely Unlikely. This event is assumed to be Extremely Unlikely, and a deterministic analysis was performed in Appendix D.

The analysis considers the release of the entire contents of the bulk liquid waste storage tank into the concrete containment dike both with fire and without fire. The chemical considered to be in the tank is again methylene chloride. The formation of phosgene is considered in the fire scenario.

The analysis conservatively assumes that the 5,000-gallon tank contains only methylene chloride. The analysis consists of performing air dispersion modeling for the assumed quantity of methylene chloride for generating a bounding toxic gas release with and without a fire in the containment dike. The model calculated the concentrations of methylene chloride at various distances from the release point. These values were then compared to the IDLH concentration of 5,000 ppm and the TWA concentration of 500 ppm for methylene chloride. The analysis assumes that the tank is ruptured, and the entire contents of the tank are spilled into the containment dike. In order to generate a conservative bounding quantity of toxic gas, the material was modeled as liquid methylene chloride and was assumed to occupy the surface area of the dike (22 m^2). No credit was taken for any HAZMAT team actions which could limit the evaporation rate of the methylene chloride.

The consequence for personnel would be marginal and the likelihood would be Extremely Unlikely. Events that fall into these combinations of consequence-likelihood categories represent a negligible risk to personnel.

The potential off-site consequences of a rupture of the bulk storage tank are shown in the analysis to be marginal. The analysis of the postulated accident associated with the release of 5,000 gallons of methylene chloride (the thermal decomposition of methylene chloride to form phosgene at 0.143 volume percent) and 7.15 (5000 * 0.143%) gallons of phosgene indicates that there would be negligible effects to the public. The environmental effects would also be negligible. The rupture of the bulk storage tank as it relates to public exposure and the environment represent a negligible risk.

Failure or Fault in Grounding and Bonding System Accidents

This accident scenario is concerned with the effects of a failure of the Building 1040 Grounding and Bonding system to prevent the buildup of static electric charge. This condition can be considered an accident condition for the flammables pumping area primarily because operational spills and localized flammable concentrations and vapors are expected during normal operations. Therefore, the failure of the grounding system would introduce an enhanced electrostatic discharge (ESD) opportunity, the ultimate manifestation of which would be to ignite flammable materials.

Existing procedures require workers to ensure that electrically conductive containers and equipment are grounded to the grounding system before beginning any operation such as pumping or pump installation. This normally can be visually verified, but the quality of the ground connection cannot be assured in this manner. Because there are many corrosive chemicals present, it is possible that electrical connections can be degraded by an oxide layer associated with exposure of the copper wire to corrosive chemical vapors. As time passes, the oxidation layer can increase to the point that a spark-like discharge could be expected due to static electricity buildup.

If a spark occurs in the immediate vicinity of a flammable mixture, a fire is possible with secondary fires following. The likelihood that a spark causes a serious fire is dependent upon the flammable chemical present, the concentration of vapors, and the energy in the spark.

Pumping operations can develop a static electric charge from the act of pumping. The container and the source are bonded together, and these are in turn bonded to the ground system, to prevent the accumulation of static electricity and the associated discharge when static potentials are sufficient. Having the filled container and source container bonded together eliminates the chance for static electricity buildup between these two conductors, but other near-by conductors (drums, containers, etc.) may be at a different potential resulting in a discharge with the potential for adverse consequences. Bonding all containers to a common ground helps ensure that this latter condition does not exist.

Historically there have been no incidents of static electricity discharge leading to an ignition of flammable materials in chemical transfer operations at the Pinellas Plant. The grounding system in Building 1040 is in good repair; and age related faults, connection oxidation for instance, are not likely; and deterioration of the system from corrosive materials is more likely to be noticed. Workers are also trained in both the grounding process and the consequences of failing to properly ground and bond their work.

The likely outcome of a static electric discharge associated with a fault in the grounding and bonding system is enhanced risk of ignition of flammable materials during pumping operations. System fault can be from either material or maintenance defect, or from operator failure to properly bond components. The latter condition is most likely and can be expected to occur several times during the life of the facility (Likely), while the former fault, if not readily apparent, would be expected to persist until the next annual inspection. The main threat posed by a failure or fault in the grounding and bounding system is that it may initiate an internal fire; internal fires are discussed in section 6.1.5.

6.3.4 Event Number 4 -- Release of Lab-Pack Liquid Waste

The spill of a liquid hazardous waste inside Bay No. 3 of Building 1040 is addressed since the bay has fewer exhaust fans and a smaller room volume than Bay No. 1. This event considered a rack of lab chemicals falling and the chemicals being released to the bay floor. The chemicals are modeled as methylene chloride and the quantity is assumed to be 55 gallons maximum (maximum quantity of chemicals that can be stored on a rack). This event is conservatively assumed to be Unlikely since the racks are secured to the concrete block walls, and the historical data for the plant indicates that this type of event has not occurred.

The surface area occupied by 55 gallons of methylene chloride would be limited and its total contribution to the vapor concentration would be the sump area and the area occupied by the spill before flowing into the sump. The analysis assumed a surface area of 10 m^2 (50% of the bay surface area). The analysis was performed with both bay exhaust fans in operation.

The analysis in Appendix E indicates that a 55-gallon spill of methylene chloride over a surface area of 10 m^2 would have an evaporation rate of 22 gallons per second of liquid. This release rate was then input into a gas clearing model using an exponential clearing rate and a ramp input. The analysis indicates that the methylene chloride concentrations inside the bay reach an equilibrium level of 21,000 ppm at approximately 15 minutes after the spill. This level is well above the IDLH value for methylene chloride. The IDLH is exceeded in approximately 65 seconds after the spill. Acute contact consequences as a result of a spill accident are minor if prompt care is given. Ingestion is not expected. Exposure via inhalation is not expected to be lethal because of the comparatively long time (several minutes to greatly exceed the IDLH) for a hazardous level to spread throughout the facility, giving the workers ample opportunity to evacuate if physically able. Prolonged exposure (more than a few minutes) to levels well above the IDLH can be expected to result in serious injury and death, but this is not considered realistic since the workers are expected to evacuate. The consequence to workers due to a large spill is therefore no greater than critical (severe occupational illness).

The consequences for personnel would be critical and the likelihood would be Unlikely. Events that fall into these combinations of consequence-likelihood categories represent a low risk to personnel.

The spill of 55 gallons of hazardous liquid waste inside Bay No. 3 of Building 1040, as it relates to public exposure and the environment would be categorized as Negligible consequence and Unlikely likelihood. These combinations of consequence-likelihood categories represent a negligible risk to the public and the environment.

6.3.5 Event Number 5 -- On-site Hazardous Waste Transportation Accident

This event postulates that hazardous waste being transported on site is involved in a traffic accident and, as a result of the accident, the entire contents of the transporting vehicle is released. Two scenarios are considered, one is the transportation of 5,000 gallons of hazardous liquid waste off site in a tank truck, and the other is the transportation of 250 gallons of hazardous liquid waste on site. The 5,000-gallon quantity was chosen to bound the off-site shipment of hazardous liquid waste. The 250-gallon quantity was chosen to bound the transportation of hazardous liquid waste on the chemical transport.

Probability of Liquid Waste Truck Accident

The tank trucks, the drums, and the chemical transport are not pressurized, and any chemical flow due to a rupture would be by gravity flow only. The traffic control on-site is much more restrictive than the public roadways. There is limited traffic on the plant site at any given time. Data obtained from Reference 39 indicates that 1.31 HAZMAT transportation accidents occur per million miles driven. The maximum quantity of hazardous liquid waste shipped off-site in 1992 and 1993 was 33 m^3. This quantity (11,374 gallons) would require three trips with a 5,000-gallon tank truck. This estimate is conservative since much of the shipped liquid waste was in 55-gallon drums. To ensure conservatism, it is assumed that there are six shipments per year of 5,000 gallons of methylene chloride from the waste management facility to off-site. A truck traveling one mile on-site with a full load for each shipment translates to six miles per year on site for a tank truck with 5,000 gallons of a hazardous liquid waste. Using the reference data, the probability of a traffic accident on site involving a tank truck loaded with 5,000 gallons of a hazardous liquid waste is 7.9E-06 per year, or Extremely Unlikely. The fact that an accident occurs does not imply that a chemical release occurs. The probability of a traffic accident and a chemical release is less than 7.9E-06 per year, but this probability is used for the modeled release because it is more conservative.

The Pinellas Plant Emergency Plan requires the evacuation of all personnel who are not part of a response team to a safe zone. The Pinellas Plant HAZMAT team is available to mitigate the consequences of a chemical spill. The HAZMAT team has the necessary equipment to contain and control a hazardous material spill. In addition, the Pinellas County HAZMAT team is available for any required assistance in mitigating the chemical spill.

Rupture of the Hazardous Liquid Waste Truck - Consequences

The tank truck is assumed to contain 5,000 gallons of methylene chloride which are assumed to spill over an area to a depth of 1 cm (1892 m^2). The 1 cm depth was chosen to account for the reduction in volume and, therefore, surface area of the chemical spill due to drainage, and pooling effects.

The transportation truck accident and subsequent release of hazardous liquid waste is assumed to occur at the Belcher Road (east) gate, which would place a spill at the closest location to the Child Development Center/Partnership School. The east gate is approximately 130 meters from the fenced boundary of the school. This school appears to be the most significant location of concern in this analysis for calculating exposures to the hazardous liquid waste.

The analysis (Appendix D) indicates that a spill of 5,000 gallons of methylene chloride at ambient temperature would result in a maximum airborne concentration of 11,000 ppm at a distance of 100 meters. This concentration is above the TWA and IDLH values for methylene chloride. This concentration could cause some adverse effects to personnel that are exposed. The concentration at the Child Development Center/Partnership School would be 8100 ppm.

The consequence for personnel would be critical and the likelihood would be Extremely Unlikely. Events that fall into this combination of consequence-likelihood categories represent a negligible risk to personnel.

The potential off-site consequences of a rupture of the bulk storage tank are shown in the analysis to be critical. The analysis of the postulated accident associated with the release of 5,000 gallons of methylene chloride and 7.15 gallons (5000 * 0.143) of phosgene indicates that there could be significant public health effects. The environmental effects would be negligible. The rupture of the bulk transportation truck as it relates to public exposure and the environment is categorized as a critical consequence and Extremely Unlikely. This combination of consequence-likelihood categories represent a negligible risk to the public and the environment.

Probability of Chemical Transport Accident On-Site

The transportation of the 55-gallon drums and the chemical transport can occur daily. The probability of a traffic accident during the transportation of either the four 55-gallon drums or chemical transport is calculated assuming that one trip a day takes place between Building 100 and Building 1040 with a distance of 0.5 miles. This translates to 182 miles on site per year and, based on the referenced data, the probability of a traffic accident on-site involving the transportation of either four 55-gallon drums or the chemical transport is 2.4E-04 per year, or Unlikely.

Chemical Transport Accident On Site - Consequences

This transportation accident is assumed to spill 250 gallons (maximum quantity of cart) of methylene chloride which is assumed to spill over an area that provides a depth of 1 cm (95 m^2). The 1 cm depth was chosen to account for the reduction in volume and, therefore, surface area of the chemical spill due to drainage and pooling effects.

The transportation accident and subsequent release of hazardous liquid waste is assumed to occur at Building 100 (Receiving Area), which would place a spill at the closest location to the Child Development Center/Partnership School. This location is approximately 160 meters from the fenced boundary of the school. This school appears to be the most significant location of concern in this analysis for calculating exposures to the hazardous liquid waste.

The analysis indicates that a spill of 250 gallons of methylene chloride at ambient temperature would result in a maximum airborne concentration of 1,900 ppm at a distance of 100 meters. This concentration is above the TWA but below the IDLH values for methylene chloride and would cause marginal effects to personnel that are exposed. The concentration at the Child Development Center/ Partnership School would be 970 ppm.

The consequence to personnel is marginal and the likelihood would be Unlikely. Events that fall into these combinations of consequence-likelihood categories represent a negligible risk to personnel.

The potential off-site consequences of a spill of 250 gallons of a hazardous liquid waste are shown in the analysis to be marginal. The analysis of the postulated accident associated with the release of 250 gallons of methylene chloride indicates that there would not be any significant public health effects. The environmental effects would also be negligible. The spill of 250 gallons of hazardous liquid waste on site as it relates to public exposure and the environment is categorized as marginal consequence and Unlikely. This combination of consequence-likelihood categories represent a negligible risk to the public and the environment.

6.4 Summary

The risk assessed in each of the accidents considered in this chapter are summarized in tabular form in Chapter 2 of this document.

7.0 ACRONYMNS

AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
ASHRAE	American Society of Heating, Refrigeration & Air Conditioning Engineers
CFM	Cubic Feet Per Minute
CFR	Code of Federal Regulation
DBA	Design Basis Accident
DBF	Design Basis Fire
DOE	Department of Energy
DOT	Department of Transportation
EPI	Emergency Prediction Information
ES&H	Environmental, Safety and Health
ES&SP	Environmental Health and Safety Procedures
ESD	Electrostatic Discharge
EPA	Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FM	Factory Mutual
FMEA	Failure Modes and Effects Analysis
GE	General Electric Company
HAZ-MAT	Hazardous Material
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation and Air Conditioning
IDLH	Immediately Dangerous to Life and Health
IWNF	Industrial Wastewater Neutralization Facility
LDR	Land Disposal Restriction
MPH	Miles Per Hour
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technologies
NFPA	National Fire Protection Association

OSHA	Occupational Safety and Health Agency
PAO	Pinellas Area Office
PCHW	Potentially Contaminated Hazardous Wastes
PPM	Parts Per Million
RCRA	Resource Conservation and Recovery Act
RMMA	Radioactive Materials Management Areas
SA	Safety Assessment
SOP	Standard Operating Procedures
SOR	Safe Operating Restrictions
SST	Safe Secure Transports
SWFWMD	Southwest Florida Water Management District
TLV	Threshold Limit Values
TSD	Treatment, Storage and Disposal
TWA	Time Weighted Average
UBC	Uniform Building Code
UL	Underwriters' Laboratory
USGS	U.S. Geological Survey
USQ	Unreviewed Safety Questions
VAT	Vinyl Asbestos Floor Tile

8.0 REFERENCES

1. DOE (U.S. Department of Energy), Safety Analysis and Review System, AL 5481.1B, January 27, 1988, Albuquerque Operations Office, Albuquerque, New Mexico.

2. Martin Marietta Specialty Components, Inc., Pinellas Plant Annual Site Environmental Report for Calendar Year 1992, MMSC-ESH-93035, June 1993, Pinellas Plant, Largo, Florida.

3. Martin Marietta Specialty Components, Inc., Pinellas Plant Facts, MMSC-SP-008, August 1992, Pinellas Plant, Largo, Florida.

4. PCHD (Pinellas County Health Department), Pinellas County Population Estimates 1990 - 1991, September 1991, Clearwater, Florida.

5. NOAA (National Oceanic and Atmospheric Administration), Local Climatological Data, Annual Summary with Comparative Data, 1991, Tampa, Florida.

6. SWFWMD (Southwest Florida Water Management District), Ground-Water Resource Availability Inventory: Pinellas County, Florida, May 1988, Brooksville, Florida.

7. CH2M-Hill, Interim Corrective Measures Study Northeast Site, TPA26350.BO.01, May 1991, Tampa, Florida.

8. M.F. Fernandez, "Reconnaissance of Water Quality as a U.S. DOE Site." U.S. Geological Survey Water Resources Investigation Report, 85-4062, 1985, Pinellas County, Florida.

9. Haztech, Inc., 4.5 Acre Draft Feasibility Study Report, prepared for U.S. Department of Energy and General Electric, 1987, Largo, Florida.

10. DOE (U.S. Department of Energy), Environmental Assessment - Pinellas Plant Site, Pinellas Area Office, DOE/EA-0209, July 1983, Pinellas Area Office, Largo, Florida.

11. James Gilluly, Aaron C. Waters, and A.O. Woodford, Principles of Geology, 3rd ed. (San Francisco: W.H. Freeman & Co., 1968).

12. PCPD (Pinellas County Planning Department), Conservation Element of the Pinellas County Comprehensive Plan, August 8, 1989, Clearwater, Florida.

13. USGS (U.S. Geological Survey), Reconnaissance of Water Quality at a U.S. Department of Energy Site, Report 85-4062, 1985, Pinellas County, Florida.

14. Martin Marietta Specialty Components, Inc., Pinellas Plant Ground Water Protection Management Program Plan, MMSC-ESH-0008, September 9, 1994, Pinellas Plant, Largo, Florida.

15. Barry F. Beck, The Sinkhole Hazard in Pinellas County: A Geologic Summary for Planning Purposes, FSRI (Florida Sinkhole Research Institute) and Sayed PSI/Jamma & Associates, Inc., FSRI Report 90-91-1, 1991.

16. DOE (U.S. Department of Energy), General Design Criteria, DOE Order 6430.1A, April 1989.

17. Martin Marietta Specialty Components, Inc., Waste Management Operating Procedures Manual, MMSC-OSP-0027, November 2, 1994, Pinellas Plant, Largo, Florida.

18. FDEP (Florida Department of Environmental Protection), Permit for Operation of a Hazardous Waste, Storage and Treatment Facility, Permit No. H052-159339, January 22, 1990, Pinellas Plant, Largo, Florida.

19. GEND (General Electric Neutron Devices), Pinellas Plant Site Specific Plan, NDPP-OSP-0052, September 1991, Pinellas Plant, Largo, Florida.

20. Martin Marietta Specialty Components, Inc., Environmental Safety & Health Manual, MMSC-ESH-0006, September 29, 1994, Revision T, Pinellas Plant, Largo, Florida.

21. LLNL (Lawrence Livermore National Laboratory), Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, UCRL - 15910, for U.S. Department of Energy, June 1990, Livermore, California.

22. Savannah River Production Reactor PRA, 1990.

23. Rocky Flats Probabilistic Risk Assessment (DRAFT), 1990.

24. NUREG (U.S. Nuclear Regulatory Commission), PRA Procedures Guide, NUREG/CR2300.6, January 1983.

25. NUREG (U.S. Nuclear Regulatory Commission), Safety Implications Associated With In-Plant Pressurized Gas Storage Systems in Nuclear Power Plants, NUREG/CR-3551, ORNL/NOAC-214, May 1985.

26. Frank T. Bodurtha, Industrial Explosion Prevention and Protection (New York: McGraw-Hill, 1980).

27. Anon., Structures to Resist the Effects of Accidental Explosions, Dept. Army Tech. Manual, TM5-1300, June 1969.

28. Process Safety Institute, Consequence Hazard Analysis Methods Course, March 1994.

29. Martin Marietta Specialty Components, Inc., MMSC-ESH-93058 , Pressure System Safety Program Manual, August 1994.

30. Conversation with Mr. Don Magnus, former General Electrical Neutron Devices employee on December 14, 1992.

31. Electric Power Research Institute, Turbine Generator Fire Protection by Sprinkler System, NP-4414, July 1985.

32. DOE (U.S. Department of Energy) Order 5500.1B, Emergency Management System, February 27, 1992.

33. International Atomic Energy Agency, "Component Reliability Data for Use in Probabilistic Safety Assessment" IAEA-TECDOC-478, Vienna, Austria, 1988.

34. Martin Marietta Specialty Components, Inc., Waste Management Operating Procedures Manual, MMSC-OSP-0027, November 2, 1994, Pinellas Plant, Largo, Florida.

35. Military Handbook, MIL-HDBK-419A, Volume 1.

36. NFPA (National Fire Protection Association), "NFPA Reports on U.S. Fire Loss", NFPA Journal, September/October 1988 p 44.

37. U.S. Bureau of the Census, Statistical Abstract, 1991.

38. Safety Analysis Report, Pantex Plant Building 12-26 Pit Vault, January 31, 1991.

39. Alan T. Gunseth, "Haz-Mat Transportation-- A Simplistic Opinion," ITE Journal, Vol. 56, No. 11, November 1986, pp. 23-25.

40. EG&G Rocky Flats, Inc., Final Safety Analysis Report, Building 664, August 1991.

41. Martin Marietta Specialty Components, Inc., MMSC-SA-93078, Safety Assessment of Battery Areas, July 1993. (Draft)

9.0 DISTRIBUTION

DOE

R. Glass	MS 015 (2 Copies)
G. Schmidtke	MS 015
OSTI (2)	

Pinellas Plant

D. Corbett	MS 040
D. Delaneuville	MS 001
J. Fox	MS 012
K. Hall	MS 012
E. Hand	MS 040
D. Hopkins	MS 001
J. Kroll	MS 040
T. Ramsay	MS 040
P. Sacco	MS 050
Records Management (MASTER)	MS 002

This page left blank intentionally.

APPENDIX A

SAFE OPERATING RESTRICTIONS

This page left blank intentionally.

1.0 SAFE OPERATING RESTRICTIONS

This appendix describes the safe operating restrictions (SORs) for Waste Management. The safe operating restrictions identify the conditions, safe boundaries and the bases thereof, and administrative controls required to ensure that no identified risks associated with Waste Management exceed the low classification as defined in SOP K.2.08-3, Safety Analysis Risk Acceptance Procedure.

Note: SORs are high-level, bounding controls that may be less stringent than restrictions found in lower-level operating procedures. While it is important that SORs not be violated, operators should use the restrictions identified in lower-level procedures as a primary reference.

i. Safety Controls

There are no safety controls required for operations in Waste Management.

ii. Operating Controls

Fire Suppression System:

Operations within Building 1040, Bay No. 1 are prohibited if the area fire suppression system is known to be inoperative. Indication that the system is not operational can be verified via notification from fire protection unit and via Communication Center personnel (such as when the system is down for repair).

Basis: Operation of the fire suppression system is expected to have a significant impact on limiting the consequences of fires initiated within Waste Management. The reliability provided by the fire suppression system reduces the likelihood of 1.5E-4 per challenge. Loss of the fire suppression system would invalidate the low likelihood associated with an internal fire.

iii. Surveillance Controls

Fire Suppression System:

The fire suppression system in Building 1040, Bay No.1 shall be inspected quarterly. Inspection shall include a test of the sprinkler alarm and performance of the riser main drain test (this is required for compliance with NFPA 13).

Basis: As discussed above, the fire suppression system mitigates the consequences of fires in Waste Management. Regular inspection supports the low likelihood that the fire suppression system will fail to perform its function.

iv. Design Controls

The following design feature directly impacts the safe operation of the facility and design modifications shall not be made prior to completion and review of a preliminary change analysis per SOP K.2.09-1, Change Analysis Procedure.

Fire Suppression System

v. Procedural Controls

There are no procedural controls required for operations in Waste Management.

APPENDIX B

FIRE ANALYSIS - BUILDINGS 1000 AND 1040

This page left blank intentionally.

1.0 FIRE ANALYSIS (BUILDING 1000)

Analysis of the potential fire events in Building 1000 indicated that the only area subject to major damage with the potential for environmental release is Bay No. 1. Bay No. 2 contains low-level radioactive oil mixed with concrete in a solid form and is essentially noncombustible. Bay No. 3 of the building is an open structure that provides covered storage for small vehicles and fork trucks. Fire in either Bay 2 or Bay 3 is a possibility, due to the loading operations, battery charging, or vehicle fires. Fire frequency in any of the areas is relatively the same. However, a fire in Bay No. 1 is considered the bounding case due to its size, enclosure, and contents. The fire analysis for Building 1000 is performed for Bay No. 1.

The storage material in Bay No. 1, closed drums of radioactive waste, is not subject to spontaneous heating. There are no combustible liquids permitted in the drums, so fire following even a multiple drum rupture would be very unlikely. Drums are placed on pallets and moved with a diesel-powered fork truck. The only credible fire scenario involving a significant amount of combustibles is the introduction of the fork truck into the area and a fire initiating within the fork truck. The initial assumption is an electrical fire that eventually involves the plastics, rubber, and fuel carried on the vehicle. This approach is conservative in that it assumes a fire would go undetected in the incipient phase prior to open flaming and no mitigative actions are taken independently of automatic systems provided in the area.

The fire scenario described was analyzed using the FPETOOL computer code developed and provided by the National Institutes of Standards and Technology (NIST). It is a reference standard in fire modeling used across the DOE complex. The output results of the code are illustrated in Figure B-1 and Figure B-2. The fire model assumes that the 3,000 lb. capacity fork truck is in Bay No. 1, the roll up door is open, and the exhaust fan is operating. The exhaust system would be disabled by fire effects on the electrical system. However a study of several input variables indicated that an operational HVAC system increased the fire severity. The exhaust system was left to operate until flashover occurred. The fire was assumed to start on the fork truck, and the model then calculated the fire temperatures and height of the hot gas layer above the floor. Model results indicate that the sprinkler system would respond in approximately 5-1/2 minutes, based on the existing intermediate heads. If no sprinkler system were available, model results indicate that flashover would occur in approximately 8 minutes. After flashover, the model indicates a gradual decrease from the 1112° F peak to complete consumption of combustibles in approximately 52 minutes. Due to the limitations of the model, both sprinkler operation and flashover times are conservative. No credit was taken for the additional sprinkler heads present under the roll up door nor were assumptions made concerning the thermal mass of the beams making up the roof structure of the bay. The design of the sprinkler system, at 0.35 gpm/sq ft, is adequate to control and extinguish a fire of this magnitude, even accounting for the fire contribution by the diesel fuel carried on board the fork truck. Due to the properties of diesel fuel, no rupture of the fuel tank is assumed.

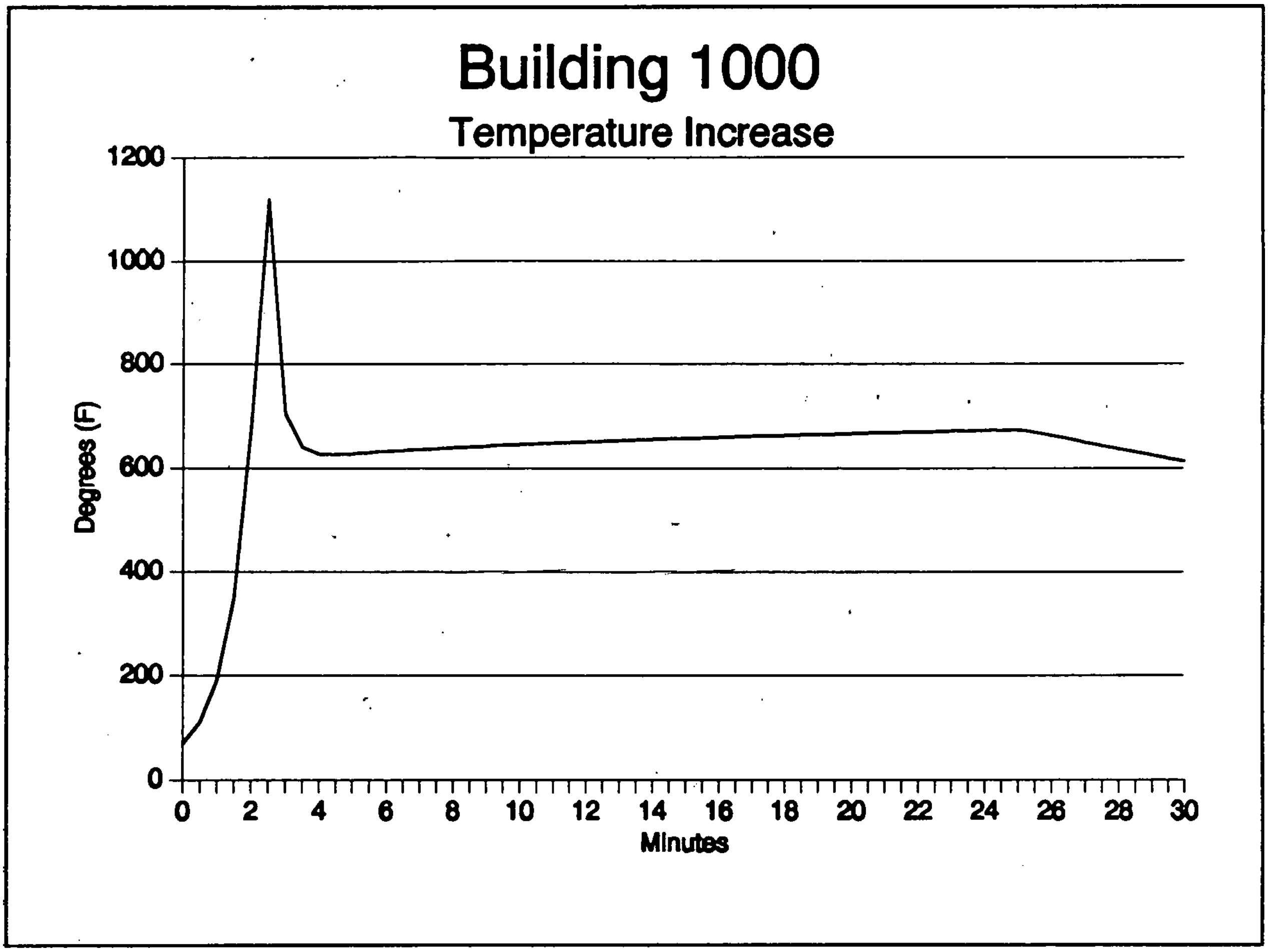


Figure B-1. Temperature Vs. Time - Fire in Building 1000 Bay No. 1

Room temperatures at the time of sprinkler operation are shown to be 662° F. Cooling effects of the sprinkler system would be rapid and effective on the metal drums. The intensity and duration of this temperature are insufficient to damage stored drums not subject to direct flame impingement. Using a subroutine of the FPETOOL fire model and assuming the nearest drums to the fire are 36 inches away (suspended from the fork truck), the model indicates that at between 240 and 270 seconds, radiant heat flux would be sufficient to ignite exposed combustibles of medium weight. However, this

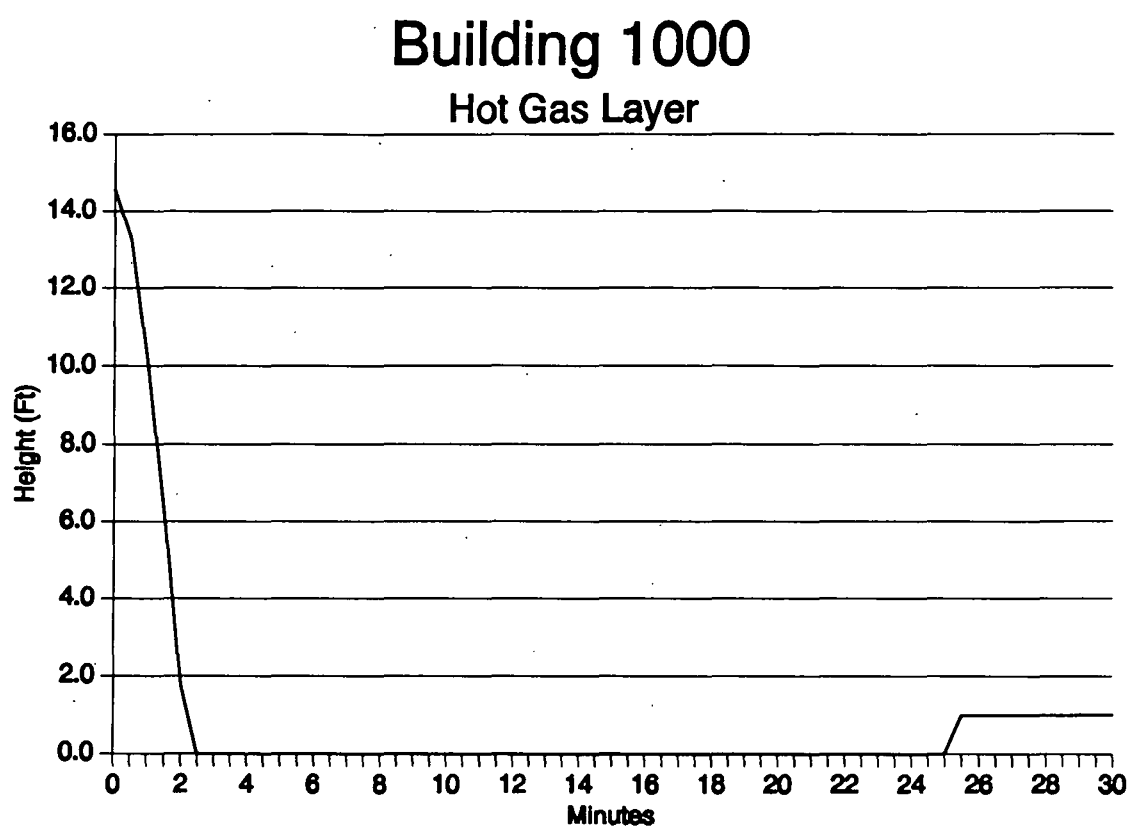


Figure B-2. Hot Gas Layer Height Vs. Time - Fire in Building 1000 Bay No. 1

does not account for the thermal shielding and inertia of the metal storage drum nor the mass of the contents. Due to the short duration between the time to reach critical radiant flux and time for sprinkler initiation (1-1/2 minutes), there is little possibility for any combustible contents inside the drum to ignite.

The fire model also serves to predict the room environment assuming the sprinklers were inoperable. Were the sprinkler system not to operate, room temperatures of 1112° F would be expected and high temperatures would be maintained for some time. The hot gas layer would descend to the floor. Prolonged exposure to elevated temperatures and radiant heat would be experienced in the drummed storage, and some ignition of drum contents would be expected. However, due to the limited oxygen available in the sealed drums, flaming would not be sustained and any small fires would be suffocated while the drum remained intact. The postulated fire would be contained within the bay of origin due to the construction of the partition walls.

The analysis demonstrated flashover should not occur. There may be some localized damage from the fire, from the smoke, and from the water discharged through the sprinkler system. The effects of the fires are expected to be reduced significantly by the mitigative features provided by the sprinkler systems and the prevention measures taken by the Fire Protection Program. The temperatures that are predicted in the analysis are not expected to reduce the structural integrity of the exterior walls in any of the areas. In conclusion, a fire in Building 1000 is expected to pose a marginal threat to area personnel.

2.0 FIRE ANALYSIS (BUILDING 1040)

Analysis of the potential fire effects in Building 1040 indicate that fire in the flammable and combustible liquids handling area, Bay No. 1, is the bounding case due to the quantity of fuel available and ease of ignition. A fire in Bay No. 2 is possible although it would require an ignition source, drum and bag rupture, and introduction of water. The batteries contained in the drums are combinations of whole batteries and those that have been sectioned for investigation. Opened batteries expose the constituent chemicals such as lithium, iron disulfide and calcium chromate to air, thereby providing the possibility of ignition if there were also a drum/bag rupture and an introduction of water.

Bay No. 3 contains chemicals that are typically noncombustible. Use of powered equipment in this bay is limited. Therefore, storage is typically performed manually due to the small container size. Risk of fire in this area is minimal and potential fuel sources are limited.

Class I and II combustible liquids are present in quantity in Bay No. 1. Although combustible liquids are typically pumped to the exterior holding tank, the building is permitted to store forty 55-gallon drums of combustibles and/or chloroflourocarbons. Handling operations create the possibility of spills, and ignition sources, through static discharge or equipment operation, are available. Explosions are a possibility due to vapor cloud buildup. An explosion scenario was examined. It was determined that occurrence of an explosion would require: a large spill, a loss of ventilation with the doors remaining closed, and an ignition source while vapors were within a flammable concentration. Equipment near the materials handling area is explosion-proof as is the electrical system. Five separate fans provide air movement although power is only from one source. Use of air-powered equipment serves to decrease available sources of ignition.

Quantities of chemicals handled are small, although the quantity stored may be considerable. Operating procedures serve to decrease potential ignition sources by bonding and grounding of the liquids trailer and the pumping equipment. Personnel doors are typically closed by automatic door closers, however the roll up door is opened with handling operations in progress. Building 1040 and the handling operations within it are in accordance with NFPA 30, the Standard for Flammable and Combustible Liquids, and NFPA 70, the National Electrical Code. Based on the safety provisions and the chemical hazards presented, explosions were eliminated as a credible scenario.

Fire in Bay No. 1 is likely given the volatile chemicals and potential ignition sources. The FPETOOL computer model was used to evaluate potential fires from the primary combustible wastes. Separate models were constructed to evaluate fires in acetone, ethanol, and toluene. These chemicals were selected for their typical quantities, low ignition temperatures, and high heats of combustion. Model parameters were varied to produce the more severe fire within the building operating standards, such as exhaust fans running, door open or shut, and roof venting. Bay No. 1 is permitted for storage of forty 55-gallon drums. The model is constructed as 10 pallets of four drums each, with a typical 8-foot aisle width and 2-foot separation between pallets. Drum storage is currently provided on containment pallets. The model assumes that liquids are free to spread along the floor, and the liquid storage provided by these pallets is neglected. The use of these pallets is acknowledged by the fire model as drum storage is limited to one layer of drums and containment pallets cannot be stacked. Storage of more than one layer of drums, i.e., two pallets high, would greatly increase fire severity, for Class I liquids.

The fire scenario presumes that a spill occurs and is ignited adjacent to a drum storage pallet. Pool fire effects on nearby drums and drum-to-drum effects are considered by the fire model. The model is limited to five fuel packages, so only storage at the spill area, drums two feet away on either side and drums across the 8-foot aisle were evaluated. However, the results may be extrapolated to the entire storage area. All storage was assumed to be Class I or II combustible liquids, which is conservative noting the typical storage of noncombustible chloroflourocarbons in the same area. More severe fires are derived from modeling Class I or II liquids; use of other chemicals with more severe environmental exposure effects, such as methylene chloride, would result in much less severe fire conditions.

The FPETOOL model results, with temperature and hot gas height graphically illustrated in Figure B-3 and Figure B-4, indicate that sprinklers would operate approximately seven seconds prior to the room reaching flashover conditions. Based on system design and number of heads, each head should flow approximately 30 gpm. Four heads are assumed to flow initially as the fire was assumed to be centered in the 90 ft^2 coverage area. Water flow from four sprinkler heads is then:

4 heads x 30 gpm x 1 min./60 sec. = 2 gal./sec.

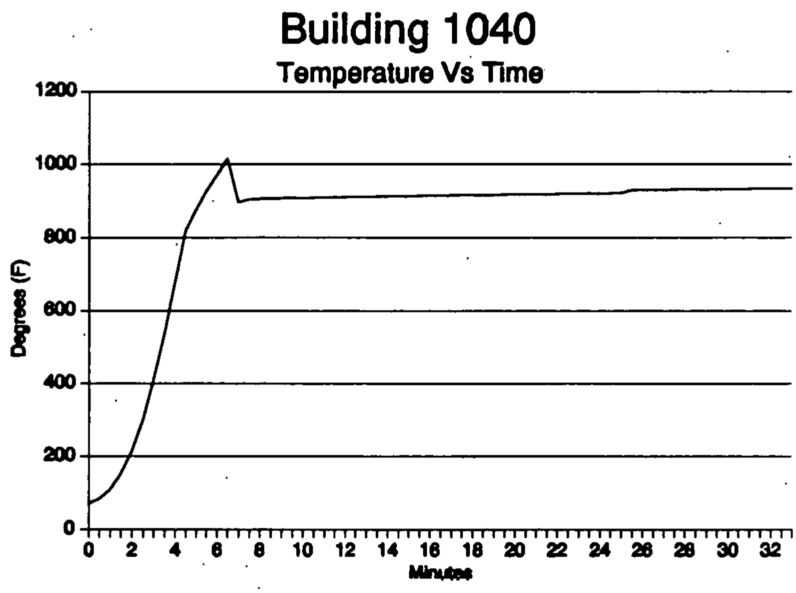


Figure B-3. Temperature Vs. Time - Fire in Building 1040

Total water flow at 2 gal./sec. provides approximately 732 btu/sec. of cooling, assuming an initial water temperature of 70°F and 25% of water is converted to steam upon discharge. The steam conversion is conservative, based on the temperature of 483° F calculated by the model at the sprinkler head. This rate of application would retard fire growth but would not prevent flashover in the bay. Flashover would involve the entire stored contents of the bay, and fire severity would be expected to overtake the building suppression system in Bay No. 1. Manual action from the designated employee or offsite fire departments would be required to extinguish the fire, or, if no action was taken, the fire would burn out in approximately 32 minutes. Damage would not extend beyond Bay No. 1 due to the concrete block construction. In conclusion, a fire in the Building 1040 Bay 1 is expected to pose a critical threat to personnel.

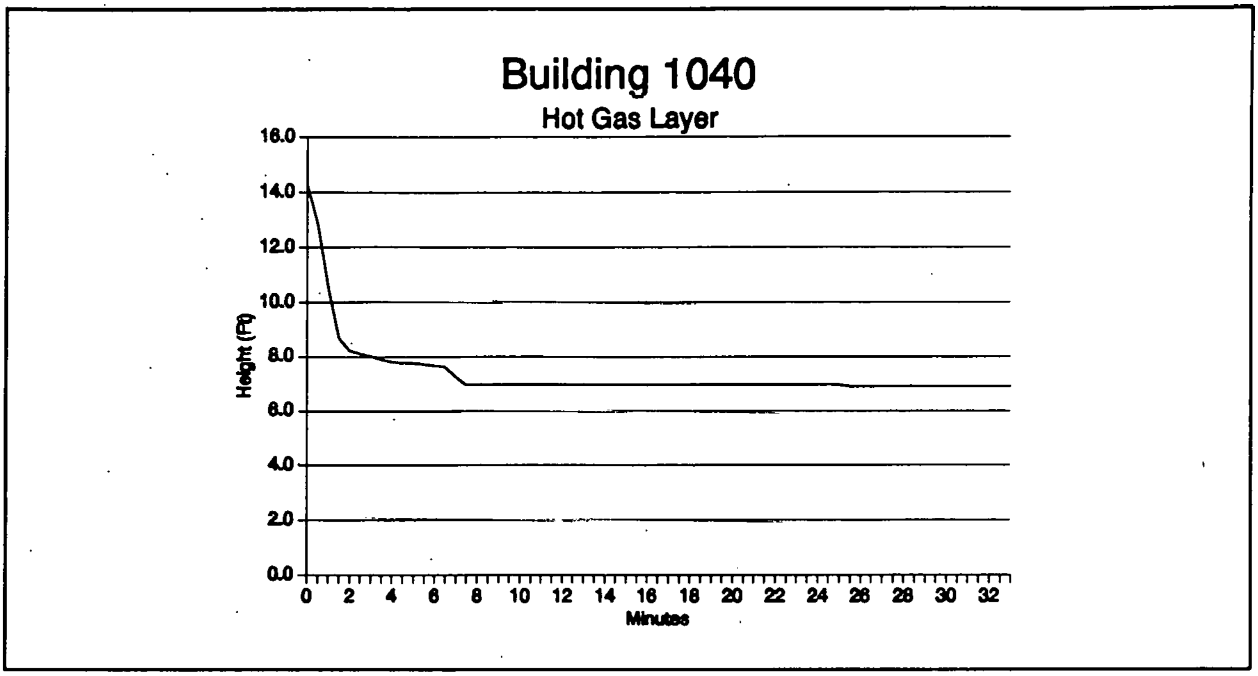


Figure B-4. Hot Gas Layer Height Vs. Time - Fire in Building 1040

L:\PUBS\SA\94151

This page left blank intentionally.

APPENDIX C

FAILURE MODES AND EFFECTS ANALYSIS
WASTE MANAGEMENT FACILITIES

This page left blank intentionally.

FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

WASTE MANAGEMENT FACILITIES

Subsystem and Function	Failure Mode	Failure Mechanism	Failure Detection	Failure Compensation	Failure Effects	Effects Category
Low Level Solid Radioactive Waste Storage in Building 1000. Storage of 55-gallon drums and B-25 Boxes containing tritium contaminated solid material.	Single drum rupture with a tritium release. Box leak with a tritium release.	Puncture of drum (forklift, missile strike, falling drum); Corrosion/damage of drum. Corrosion/damage of box	Visual detection.	Building internal containment; Plastic liners.	Maximum release of 1,000 Ci of tritium oxide to environment; Personnel exposure to tritium oxide.	III,a,b III,c
	Multiple drum rupture with a tritium release.	External fire; Building collapse; External explosion; Forklift accident.	Visual detection; Fire alarm.	Fire protection system; Building internal containment; Plastic liners.	Maximum release of 1,000 Ci of tritium oxide per drum to environment; personnel exposure to tritium oxide.	III,a,b II,c
Storage of 55-gallon drums containing tritium contaminated waste oil.	Single drum rupture with a tritium release.	Puncture of drum (forklift, missile strike, falling drum); Corrosion/damage of drum.	Visual detection.	Building internal containment; Oil is solidified.	Release of tritium oxide to the environment; Personnel exposure to tritium oxide.	III,a,b III,c
	Multiple drum rupture with a tritium release.	External fire; Building collapse; External explosion; Forklift accident.	Visual detection; Fire alarm.	Fire Protection system; Building internal containment.	Release of tritium oxide to the environment; Personnel exposure to tritium oxide.	III,a,b II,c
Storage of Reactive Waste in Building 1040, Bay No. 2. Storage of 55-gallon drums containing solid reactive waste (EPA Waste No. D001-D004, D007-D009, U032, and U223).	Single drum rupture with the reactive waste exposed to water and subsequent fire.	Puncture of drum (forklift, missile strike, falling drum); Corrosion/damage of drum.	Visual detection; Fire alarm.	Building internal containment; Plastic liner in drum; Fire Protection System; emergency shower/eyewash.	Reactive wastes are released to the environment; Personnel exposure to reactive materials.	III,a IV,b III,c
	Multiple drum rupture with the reactive waste exposed to water and subsequent fire.	External fire; Building collapse; External explosion; Forklift accident.	Visual detection; Fire alarm.	Fire Protection System; Building internal containment; Plastic liners in drums; emergency shower/eyewash.	Reactive wastes are released to the environment; Personnel exposure to reactive materials.	III,a,b II,c

FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

WASTE MANAGEMENT FACILITIES

Subsystem and Function	Failure Mode	Failure Mechanism	Failure Detection	Failure Compensation	Failure Effects	Effects Category
Storage of Flammable, Toxic, and Corrosive Liquid Waste in Building 1040, Bay No. 1. Storage of 55-gallon drums containing EPA Waste No. F001-F003, F005-F009, D001, D002, D004, D007-D009, D011, U032, U223.	Single drum rupture with a release of hazardous liquid waste.	Puncture of drum (forklift, missile strike, falling drum); Corrosion/damage of drum.	Visual detection.	Building internal containment; emergency shower/eyewash.	Hazardous liquid waste is released to the environment; Personnel exposure to hazardous liquid waste.	IV,a,b III,c
Storage of Flammable, Toxic, and Corrosive Liquid Waste in Building 1040, Bay No. 1.	Multiple drum rupture with a release of hazardous liquid waste.	External fire; Building collapse; External explosion; Forklift accident.	Visual detection; Fire alarm.	Fire Protection System; Building internal containment; emergency shower/eyewash.	Hazardous liquid waste is released to the environment; Personnel exposure to hazardous liquid waste .	IV,a,b I,c
Storage of Asbestos in Building 1040. Storage of 55-gallon drums containing waste asbestos.	Single drum rupture with a release of asbestos.	Puncture of drum (forklift, missile strike, falling drum); Corrosion/damage of drum.	Visual detection.	Building internal containment; plastic liner in drum; personnel wear respirators when handling asbestos; emergency shower/eyewash.	Waste asbestos is released to the environment; Personnel exposure to waste asbestos.	III,b III,c
	Multiple drum rupture with a release of asbestos.	External fire; Building collapse; External explosion; Forklift accident.	Visual detection; Fire alarm.	Fire Protection System; Building internal containment; plastic liner in drum; personnel wear respirators when handling asbestos; emergency shower/eyewash.	Waste asbestos is released to the environment; Personnel exposure to waste asbestos.	III,a,b III,c
Storage of Lab-Pack Wastes in Building 1040. Storage of lab-pack waste.	Multiple containers are breached with a subsequent release of material.	External fire; Building collapse; External explosion; missile strike.	Visual detection; Fire alarm.	Building internal containment; Fire Protection System; emergency shower/eyewash.	Toxic and flammable material released to the environment; Personnel exposure to toxic or flammable material.	IV,a,b I,c

FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

WASTE MANAGEMENT FACILITIES

Subsystem and Function	Failure Mode	Failure Mechanism	Failure Detection	Failure Compensation	Failure Effects	Effects Category
5,000-gallon Flammable Liquids Storage Tank. Storage of flammable liquids (EPA Waste No. F001-F003, F005, and D001).	Tank rupture or leak.	Missile strike; vehicle impact; corrosion; external fire.	Olfactory detection; visual detection.	Containment dike surrounds the tank; tank is vented for pressure relief.	Flammable liquids are released to the environment with the potential for fire and/or explosion; Personnel exposure to fire.	IV,a I,c
	Tank line break or leak.	Missile strike; vehicle impact; corrosion; external fire.	Olfactory detection; visual detection.	Pipe is double walled outside the containment dike.	Flammable liquids are released to the environment with the potential for fire and/or explosion; Personnel exposure to fire.	III,a III,c
2,000-gallon Halogenated Hydrocarbon Storage Tank. Storage of halogenated hydrocarbons (EPA Waste No. F001 and F002).	Tank rupture or leak.	Missile strike; vehicle impact; corrosion; external fire.	Olfactory detection; visual detection.	Containment dike surrounds the tank; tank is vented for pressure relief.	Halogenated hydrocarbons are released to the environment with the potential for fire; Personnel exposure to halogenated hydrocarbons and fire.	IV,a I,c
	Tank line break or leak.	Missile strike; vehicle impact; corrosion; external fire.	Olfactory detection; visual detection.	Pipe is double walled outside the containment dike.	Halogenated hydrocarbons are released to the environment with the potential for fire; Personnel exposure to halogenated hydrocarbons and fire.	III,a III,c
500-gallon Waste Oil Storage Tank. Storage of waste oil.	Tank rupture or leak.	Missile strike; vehicle impact; corrosion; external fire.	Visual detection.	Containment dike surrounds the tank; tank is vented for pressure relief.	Waste oil is released to the environment; Personnel exposure to waste oil.	IV,a IV,c

FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

WASTE MANAGEMENT FACILITIES

Subsystem and Function	Failure Mode	Failure Mechanism	Failure Detection	Failure Compensation	Failure Effects	Effects Category
	Tank line break or leak.	Missile strike; vehicle impact; corrosion; external fire.	Visual detection.	Pipe is double walled outside the containment dike.	Waste oil is released to the environment; Personnel exposure to waste oil.	IV,a IV,c
5,000-gallon Standby Storage Tanks. Standby tanks used to store flammable liquids or halogenated hydrocarbons.	Tank rupture or leak.	Missile strike; vehicle impact; corrosion; external fire.	Olfactory detection; visual detection.	Containment dike surrounds the tank; tank is vented for pressure relief.	Flammable liquids or halogenated hydrocarbons are released to the environment with a potential for fire; Personnel exposure to hazardous liquids and/or fire.	IV,a I,c
	Tank line break or leak.	Missile strike; vehicle impact; corrosion; external fire.	Olfactory detection; visual detection.	Pipe is double walled outside the containment dike.	Flammable liquids or halogenated hydrocarbons are released to the environment with a potential for fire; Personnel exposure to hazardous liquids and/or fire.	IV,a III,c
Transportation of Hazardous Waste to the Waste Storage Facilities. Transport of up to four 55-gallon drums of hazardous waste.	Drums rupture or leak.	Vehicle impact; dropped drum.	Visual detection.	None	Hazardous waste are released to the environment; Personnel are exposed to hazardous waste.	III,a II,c
Transport of liquid hazardous waste with the chemical transport.	Transport tank ruptures or leaks.	Vehicle impact; operator error.	Visual detection.	Transport tanks are surrounded by a dike; tanks are vented.	Hazardous waste are released to the environment with potential for fire; Personnel exposure to hazardous waste and/or fire.	III,a II,c

FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

WASTE MANAGEMENT FACILITIES

Subsystem and Function	Failure Mode	Failure Mechanism	Failure Detection	Failure Compensation	Failure Effects	Effects Category
Transfer of Hazardous Waste to Drums and/or Tanks. Liquid waste from transport pumped into drums and/or storage tanks.	Hose ruptures while transferring liquid.	Material failure of hose; transfer pump overpressure; operator error.	Visual detection.	Closed internal sump inside Building 1040, Bay No. 1.	Hazardous liquid waste are released to the environment with the potential for fire; Personnel exposure to hazardous waste and/or fire.	IV,a,b III,c
Transfer of Hazardous Waste to Drums and/or Tanks. Liquid waste from transport pumped into drums and/or storage tanks.	Small incidental spills during transfer operation.	Hose mispositioned; operator error.	Visual detection.	Closed internal sump inside Building 1040, Bay No. 1.	Hazardous liquid waste are released to the environment with the potential for fire; Personnel exposure to hazardous waste and/or fire.	IV,a,b IV,c
Reactive Metals Treatment. Materials contaminated with reactive metals are exposed to water in a vessel to remove reactivity.	Reaction of reactive metals and water is inadvertently initiated prior to placement into vessel.	Operator error.	Inspection.	Operators wear protective clothing.	Reactive materials are released to the environment; Personnel exposure to reactive material.	IV,a,b III,c
Thermal Treatment. Explosive materials are ignited in a vessel in order to remove their explosive characteristics.	Failure of reaction vessel to contain material.	Mechanical failure or operator error (failure to secure vessel).	Inspection.	Operators wear protective clothing.	Personnel exposure to fire and explosive materials.	III,c
Transportation of Hazardous Waste Off Site. Tank truck transportation of bulk liquid hazardous waste.	Rupture of transport truck prior to leaving the site.	Traffic accident; operator error.	Visual detection.	None.	Hazardous liquid waste are released to the environment with the potential for fire; Personnel exposure to hazardous waste and/or fire.	II,a I,c
Transportation of Hazardous Waste Off Site. Tank truck transportation of bulk liquid hazardous waste.	Hose ruptures during transfer of bulk liquid hazardous waste.	Material failure of hose; transfer pump overpressure; operator error.	Visual detection.	None.	Hazardous liquid waste are released to the environment with the potential for fire; Personnel exposure to hazardous waste and/or fire.	III,a I,c

FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

WASTE MANAGEMENT FACILITIES

Subsystem and Function	Failure Mode	Failure Mechanism	Failure Detection	Failure Compensation	Failure Effects	Effects Category
	Small incidental spills during transfer operation.	Hose mispositioned; operator error.	Visual detection.	None.	Hazardous liquid waste are released to the environment with the potential for fire; Personnel exposure to hazardous waste and/or fire.	IV,a IV,c
Transportation of Hazardous Waste Off site. Truck transport of 55-gallon drums of hazardous waste.	Drums rupture prior to leaving site.	Traffic accident; operator error.	Visual detection.	None.	Hazardous waste are released to the environment with the potential for fire; Personnel exposure to hazardous waste and/or fire.	II,a I,c
Transportation of Radioactive Waste Off Site. Truck transport of 55-gallon drums of radioactive waste.	Drums rupture prior to leaving site.	Traffic accident; operator error.	Visual detection.	None.	Maximum release of 1,000 Ci of tritium oxide per drum to the environment; Personnel exposure to tritium oxide.	II,a I,c

APPENDIX D

HAZARDOUS CHEMICAL EVENTS ON SITE

This page left blank intentionally.

1.0 HAZARDOUS CHEMICAL EVENTS ON SITE

Hazardous chemical release events for Waste Management facilities are analyzed in this attachment. Events leading to the postulated releases include a fire in Building 1040, Bay No. 2; rupture of the 5,000-gallon bulk liquids storage tank; and two transportation accidents. The deterministic analyses were performed with the use of Emergency Prediction Information (EPI) Code (Ref. 1). The EPI Code is an air dispersion modeling code that calculates ground level airborne concentration of a chemical substance of concern using a Gaussian Plume Model. The EPI code has five different types of releases that can be modeled. The specific type of release for each scenario is described in each analysis. Analysis performed in this attachment included term releases and liquid spills. Table D-1 summarizes each hazardous chemical release scenario.

Table D-1. Hazardous Chemical Release Events

Location	Chemical Released	Quantity	Release Type	Fire
Building 1040, Bay No. 2	Sulfur Dioxide	132 Grams	Term	Yes
Flammable Liquids Storage Tank	Methylene Chloride	5,000 Gallons	Term	Yes
Flammable Liquids Storage Tank	Phosgene	7.15 Gallons	Term	Yes
Flammable Liquids Storage Tank	Methylene Chloride	5,000 Gallons	Liquid Spill	No
Parking Lot (Transportation Accident)	Methylene Chloride	5,000 Gallons	Term	Yes
Parking Lot (Transportation Accident)	Phosgene	7.15 Gallons	Term	Yes
Parking Lot (Transportation Accident)	Methylene Chloride	5,000 Gallons	Liquid Spill	No
Parking Lot (Transportation Accident)	Methylene Chloride	250 Gallons	Liquid Spill	No

Fires associated with release scenarios were modeled with the term release option. All term releases were modeled as stacks with terms of the releases set at 30 minutes. Thirty minutes was chosen as the duration of a fire that releases chemicals via volatilization at elevated temperatures expected in a fire. No credit was taken for combustion of chemicals released. Each specific analysis describes the stack modeling assumption. The required input for a term release in EPI Code are: (1) Physical Stack Height, (2) Stack Diameter, (3) Stack Exit Velocity, (4) Stack

Effluent Temperature, (5) Ambient Temperature, (6) Stability Class, and (7) Wind Speed. From this input data, EPI Code calculates an effective release height for the chemical substance released. Effective release height is used in the code instead of initial release height in order to account for plume rise. Chemical dispersion occurring with plume rise is not considered but is compensated for by treating the release as a point source/stack.

Stack height and stack diameter for each term release are described separately in each analysis. Stack exit velocity is conservatively assumed to be 0.1 m/sec. This value was chosen so low in order to account for and calculate the effect of temperature rise in the modeled stack. Since term releases considered in this attachment are all associated with a fire, stack effluent temperature is always input as 1093°C, which is the temperature expected during a fire condition. Ambient temperature is always input as 25°C in term releases considered in this attachment. EPI Code allows several meteorological conditions to be chosen for analysis. The "Worst Case" meteorological condition option was chosen for all the EPI Code runs performed in this attachment. EPI Code calculates airborne concentration of the chemical substance of concern at the worst meteorological condition at each distance increment. Analysis was performed for each chemical release scenario with a wind speed of 1 m/sec and 6 m/sec. These wind speeds give a conservative lower and upper bound for wind speeds expected at Pinellas Plant during a chemical release event.

In events without a fire, release scenarios were modeled with the liquid spill option chosen in EPI Code. Required inputs for a liquid spill release event are: (1) Spill Area, (2) Liquid Temperature, (3) Wind Speed, and (4) Stability Class. Input is then used in EPI Code with an evaporation model to determine evaporation rate of the chemical substance released. This release rate is then input into the Gaussian Plume Model, and ground level concentrations as a function of distance from source are calculated.

Spill area for each liquid spill scenario is discussed separately in each analysis. Liquid temperature is conservatively assumed to be 32°C in each liquid spill. This temperature increases vapor pressure for the chemicals evaluated as compared to a lower temperature.

Analyses were again performed with a lower and upper bounding wind speed of 1 m/sec and 6 m/sec. The "Worst Case" stability class option was chosen for all of the liquid spill scenarios.

In each analysis (both term and liquid spill), calculated ground level concentrations of the analyzed chemicals were then compared to their respective Time Weighted Average (TWA) and Immediately Dangerous to Life and Health (IDLH) values. TWA is defined by the American Industrial Hygiene Association as the time-weighted average concentration to which nearly all workers may be repeatedly exposed, for a normal eight-hour workday and a forty-hour work week, day after day, without adverse effect. The IDLH is defined by the Standard Completion Program (NIOSH and OSHA) as the maximum concentration from which one could escape within 30-minutes without any escape-impairing symptoms or any irreversible health effects. The TWAs and IDLHs used were obtained from Reference 2 and are listed in Table D-2 for each chemical analyzed.

Table D-2. TWA and IDLH Values for the Chemicals Analyzed

Chemical	TWA	IDLH
Methylene Chloride	500 ppm	5000 ppm
Phosgene	0.1 ppm	2.0 ppm
Sulfur Dioxide	2.0 ppm	100 ppm

2.0 RELEASE OF REACTIVE CHEMICALS FROM BUILDING 1040, BAY NO. 2

In this scenario the entire inventory of 55-gallon drums of reactive waste are assumed to have ruptured due to a fire in the bay. Contents of the drums are then assumed to react with water produced from the sprinkler system. There are no liquids stored in Bay No. 2 and, therefore, voids exist in the 55-gallon drums. A sensitivity analysis of the wastes stored in Bay No. 2 indicate that the most toxic credible gas that could be generated in a significant quantity as a result of a fire and exothermic reactions is sulfur dioxide (SO_2). The analysis assumes that the twenty-four 55-gallon drums contain 6000 cells (250 cells per drum). A single cell contains about 0.022 grams of sulfur dioxide at the end of its useful life. This corresponds to a quantity 132 grams available during the event. This quantity of SO_2 is released at elevated temperature assumed in a fire (1,093°C).

During the postulated accident it was assumed that the overhead roll-up door in Bay No. 2 would be open. The bay was modeled as a stack with an equivalent diameter of 5 meters (area of bay is approximately 20 m^2), and a stack height of 2 meters. The stack height used is 50% of the wall height in Building 1040 and was chosen to account for effluent released through the open bay door. Two term releases of

132 grams of sulfur dioxide for 30 minutes were then run using EPI Code (one with a wind speed of 1 m/sec and one with a wind speed of 6 m/sec). Input data and the previously discussed stack exit velocity were then entered into the EPI Code along with the "Worst Case" meteorological option, and an effective release height of 96 meters was calculated with a wind speed of 1 m/sec and 25 meters with a wind speed of 6 m/sec. Resulting concentrations were compared to the TWA and IDLH of 2.0 ppm and 100 ppm respectively for SO_2. The two wind speeds were chosen to have a conservative bounding upper and lower wind speed.

Results indicate that the maximum sulfur dioxide concentration of 0.0013 ppm occurs at a distance of 100 meters from the bay with a 6 m/sec wind speed (maximum concentration is 0.0049 ppm at 300 meters with a 1 m/sec wind speed). The site boundary is approximately 200 meters from the bay where the concentration is 0.0010 ppm. These values are below the TWA and IDLH values for sulfur dioxide. It can be concluded that the concentrations calculated for the accident analyzed would cause negligible effects to exposed personnel.

3.0 RELEASE OF METHYLENE CHLORIDE FROM THE 5,000 GALLON STORAGE TANK

In this scenario the entire contents of the 5,000-gallon flammable liquids storage tank are assumed to be released to the concrete containment dike. Contents are assumed to be 100% liquid methylene chloride. This assumption was made based on a sensitivity analysis of the various permitted chemicals in the storage tank and their hazardous effects. The methylene chloride release is considered with a fire and without a fire (evaporation). In the case of the fire, the production of phosgene is also considered.

3.1 5,000 Gallon Storage Tank Release With A Fire

Release of 5,000 gallons of methylene chloride into the containment dike with a fire was modeled as a stack with an equivalent diameter of 5 meters (area of dike is approximately 20 m^2) and a stack height of 1 meter. Stack height used is slightly less than the dike wall height. Two term releases of 5,000 gallons of methylene chloride for 30 minutes were then run using EPI Code (one with a wind speed of 1 m/sec and one with a wind speed of 6 m/sec) with an elevated temperature of 1093 °C. Input data and the previously discussed stack exit velocity were then entered into the EPI Code along with the "Worst Case" meteorological option, and an effective release height of 95 meters was calculated with a wind speed of 1 m/sec and 24 meters with a wind speed of 6 m/sec. Resulting concentrations were compared to the TWA and IDLH of 500 ppm and 5,000 ppm respectively. Two wind speeds were chosen to have a conservative bounding upper and lower wind speed.

Results indicate that the maximum methylene chloride concentration of 200 ppm occurs at a distance of 100 meters from the bay with a 6 m/sec wind speed (maximum concentration is 72 ppm at 300 meters with a 1 m/sec wind speed). The site boundary is approximately 200 meters from the bay where maximum concentration is 150 ppm. The maximum concentration calculated at the location of the Child Development Center/Partnership School (485 meters from the bay) is 98 ppm with a wind speed of 6 m/sec. These values are lower than the TWA for methylene chloride and significantly lower than the IDLH. It can be concluded that the concentrations calculated for the accident analyzed should not cause any adverse effects to exposed personnel.

Phosgene formed due to thermal decomposition of methylene chloride is the most toxic of the gases that could be produced. Thermal decomposition of methylene chloride is reported to form phosgene in the range of zero to 0.143 volume percent (Ref. 3). Maximum quantity of 5,000 gallons of methylene chloride and maximum percent of 0.143 produces 7.15 gallons of phosgene. This quantity of phosgene is then released using the same stack model as described above and at elevated temperature assumed in a fire (1,093°C) for 30 minutes. Input data was entered into the EPI Code along with the "Worst Case" meteorological option, and an effective release height of 95 meters was calculated with a wind speed of 1 m/sec and 24 meters with a wind speed of 6 m/sec. The resulting concentrations were compared to the TWA and IDLH of 0.1 ppm and 2.0 ppm respectively. Two wind speeds were chosen to have a conservative bounding upper and lower wind speed.

Results indicate that the maximum phosgene concentration of 0.25 ppm occurs at a distance of 100 meters from the bay with a 6 m/sec wind speed (maximum concentration is 0.092 ppm at 300 meters with a 1 m/sec wind speed). The site boundary is approximately 200 meters from the bay where the concentration is 0.19 ppm. Maximum concentration calculated at the location of the Child Development Center/Partnership School (485 meters from the bay) is 0.12 ppm with the wind speed of 6 m/sec. These values are slightly above the TWA but lower than the IDLH. It can be concluded that concentrations of phosgene calculated for the accident analyzed would not cause any adverse effects to exposed personnel.

3.2 5,000 Gallon Storage Tank Release Without A Fire

Release of 5,000 gallons of methylene chloride into the containment dike without a fire was modeled as a spill with a surface area of 22 m^2. Two liquid spills of 5,000 gallons of methylene chloride were then run using EPI Code (one with a wind speed of 1 m/sec and one with a wind speed of 6 m/sec) with an ambient temperature of 32°C. Input data was then entered into the EPI Code along with the "Worst Case" meteorological option.

Results indicate that the maximum methylene chloride concentration of 570 ppm occurs at a distance of 100 meters from the bay with a 1 m/sec wind speed (maximum concentration is 480 ppm at 100 meters with a 6 m/sec wind speed). It can be concluded that concentrations calculated for the accident analyzed would not cause any adverse effects to exposed personnel.

Results of these EPI Code runs for release of methylene chloride from the storage tank are illustrated graphically in Figures D-1, D-2, and D-3.

4.0 CHEMICAL TRANSPORTATION ACCIDENT

In this scenario the transportation equipment for hazardous chemical wastes considered is assumed to experience an event that results in the entire contents of the transportation container being released to the ground. For the releases considered, no credit is specifically taken for pooling effects (i.e., reduced surface area) of the chemical due to contour of the ground other than in selection of spill depth. Spill surface area is based on a spill depth of 1 cm. Two releases were considered: (1) a 5,000-gallon tank truck release at the east Belcher Rd. gate, which is approximately 130 meters from the school boundary and (2) a 250-gallon release.

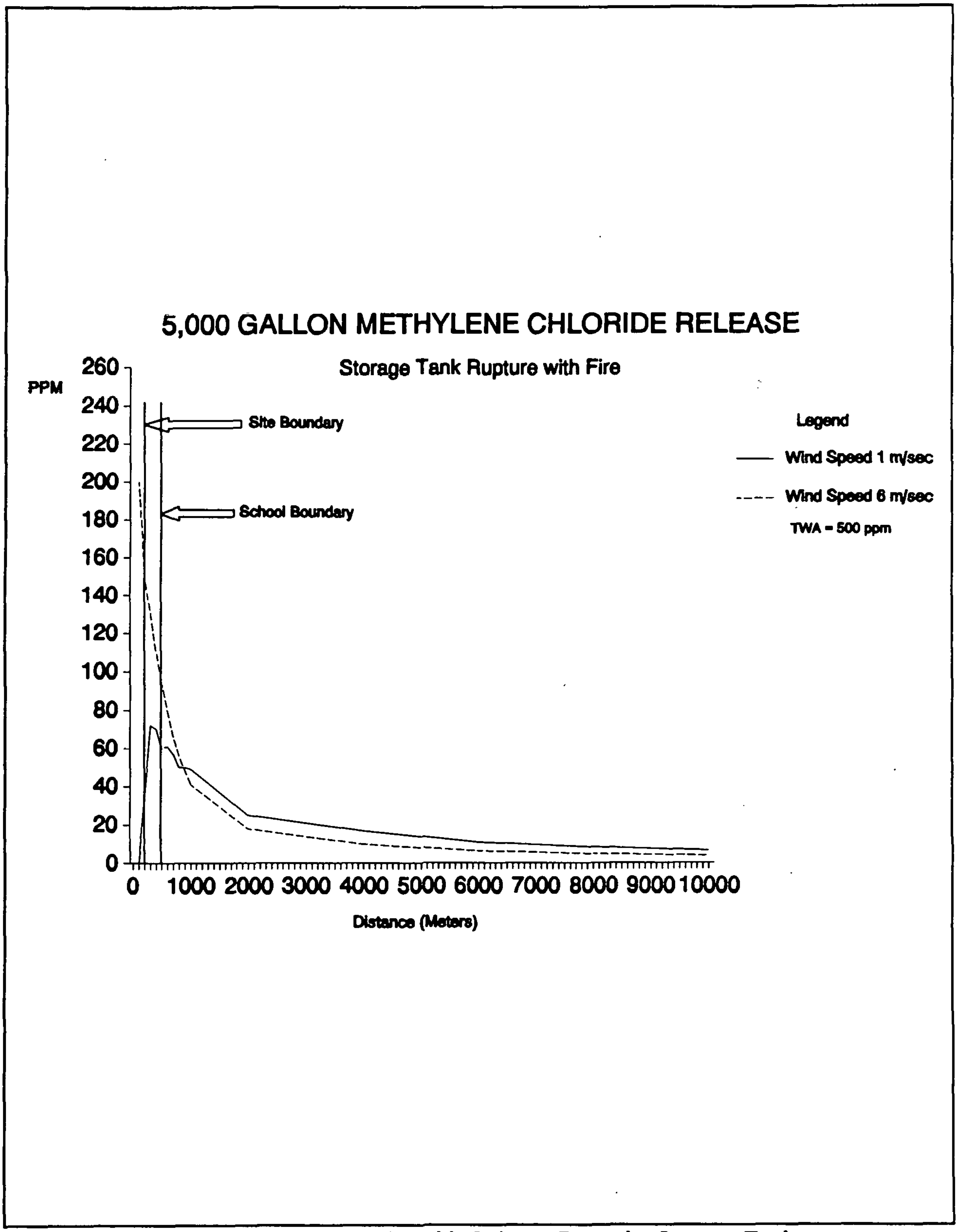


Figure D-1. 5,000 Gallon Methylene Chloride Release From the Storage Tank

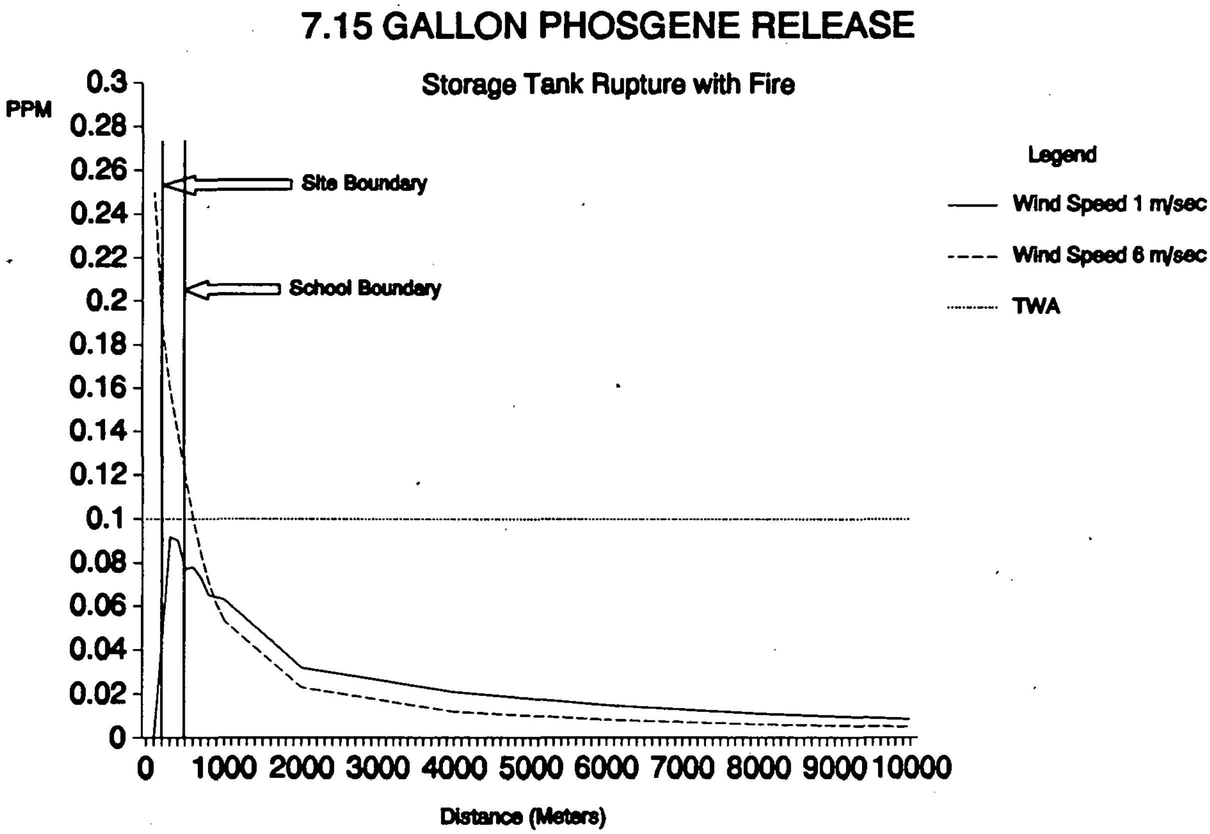


Figure D-2. 7.15 Gallon Phosgene Release From the Storage Tank

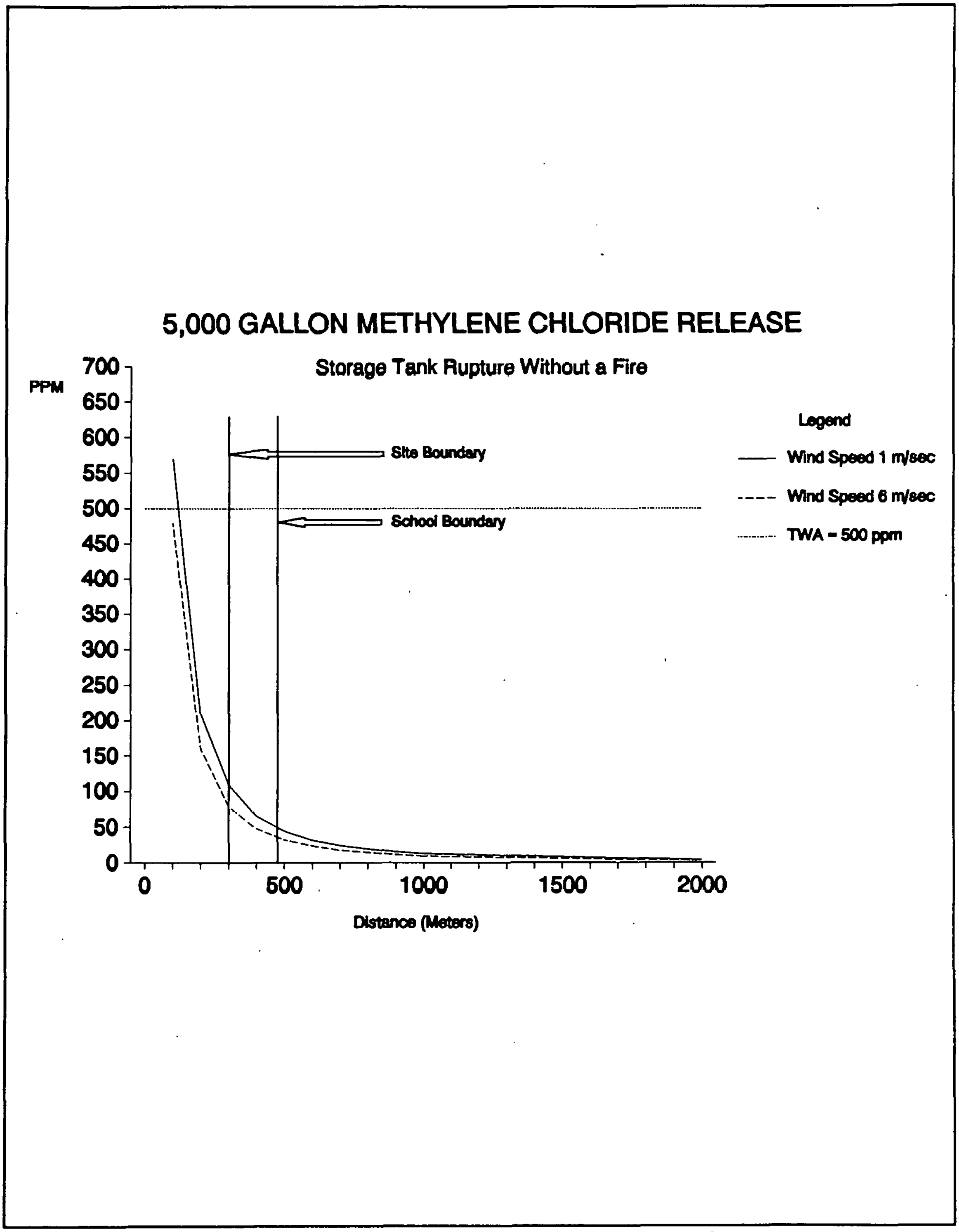


Figure D-3. 5,000 Gallon Methylene Chloride Spill From Storage Tank

4.1 5,000 Gallon Hazardous Liquid Waste Release

In this scenario the entire contents of a transportation tank are assumed to be released prior to leaving the site. The truck is assumed to be carrying 5,000 gallons of methylene chloride. This is a conservative assumption since the maximum quantity of liquid waste available for bulk transport is 5,000 gallons, and the percentage of methylene chloride would be much less than 100%. Spill area assumed in the analysis was 1,900 m^2, which is equivalent to a spill depth of 1 cm. This scenario considered both a spill with a fire and without a fire.

4.1.1 5,000 Gallon Hazardous Liquid Spill with a Fire

Release of 5,000 gallons of methylene chloride onto the site surface with a fire was modeled as a stack with an equivalent diameter of 50 meters (area of spill is approximately 95 m^2) and a stack height of 0 meters. Stack height used is based on a ground release. Input data and the previously discussed stack exit velocity were then entered into the EPI Code along with the "Worst Case" meteorological option, and an effective release height of 296 meters was calculated with a wind speed of 1 m/sec and 107 meters with a wind speed of 6 m/sec.

Results indicate that the maximum methylene chloride concentration of 10 ppm occurs at a distance of 400 meters from the spill/fire with a 6 m/sec wind speed (maximum concentration is 7.2 ppm at 1,000 meters with a 1 m/sec wind speed). These values are below the TWA and IDLH values for methylene chloride. It can be concluded that the concentrations calculated for the accident analyzed would not cause any adverse effects to exposed personnel.

The quantity of phosgene (7.15 gallons) is released using the same stack model and input data as described above.

Results indicate that the maximum phosgene concentration of 0.012 ppm occurs at a distance of 400 meters from the spill/fire with a 6 m/sec wind speed (maximum concentration is 0.0092 ppm at 1,000 meters with a 1 m/sec wind speed). These values are below the TWA and IDLH values for phosgene. It can be concluded that the concentrations calculated for the accident analyzed would not cause any adverse effects to exposed personnel.

4.1.2 5,000 Gallon Hazardous Liquid Spill without a Fire

Release of 5,000 gallons of methylene chloride onto the site surface without a fire was modeled as a spill with a surface area of 1,900 m^2.

Results indicate that the maximum methylene chloride concentration of 11,000 ppm occurs at a distance of 100 meters from the spill with the 1 m/sec wind speed (maximum concentration is 8,100 ppm at 100 meters with the 6 m/sec wind speed). These values are above the TWA and IDLH values for methylene chloride. It can be concluded that the concentrations calculated for the accident analyzed could cause some adverse effects to exposed personnel.

The results of these EPI Code runs for release of 5,000 gallons of methylene chloride from the transportation accident are illustrated graphically in Figures D-4, D-5, and D-6.

4.2 250 Gallon Hazardous Liquid Waste Release

In this scenario the entire contents of the chemical transport are assumed to be released prior to entering Building 1040. The chemical transport can carry a maximum of 250 gallons of total liquid. It was assumed then that 250 gallons of methylene chloride are released. Spill area assumed in the analysis was 95 m^2, which is equivalent to a spill depth of 1 cm.

Results indicate that the maximum methylene chloride concentration of 1,900 ppm occurs at a distance of 100 meters from the spill with a 1 m/sec wind speed (maximum concentration is 1,400 ppm at 100 meters with a 6 m/sec wind speed). These values are above the TWA but are below the IDLH for methylene chloride. It can be concluded that the concentrations calculated for the accident analyzed should not cause any adverse effects to exposed personnel.

Results of the EPI Code runs for the release of 250 gallons of methylene chloride are illustrated graphically in Figure D-7.

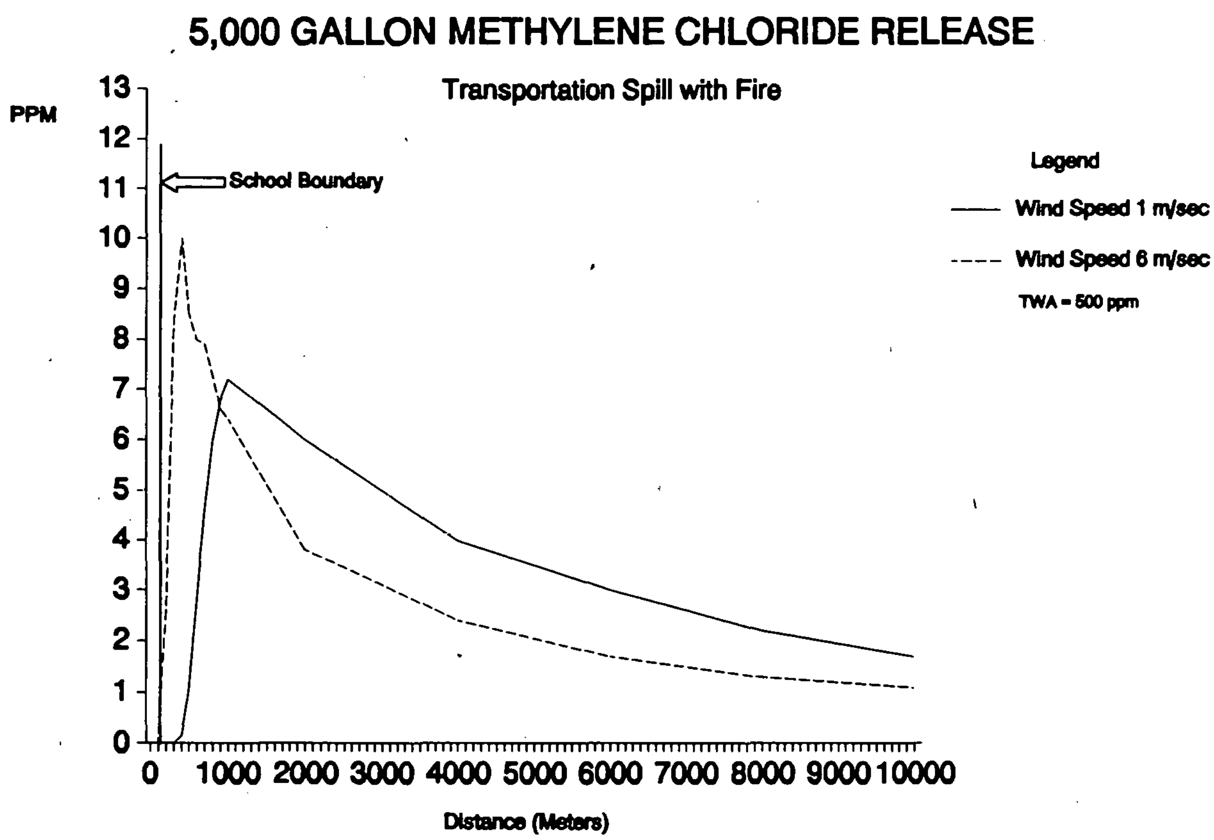


Figure D-4. 5,000 Gallon Methylene Chloride Transportation Release

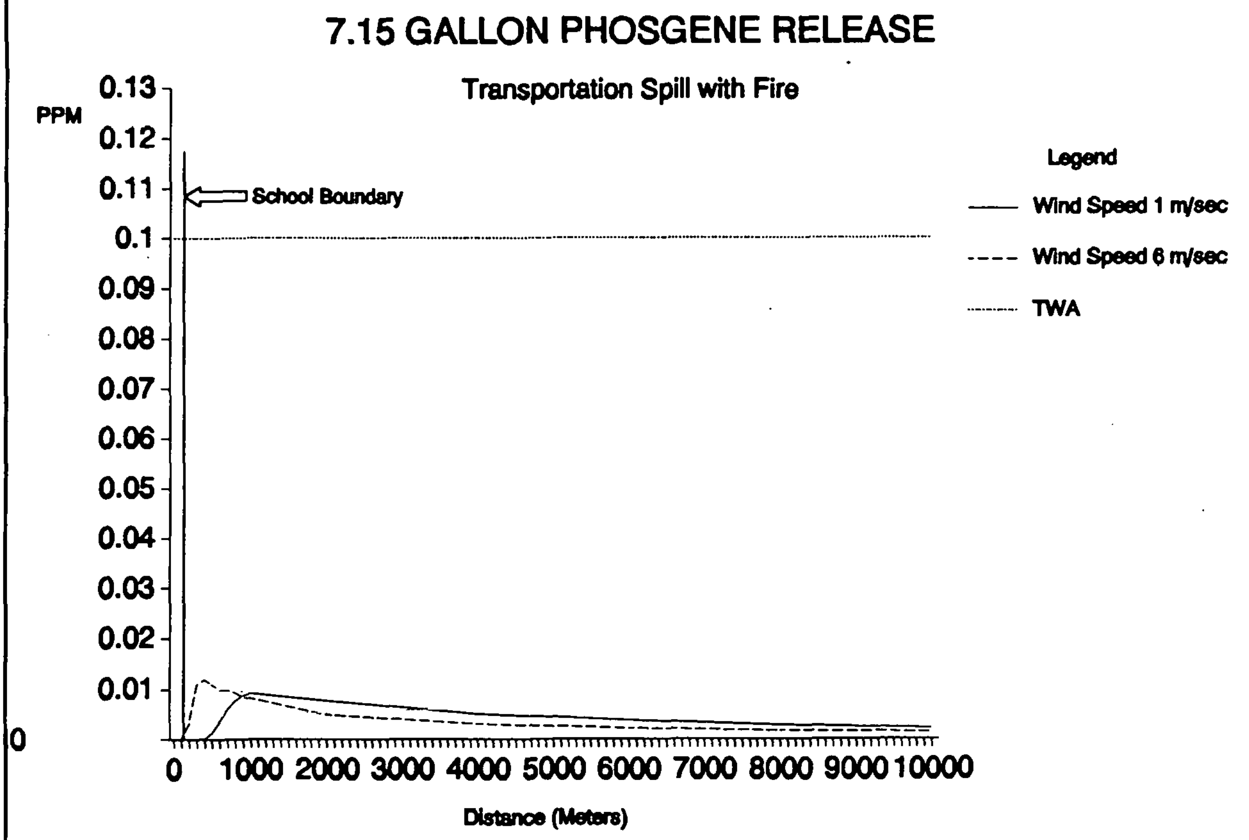


Figure D-5: 7.15 Gallon Phosgene Transportation Release

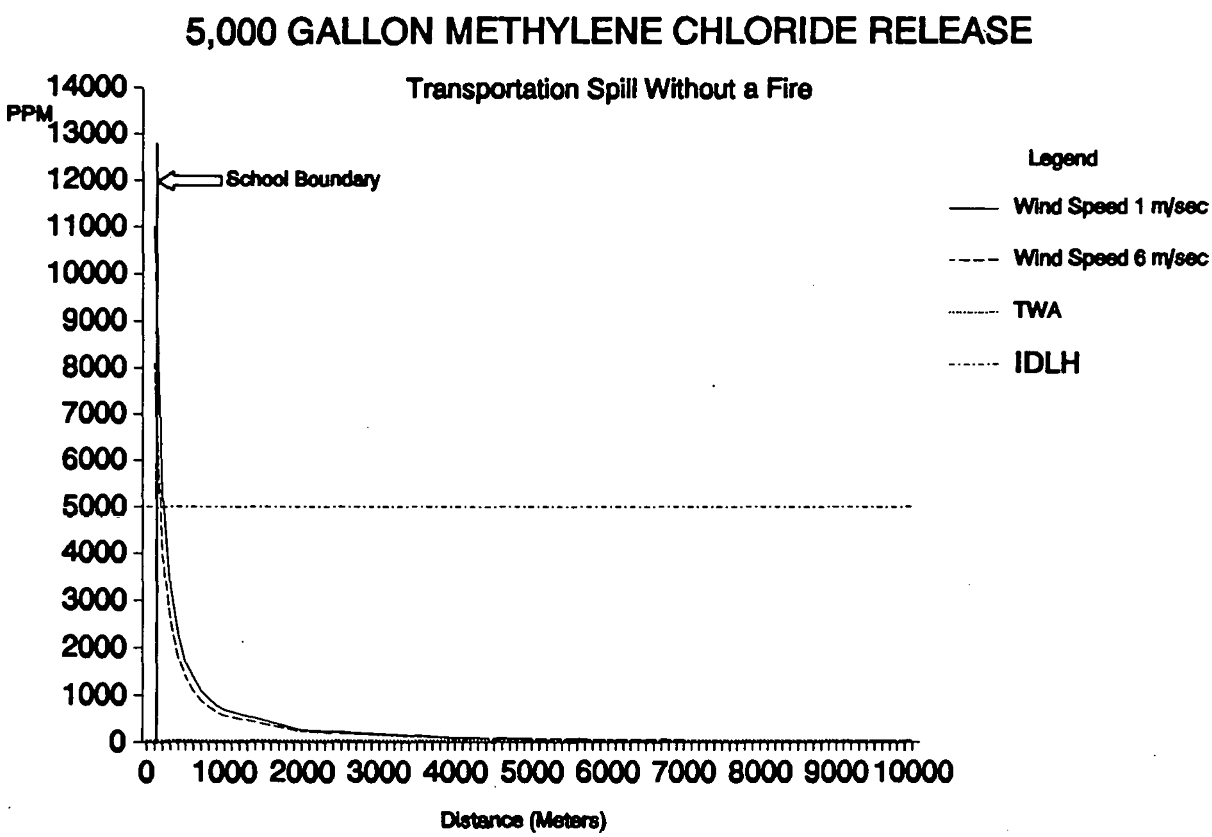


Figure D-6. 5,000 Gallon Methylene Chloride Transportation Spill

L:\PUBS\SA\94151

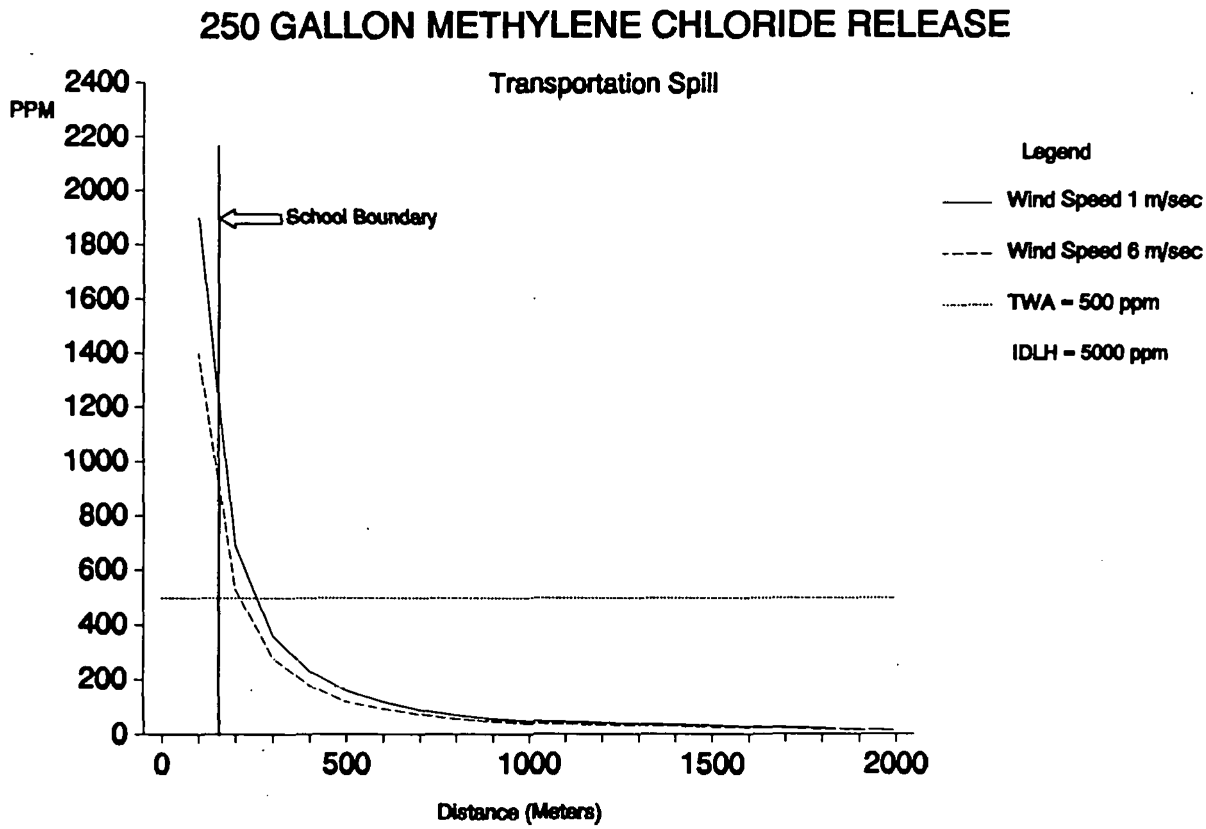


Figure D-7. 250 Gallon Methylene Chloride Release

REFERENCES

1. Kevin J. Anderson, Emergency Prediction Information Code, (Fremont, California: Homann Associates, 1988).

2. NIOSH (National Institute of Occupational Safety and Health), Pocket Guide to Chemical Hazards, (Washington, D.C.: U.S. Department of Health and Human Services, 1990).

3. NIOSH (National Institute Of Occupational Safety and Health), Occupational Exposure to Phosgene, (Washington D.C. U.S. Department Of Health, Education and Welfare, 1976).

/

APPENDIX E

HAZARDOUS CHEMICAL RELEASE INSIDE BUILDING 1040

This page left blank intentionally.

1.0 HAZARDOUS CHEMICAL RELEASE INSIDE BUILDING 1040

Hazardous chemical release events for spills inside Waste Management facilities are analyzed in this attachment. Events leading to the postulated releases include a fork lift accident in Building 1040, Bay No. 1, and a spill in Building 1040, Bay No. 3. The fork lift accident results in rupture of four 55-gallon drums. The event in Bay No. 3 considers a spill of a magnitude equivalent to one 55-gallon drum. In both cases, the entire contents are assumed to spill on the bay floor. No credit is taken for the containment basin of pallets in Bay No. 1. Liquid is assumed to cover 50% of the surface area for each bay, and no credit is taken for trench drains and sumps. Drums are assumed to contain methylene chloride for the purposes of this analysis.

Deterministic analyses were performed with the use of gas clearing models using exponential clearing rates and ramp inputs. In each analysis, calculated concentrations of methylene chloride are compared to the TWA and to IDLH values. The TWA and IDLH were obtained from Reference 1 and are listed in Table E-1.

Table E-1. TWA and IDLH Values for Methylene Chloride

Chemical	TWA	IDLH
Methylene Chloride	**500 ppm**	**5,000 ppm**

2.0 RUPTURE OF FOUR 55-GALLON DRUMS IN BUILDING 1040 BAY NO. 1

In this scenario, four 55-gallon drums in Building 1040, Bay No. 1 are assumed to have been ruptured by a fork lift. Contents of the drums are assumed to be 100% liquid methylene chloride. This assumption was made based on a sensitivity analysis of the various permitted chemicals in the bay and their hazardous effects. No credit is taken for liquid draining into the pallet containment basin, trench drain, or sump. The 220 gallons of methylene chloride released are assumed to occupy 50% of the bay surface area, or 50 m^2. Analysis was performed with all five bay exhaust fans in operation.

The Emergency Prediction Information (EPI) Code (Ref. 2) was used to calculate evaporation rate of methylene chloride. The EPI Code uses the following equation for calculating the evaporation rate of methylene chloride:

L:\PUBS\SA\94151

$$Q = \frac{0.0139 * U^{0.78} * MW^{0.67} * A * VP(T_1)}{T_1 + 273}$$

Where

Q	=	Rate of release to air, lbs/min
MW	=	Molecular weight, g/mole
U	=	Wind speed, meter/sec
A	=	Surface area of spilled material, meter^2
$VP(T_1)$	=	Temperature of spilled material, degrees C

The equation is solved for Q, using a wind speed (U) equal to 0.25 meter/sec (speed of air movement inside the bay) with the following results:

Q = 111 g/sec

This evaporation rate is then used in the following analysis to calculate the methylene chloride airborne concentration in Building 1040, Bay No. 1.

2.1 Analysis

The gas clearing model uses an exponential clearing rate and a ramp input.

Methylene chloride released within Building 1040 Bay No. 1 as shown in the attached MATHCAD® pages, indicates that the concentration inside the bay reaches equilibrium level of 39,000 ppm after 25 minutes. This level is well above the IDLH value. It can be concluded that personnel exposed to these concentrations could experience or develop life-threatening or irreversible health effects.

® Registered Trademark of MathSoft, Inc. (MATHCAD)

3.0 SPILL OF 55-GALLONS OF METHYLENE CHLORIDE IN BUILDING 1040 BAY No. 3

In this scenario, a rack of lab chemicals in Building 1040, Bay No. 3 falls and chemicals are released on to the bay floor. Chemicals are modeled as methylene chloride, and the quantity is assumed to be 55 gallons. This assumption was made based on a sensitivity analysis of various permitted chemicals in the bay, quantities, and their hazardous effects. No credit is taken for liquid draining into the trench drain and sump. The 55 gallons of methylene chloride released are assumed to occupy 50% of the bay surface area, or 10 m^2. Analysis was performed with both bay exhaust fans in operation.

EPI Code (Ref. 2) was used to calculate evaporation rate of methylene chloride. The equation is solved for Q, using a wind speed (U) equal to 0.25 meter/sec (speed of air movement inside the bay) with the following results:

$$Q = 22 \text{ g/sec}$$

This evaporation rate is then used in the following analysis to calculate the methylene chloride airborne concentration in Building 1040, Bay No. 3.

3.1 Analysis

The gas clearing model uses an exponential clearing rate and a ramp input.

Methylene chloride released within Building 1040, Bay No. 3 as shown in the attached MATHCAD® pages, indicates that the concentration inside the bay reaches equilibrium level of 21,000 ppm after 15 minutes. This level is well above the IDLH value. It can be concluded that personnel exposed to these concentrations could experience or develop life-threatening or irreversible health effects.

® Registered Trademark of MathSoft, Inc. (MATHCAD)

REFERENCES

1. NIOSH (National Institute of Occupational Safety and Health), "Pocket Guide to Chemical Hazards", U.S. Department of Health and Human Services, Washington, D.C., June 1990.

2. Kevin J. Anderson, Emergency Prediction Information Code (Fremont, California: Homann Associates, Inc., 1988).

L:\PUBS\SA\94151

METHYLENE CHLORIDE SPILL-55-GALLONS

This is an examination of the consequences of a spill of 55-gallons of methylene chloride within Bay No. 3 of Building 1040. It assumes that the spill is prompt (all spilled simultaneously) and considers the effect with the exhaust fans operational.

$Vroom := 80 \cdot m^3$ Volume of Storage Bay

$Vent := 29.416 \cdot \frac{m^3}{min}$ Actual ventilation flow rate

$Exrate := \frac{Vroom}{Vent}$ Air exchange rate

$Exrate = 2.72 \cdot min$

$Erate := 22 \cdot \frac{gm}{sec}$ Evaporation rate (from EPI code using 32 degrees C ambient temperature)

$Vden := 3.79 \cdot \frac{kg}{m^3}$ Vapor density of Methylene Chloride (CH2Cl2)

$Vrel := \frac{Erate}{Vden}$

$Vrel = 0.006 \cdot \frac{m^3}{sec}$ Volumetric release rate

Compute exponential coefficient for air clearing model

$clear := e^{-\beta \cdot t_n}$ Clearing function as a ratio given some initial concentration of 1.

$eff := 40 \cdot \%$ Effectiveness of air clearing system (40% of contaminants remain in the room after one air change without the addition of more contaminants)

$\beta := \frac{-\ln(1 - eff)}{Exrate}$ Compute Beta such that eff percent of the initial contaminants are removed after one air change.

$\beta^{-1} = 5.324 \cdot min$ Characteristic clearing time

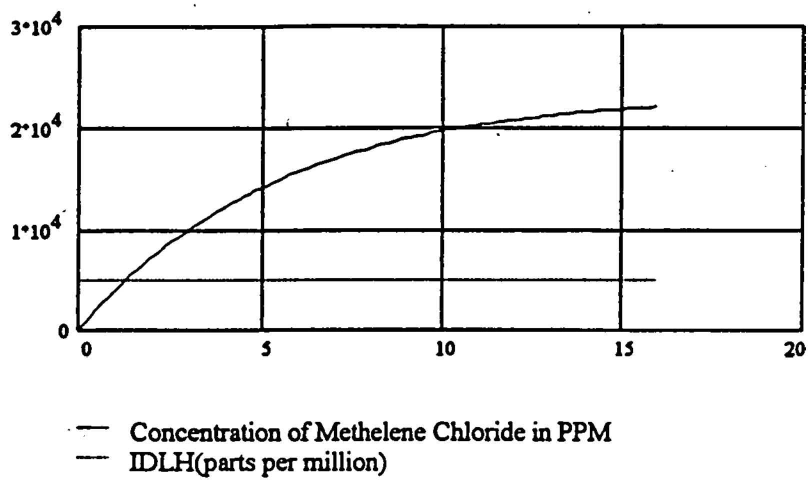
Since the release rate is a constant and small compared to the clearing rate from the ventilation system, the analysis convolved the clearing and release functions to determine the system response.

$Con(t) := \frac{Vrel}{\beta \cdot Vroom} \cdot \left(1 - e^{-\beta \cdot t}\right) \cdot 10^6$ Convolved release function with results in parts per million

$tinc := 0\cdot min, \frac{3}{\beta\cdot 100} .. 3\cdot\beta^{-1}$

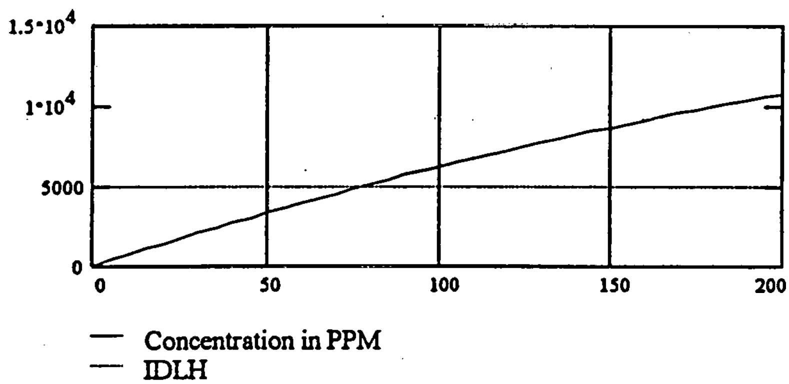
Time increments for 3 time constants using 100 data points.

Concentration of CH2Cl2 in PPM in Minutes Since Release



$tIDLH := 0\cdot sec, 5\cdot sec .. 200\cdot sec$

Concentration in PPM - Time to Reach IDLH in Seconds



METHYLENE CHLORIDE SPILL-FOUR 55-GALLON DRUMS

This is an examination of the consequences of a spill of four 55-gallon drums of methylene chloride within Bay No. 1 of Building 1040. It assumes that the spill is prompt (all spilled simultaneously) and considers the effect with the exhaust fans operational.

$Vroom := 400 \cdot m^3$	Volume of Storage Bay
$Vent := 88.167 \cdot \frac{m^3}{min}$	Actual ventilation flow rate
$Exrate := \frac{Vroom}{Vent}$	Air exchange rate
$Exrate = 4.537 \cdot min$	
$Erate := 111 \cdot \frac{gm}{sec}$	Evaporation rate (from EPI code using 32 degrees C ambient temperature)
$Vden := 3.79 \cdot \frac{kg}{m^3}$	Vapor density of Methylene Chloride (CH2Cl2)
$Vrel := \frac{Erate}{Vden}$	
$Vrel = 0.029 \cdot \frac{m^3}{sec}$	Volumetric release rate

Compute exponential coefficient for air clearing model

$clear := e^{-\beta \cdot t_0}$	Clearing function as a ratio given some initial concentration of 1.
$eff := 40 \cdot \%$	Effectiveness of air clearing system (40% of contaminants remain in the room after one air change without the addition of more contaminants)
$\beta := \frac{-\ln(1 - eff)}{Exrate}$	Compute Beta such that eff percent of the initial contaminants are removed after one air change.
$\beta^{-1} = 8.881 \cdot min$	Characteristic clearing time

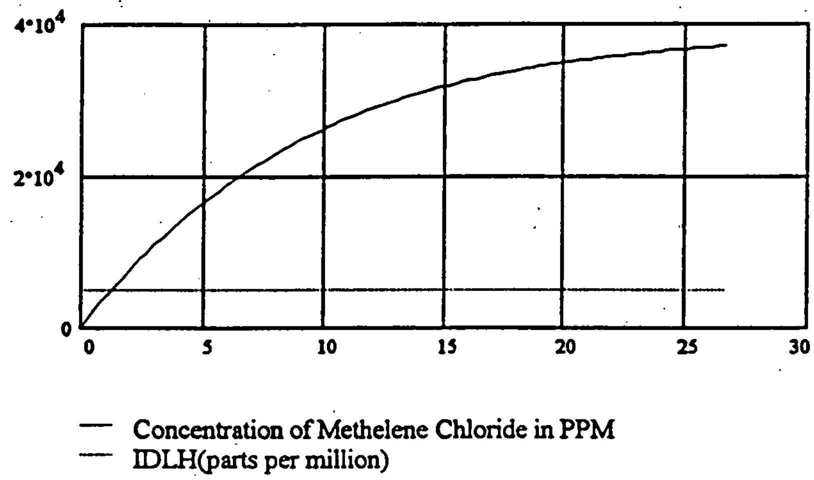
Since the release rate is a constant and small compared to the clearing rate from the ventilation system, the analysis convolved the clearing and release functions to determine the system response.

$Con(t) := \frac{Vrel}{\beta \cdot Vroom} \cdot \left(1 - e^{-\beta \cdot t}\right) \cdot 10^6$	Convolved release function with results in parts per million

$tinc := 0 \cdot min, \frac{3}{\beta \cdot 100} .. 3 \cdot \beta^{-1}$

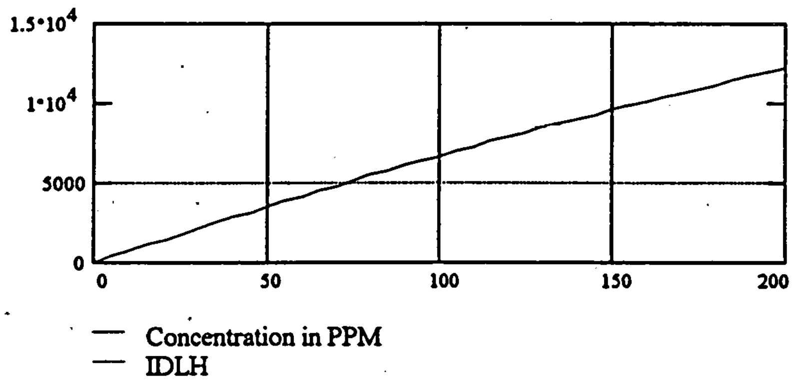
Time increments for 3 time constants using 100 data points.

Concentration of CH2Cl2 in PPM in Minutes Since Release



$tIDLH := 0 \cdot sec, 5 \cdot sec .. 200 \cdot sec$

Concentration in PPM - Time to Reach IDLH in Seconds



APPENDIX F

CONTAINER RELEASE OF RADIOACTIVE WASTE

This page left blank intentionally.

1.0 CONTAINER RELEASE OF RADIOACTIVE WASTE

This appendix contains the derivation of the release and clearing functions used to evaluate the potential dose to personnel as the result of a release of tritium from a container storing radioactive waste. It contains sensitivity analyses examining several parameters of the area ventilation systems in order to aid in understanding the criticality of these features. This analysis includes only the derivation and computations associated with the release model used to support the accident event described in Chapter 6. MATHCAD® computations and analyses in support of this discussion are included at the end of this appendix.

2.0 EXAMINATION OF KEY MODELING ASSUMPTIONS

In this release and clearing model development, several assumptions were made. This discussion further examines some of assumptions related to the relationship between air removal and maximum dose in order to better understand the effect of the assumptions on the potential maximum dose to workers and others who may be present in Building 1000 Bay No. 1 at the time of a release.

The accident analysis assumes the ventilation system is effective in clearing contamination at a rate modeled by a decreasing exponential function. The exponent is chosen to reflect the quantity of air that is removed (including any contaminants) during one air change period. The analysis chose a value of 50% removal of the ambient air present at the beginning of the exchange period (which is representative of a good quality system) since the actual nature of "dead areas" in the bay is not known. To facilitate this investigation the analysis assumes that it takes thirty minutes to release 90% of the contents of the container by using a decreasing exponential rate. It is worthwhile to note that the clearing function is based solely on the ventilation system characteristics. This is appropriate, even though from a mass balance standpoint, the released tritium modifies this function. For example, if the release rate was on the same order as the ventilation rate, then the actual volumetric air movement would most likely not be the ventilation rate without considering the release contribution, but some larger value. But, in this problem the tritium release rate is negligible compared to the ventilation rate and its contribution can be ignored.

®Registered Trademark of MathSoft, Inc. (MATHCAD)

The various models for tritium releases were as developed in the Area 108 Safety Assessment (Ref. 1). This assessment utilizes the models to examine the effects of a tritium release in Building 1000 Bay No. 1.

REFERENCES

1. MMSC (Martin Marietta Specialty Components, Inc), Safety Assessment Of Area 108, Tube Exhaust, MMSC-SA-93076, January 1994, Pinellas Plant, Largo Florida.

L:\PUBS\SA\94151

Analysis for a 1000 Curie Release in Building 1000 Bay No. 1

Derivation of the dose expression for Bay No. 1 as a function of exponential parameters and time.

Define exponents and other critical parameters:

Define exponential clearing function $e^{-\beta \cdot t}$

Rate of nominal room air exchange (time to change one air volume):

$Rnom := 9.2 \cdot min$ Bay No. 1 air change rate

$Rvent := Rnom$ $\qquad$ $Rvent = 9.2 \cdot min$ $\qquad$ Effective air change interval

Efficiency of removal (amount of original air removed after one air change period)

$Effl := 40 \cdot \%$

$$\beta := \frac{-\ln(1 - (Effl))}{Rvent}$$ The exponent that describes exponential clearing.

$\beta = 9.254 \cdot 10^{-4} \cdot sec^{-1}$ $\beta^{-1} = 18.01 \cdot min$ $\qquad$ Characteristic clearing time

Define the tritium release function (90% of the tritium is released in 30 minutes) given the following form of the release ratio ("released" to "available to be released") as a function of time. The release function was developed for a uranium bed release. The function remains the same but the time interval has been estimated to approximate the release of tritium oxide vapor from tritium-contaminated waste.

$q(t) := 1 - e^{-\alpha \cdot t}$

Determine the release exponent:

$tnom := 30 \cdot min$

$mom := 90 \cdot \%$

$$\alpha := \frac{-\ln(1 - mom)}{tnom}$$

$\alpha^{-1} = 13.029 \cdot min$ $\qquad$ Characteristic release time

The relative release rate (necessary for convolution with the clearing rate) is the time derivitive of the release function:

$$\frac{d}{dt}\left(1 - e^{-\alpha \cdot t}\right) = \alpha \cdot \exp(-\alpha \cdot t)$$

The release rate and the clearing rate are combined to obtain the system response.

$$\int_0^t \alpha \cdot \exp(-\alpha \cdot \lambda) \cdot e^{-\beta \cdot (t - \lambda)} \, d\lambda = \alpha \cdot \frac{(-\exp(-\alpha \cdot t) + \exp(-\beta \cdot t))}{(-\beta + \alpha)}$$

$f1(t) := 1 - e^{-\alpha \cdot t}$ $\qquad$ f1(t) describes the release without clearing

$$f2(t) := \alpha \cdot \frac{(-\exp(-\alpha \cdot t) + \exp(-\beta \cdot t))}{(-\beta + \alpha)}$$

f2(t) describes the release with clearing

Define time vector for graphic:

$points := 100$

$tm := 0 \cdot min, \frac{5 \cdot (tfin)}{points} .. 5 \cdot (tfin)$

$5 \cdot tfin = 90.05 \cdot min$

$tfin := if(\beta < \alpha, \beta^{-1}, \alpha^{-1})$

Select the longer time constant for the ending interval for the graphic presentation.

$5 \cdot \frac{tfin}{points} = 0.901 \cdot min$

Time increment

Derive the Dose Function:

The release concentration is integrated with respect to time. It is then multiplied by several constants and by the inhalation rate to obtain the dose function.

$$\alpha \cdot \frac{(-\exp(-\alpha \cdot t) + \exp(-\beta \cdot t))}{(-\beta + \alpha)}$$

Release concentration function.

Define Constants:

$rem := 1Q$

$$\int_0^z 1 - e^{-a \cdot t} \, dt$$

Function used for no exhaust

integrated yields

$$\frac{(z \cdot a + \exp(-z \cdot a))}{a} - \frac{1}{a}$$

then simplifies to

$$\frac{(z \cdot a + \exp(-z \cdot a) - 1)}{a}$$

Integrate the release function from time 0 to z. Function below for exhaust on.

$$\int_0^z \alpha \cdot \frac{(-\exp(-\alpha \cdot t) + \exp(-\beta \cdot t))}{(-\beta + \alpha)} \, dt$$

integrated yields

$$\frac{-(-\exp(-\alpha \cdot z) \cdot \beta + \exp(-\beta \cdot z) \cdot \alpha)}{(\beta \cdot (-\beta + \alpha))} + \frac{1}{\beta}$$

then simplifies to

$$\frac{-(-\exp(-\alpha \cdot z) \cdot \beta + \exp(-\beta \cdot z) \cdot \alpha + \beta - \alpha)}{(\beta \cdot (-\beta + \alpha))}$$

The above expression is the integral of the exhausted release function.

Therefore, the integral of the no exhaust release function is defined as:

$$Rn(z) := \frac{(z \cdot \alpha + \exp(-z \cdot \alpha) - 1)}{\alpha}$$

Next the constants are defined that, when combined with the integral expressions for exhausted or non-exhausted releases, will yield worst case dose.

$\text{Curie} := 1000 \cdot 10^6$ Content of waste container (1,000 Curie maximum)

$\text{conv} := \dfrac{4.21 \cdot 10^{-3} \cdot \text{rem}}{\left(\dfrac{1}{\text{liter}}\right)}$ Conversion Factor for Dose in rem

$\text{VolRoom} := 2422985 \cdot \text{liter}$ Volume of Room where exposure can take place

$\text{VolPerson} := 42 \cdot \text{liter}$ Volume of standard person

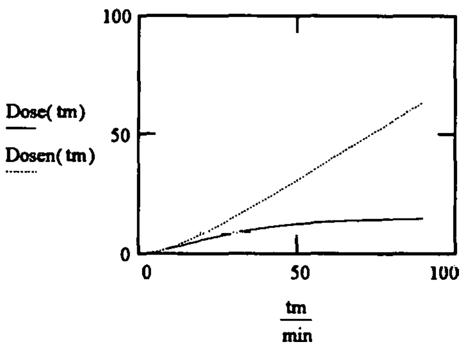
$\text{Uptake} := \dfrac{20 \cdot \text{liter}}{\text{min}}$ Uptake rate for contamination

$K := \dfrac{\text{Curie} \cdot \text{conv} \cdot \text{Uptake}}{\text{VolRoom} \cdot \text{VolPerson}}$ Constant used in calculation

$K = 0.014 \cdot \text{sec}^{-1} \cdot \text{rem}$

$\text{Dose}(t) := K \cdot \left[\dfrac{-(\exp(-\alpha \cdot t) \cdot \beta - \exp(-\beta \cdot t) \cdot \alpha)}{(\beta \cdot (\beta - \alpha))} + \dfrac{1}{\beta}\right]$ Expression for calculating dose using exhaust clearing

$\text{Dosen}(t) := K \cdot \text{Rn}(t)$ Expression for calculating dose with no clearing (see definition of Rn(t) above



Graphic of variation in dose with and without clearing as a function of exposure time.

Data for Bay No. 1, 1,000 Curie release

$\text{Curie} = 1 \cdot 10^9$ Microcurie Release

Data for Exhaust On Exposure	Data for No Exhaust Exposure	
$\text{Dose}(8 \cdot \text{hr}) = 14.901 \cdot \text{rem}$	$\text{Dosen}(8 \cdot \text{hr}) = 386.369 \cdot \text{rem}$	Eight hour exposure

Dose after elapsed time

$\text{Dose}(1 \cdot \text{min}) = 0.03 \cdot \text{rem}$	$\text{Dosen}(1 \cdot \text{min}) = 0.031 \cdot \text{rem}$
$\text{Dose}(5 \cdot \text{min}) = 0.639 \cdot \text{rem}$	$\text{Dosen}(5 \cdot \text{min}) = 0.701 \cdot \text{rem}$
$\text{Dose}(30 \cdot \text{min}) = 8.613 \cdot \text{rem}$	$\text{Dosen}(30 \cdot \text{min}) = 15.12 \cdot \text{rem}$

Constants:

$\text{VolRoom} = 2.423 \cdot 10^6 \cdot \text{liter}$	Volume of room
$\text{Rvent} = 9.2 \cdot \text{min}$	Ventilation Exchange Rate
$\beta^{-1} = 18.01 \cdot \text{min}$	Characteristic Clearing Time

MMSC-HA-94152

MARTIN MARIETTA
SPECIALTY COMPONENTS, INC.

MARTIN MARIETTA

HAZARDS ASSESSMENT - WASTE MANAGEMENT

January 19, 1995

Martin Marietta Specialty Components, Inc., is the Management and Operating Contractor for the Pinellas Plant Under U. S. Department of Energy Contract No. DE–AC04–92AL73000.

Title: Hazards Assessment - Waste Management

Number: MMSC-HA-94152

Issue Date: January 23, 1995

DOCUMENT CONTROL

This document will be maintained by Technical Support in accordance with the site-wide document control procedures. Document control elements include unique issue numbers, document identification, numbered pages, document distribution records, tracking of revisions, a document MASTER filing and retrieval system, and a document archiving system.

The Pinellas Plant
P.O. Box 2908
Largo, Florida 34649-2908

Martin Marietta Specialty Components, Inc., is the Management and Operating Contractor for the Pinellas Plant Under U.S. Department of Energy Contract No. DE-AC04-92AL73000.

This page left blank intentionally.

TABLE OF CONTENTS

Listing of Tables

Listing of Appendices

This page left blank intentionally.

1.0 INTRODUCTION

This report documents the hazards assessment for the Waste Management operations in Buildings 1000 and 1040, located at the Department of Energy (DOE) Pinellas Plant. The Pinellas Plant is operated by Martin Marietta Specialty Components, Inc., (Specialty Components).

The hazards assessment was conducted in accordance with DOE Headquarters guidance to fulfill DOE Order 5500.3A requirements. The facility-specific hazards assessment provides the technical basis for facility emergency planning efforts.

The introductory facility and hazards information required for this assessment is documented in the Safety Assessment - Waste Management. Table 1 cross-references the introductory Hazard Assessment Sections (as defined in the Emergency Planning Guide) with the pertinent section in the Safety Assessment. To avoid redundancy and to facilitate document control, the introductory sections are only referenced and not repeated in this document.

Table 1. Safety Assessment Cross Reference

Description	Section in Safety Assessment	Description
Site Description	3	*Site Description and Assessment*
Facility Description	4	*Description of Facility*
Facility Operations	5	*Description of Operations*
Hazard Characterization	5, 6	*Hazards and barriers are described in detail in Section 5, Description of Operations. Section 6, Accident Assessment, contains additional hazard information.*
Event Scenarios	6	*Accident Assessment*

2.0 EVENT CONSEQUENCES

2.1 Definitions

The following definitions serve to familiarize the reader with the terminology used in the Hazard Assessment:

Emergency Response Planning Guidelines

Emergency Response Planning Guide (ERPG) values are concentration levels above which one could reasonably anticipate observing adverse effects as described in the definitions for ERPG-1, ERPG-2, and ERPG-3. The American

Industrial Hygiene Association publishes ERPG values for several common industrial chemicals. The three levels are defined as follows (in order of increasing severity):

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

ERPG-2: 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 which could impair an individual's ability to take protective action.

ERPG-3: 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.

Protective Action Guidelines

The consequence thresholds for radiological exposures are published by the U.S. Environmental Protection Agency. Protective Action Guides (PAGs) serve the same function as ERPG values, but PAGs are used for radiological releases only.

Emergency Planning Zone

The Emergency Planning Zone (EPZ) is defined as the area surrounding a facility for which special planning and preparedness efforts are required to ensure that prompt and effective protective actions can be taken to minimize the risk to workers, the general public, and the environment. The EPZ is strictly defined as the radius containing the ERPG-3 or PAG value. The EPZ is normally chosen to conform to jurisdictional or geographic boundaries, such as a site boundary.

Emergency Classes

Emergency classes, specified in DOE 5500.2B, are defined as follows, listed in order of increasing severity: Alert, Site Area Emergency (SAE), and General Emergency (GE). An Alert shall be declared when "any release of hazardous materials (radiological or nonradiological) is expected to be limited to small fractions of the appropriate PAG or ERPG exposure levels." A SAE shall be declared when "any release of hazardous materials (radiological or nonradiological) is expected to exceed appropriate PAG or ERPG exposure levels on site, but not expected to exceed the appropriate PAG or ERPGs off site." A GE shall be declared when a "release of hazardous materials (radiological or nonradiological) that can reasonably be expected to exceed appropriate PAG or ERPG exposure levels off site" has occurred. References to "ERPG" values indicate ERPG-2 levels.

Protective Actions

Protective Actions are specific, predetermined actions to be taken in response to emergency conditions to protect on-site personnel and the public.

Emergency Action Levels

The specific criteria used to recognize and categorize an event; i.e., instrument readings, equipment status, valve positions, monitor readings, and visual observations. The emergency action level (EAL) forms the basis for notification and participation of off-site organizations and for determining what and when protective measures will be implemented.

Boundaries, Facility and Site

The **Facility Boundary** is defined as the physical limits (structural or geographical) containing a process. This boundary should include all buildings, structures, support equipment, and auxiliary systems that support a common mission. In most cases, this boundary will have been previously defined by a security boundary or a fence.

The **Site Boundary** for the Pinellas Plant is defined as the boundary formed by the security fence surrounding the property, with the exception of the entrances to the plant, where the boundary is defined as a line continuing across the opening to where the fence continues in the original direction.

2.2 Declarations

The following declarations provide specific qualitative or quantitative levels used in this Hazards Assessment.

2.2.1 Exposure Thresholds

This hazards assessment analyzes several scenarios involving the atmospheric release of hazardous chemicals. Table 2 lists the ERPG-2 values for these chemicals. Where ERPG levels have not been determined for a particular chemical, a calculated ERPG-2 equivalent, using the TWA (Timo Weighted Average), is used as a substitute.

Table 2. Exposure Thresholds

CHEMICAL	ERPG-2 Level (or equivalent)
Methylene Chloride (CH_2Cl_2)	2500 ppm (5 x TWA)*
Phosgene	0.2 ppm

*TWA: *similar* to ERPG-1.

2.2.2 Facility Boundary

This *facility* includes Buildings 1000, 1010, 1040, and the Scrap Metal Storage Area, as well as the areas between each of these buildings. The Facility Boundary is defined as a rectangle containing only these four areas and the included property.

2.3 Event Consequences

The scenario descriptions of Section 6 of the Safety Assessment include the consequences of those events. Table 3 lists each event and the section number of the Safety Assessment in which it is found. The Safety Assessment thoroughly considers each possible failure mode. Modeling of chemical releases is included in the appendices of the Safety Assessment.

The Emergency Class is defined for each scenario. Table 3 summarizes the emergency classes for the defined scenarios.

Table 3. Hazardous Events

Event	Section Number in Safety Assessment
Toxic Waste Release	6.3.3
Lab Pack Liquid Waste Release	6.3.4
On-Site Hazardous Waste Transportation Accident	6.3.5

EVENT NO. 1: TOXIC WASTE RELEASE ACCIDENT

This event is described in Section 6.3.3 of the Safety Assessment.

Methylene chloride was determined to be the most hazardous chemical stored in Bay No. 1 of Building 1040, and it was therefore used as the material of release in each of the following scenarios:

Rupture of Four 55-Gallon Drums Inside Building 1040, Bay No. 1

This scenario postulates the rupture of four 55-gallon drums inside Bay No. 1 of Building 1040. From the analysis in Appendix E of the Safety Assessment, the calculated ERPG-2 value of 2500 ppm would be exceeded within the building approximately 30 seconds after the spill.

The airborne concentrations outside the building would exceed the calculated ERPG-2 level within two minutes, assuming the bay doors are open. From the Epicode data listed in Appendix A of this document, the calculated ERPG-2 level, 2500 ppm, would be present 60 meters from the spill area.

Since the ERPG-2 level is exceeded outside the Facility Boundary, but not outside the Site Boundary, this scenario is given an emergency class of SAE.

Rupture of the 5,000-Gallon Bulk Liquid Waste Storage Tank, No Fire

This scenario postulates that the entire inventory of liquid waste in the bulk liquid waste storage tank is released into the concrete containment dike. It is analyzed in Appendix D of the Safety Assessment. At the time of the writing of this document the 5,000-gallon storage tank stands empty. The permit for its use, however, remains active.

In the case of a release of 5,000 gallons of methylene chloride to the dike, ERPG-2 levels would be exceeded within the Facility Boundaries. According to data produced by analysis using Epicode (included in Appendix A), this level will not be exceeded outside the Facility Boundaries due to the limited surface area of the spill (the dike confines a spill area to 22 square meters). Thus, though the amount spilled is much greater than the previous scenario of four 55-gallon drums, the consequences are not as great since the four-drum spill spread to an area of 50 square meters.

Since the ERPG-2 level is not exceeded outside the Facility Boundary, this scenario is given an emergency class of Alert.

Rupture of the 5,000-Gallon Bulk Liquid Waste Storage Tank, With Fire

This scenario postulates that the entire inventory of liquid waste in the bulk liquid waste storage tank is released into the concrete containment dike and ignited. The burning methylene chloride vapors decompose to form phosgene, which is dispersed in the heat stack created by the fire.

The dispersion of phosgene is analyzed in Appendix D of the Safety Assessment. Epicode output data is listed in Appendix A of this document. Results indicate that the maximum phosgene concentration with a wind of 1 meter/sec. is 0.092 ppm at a distance of 300 meters from the 5,000-gallon tank. This is well below the ERPG-2 level of 0.2 ppm. Assuming a wind speed of 6 meters/sec., the airborne concentrations found from 60 to 180 meters from the tank exceed the ERPG-2 level, with the maximum concentration of 0.26 ppm at 85 meters from the tank.

The Child Development Center is located 485 meters from the tank. The maximum airborne concentration found at this distance is 0.12 ppm for the 6 meters/sec. condition. This represents a safe level for the short duration of the postulated accident.

The concentration at the Site Boundary, 200 meters from the tank, is 0.19, which is below the ERPG-2 level. Therefore, this scenario is given an emergency class of SAE.

EVENT NO. 2: LAB-PACK LIQUID WASTE RELEASE

This event is described in Section 6.3.4 of the Safety Assessment. Appendix E of the Safety Assessment models a spill of 55 gallons of methylene chloride in Bay No. 3 of Building 1040. This amount is the maximum amount of chemicals that can be stored on a rack. The rack is assumed to fall to the floor, thus releasing its entire inventory. Methylene chloride is used in this scenario since it is the most hazardous material present.

According to the analysis, the calculated ERPG-2 level for methylene chloride is exceeded within 30 seconds, with the final airborne concentration in the room leveling off at 21,000 ppm.

The output data from analysis using Epicode is included in Appendix A of this document. This analysis shows that airborne concentrations outside the Facility Boundary do not exceed the ERPG-2 level of 2500 ppm. Since the ERPG-2 level is not exceeded beyond the Facility Boundary, this scenario is given an emergency class of Alert.

EVENT NO. 3: ON-SITE HAZARDOUS WASTE TRANSPORTATION ACCIDENT

This event is described in Section 6.3.5 of the Safety Assessment. Appendix D of the Safety Assessment models both a large spill from the rupture of a tank truck (5,000 gallons) and a small spill from a plant chemical transport (250 gallons) of methylene chloride.

Release of 5,000 Gallons of Methylene Chloride, Belcher Gate

Analysis of a 5,000-gallon tank truck release at the Belcher Gate indicates that airborne concentrations exceeding the ERPG-2 level would be found 450 meters from the spill, well beyond the Site Boundary. The concentration at the Child Development Center would be 8100 ppm (assuming the wind is in the direction of the school).

Since the ERPG-2 level is exceeded outside the Site Boundary, this scenario is given an emergency class of GE.

Release of 250 Gallons of Methylene Chloride, Building 100 Receiving Area

Analysis of a 250-gallon spill from the hazardous waste chemical transport at the Building 100 Receiving Area indicates that although concentrations local to the transport exceed the ERPG-2 level, concentrations at the Child Development Center do not exceed the ERPG-2 level.

Since concentrations exceeding the ERPG-2 level are not confined to the Facility Boundary (the spill does not occur in the facility), yet levels at the Site Boundary do not exceed this level, this scenario is given an emergency class of SAE.

Table 4. Emergency Classes for Accident Scenarios

Event	Scenario	Distance to ERPG-2* Radius (Meters)	Emergency Class
Toxic Waste Accident	Rupture of four drums in Building 1040, Bay 1	60	SAE
	Rupture of 5,000 gallon liquid waste tank, NO FIRE	<10	Alert
	Rupture of 5,000 gallon liquid waste tank, WITH FIRE	180	SAE
Lab-Pack Liquid Waste Release	Rack Falls and releases 55 gallons methylene chloride	<10	Alert
On-Site Hazardous Waste Transport Accident	Release of 5,000 gallons of methylene chloride from tank truck, at Belcher Gate	450	General
	Release of 250 gallons of methylene chloride from chemical transport, at Receiving Area	<100	SAE

* Or *calculated* ERPG-2 level

3.0 EMERGENCY PLANNING ZONE

3.1 Minimum EPZ Radius

In accordance with DOE Headquarters guidance, the results of the consequence analysis are used to develop a proposed EPZ for Waste Management. As demonstrated in Section 2, the highest facility emergency class is GE.

The purpose of the EPZ is to provide an area for planning and executing actions in response to an incident. This area must be large enough to encompass the area of contamination and a buffer area in which emergency crews and command may establish a staging area. The EPZ boundary for an incident involving a Waste Management operation, based on the truck spill, is defined as a circle of radius equal to 380 meters, with its center at the Belcher Gate. This area is sufficient to establish and coordinate emergency response actions for any of the postulated scenarios.

3.2 Tests of Reasonableness

1. Are the maximum distances to the ERPG-2 level impacts for most of the analyzed accident scenarios equal to or less than the EPZ radius selected?

   The hazards associated with an atmospheric release of the most severe accident postulated are entirely contained within the defined EPZ.

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

   There are no constraints limiting the enlargement of the EPZ to allow for a greater response planning and preparedness area.

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

   The contaminated area from an airborne release is typically ellipsoidal and extends in only one direction from the source. Since the EPZ is defined as a circular area around the source, most of its area is well out of the path of the plume travel. Thus, the EPZ contains sufficient area for response activities required for the events listed in Section 2.

4. What enhancement of the facility and site preparedness stature would be achieved by increasing the selected EPZ radius?

   Since the effects of all scenarios, in their worst-case simulations, are contained within the EPZ, there would be no advantage in enlarging it.

4.0 EMERGENCY CLASSES, EMERGENCY ACTION LEVELS AND PROTECTIVE ACTIONS

4.1 Emergency Action Levels

Table 5 describes the EALs (indicators which trigger emergency actions) for each event. Spills can occur in various amounts, with consequences varying accordingly. It is, therefore, always important to assess each situation carefully and use these EALs/Emergency Classes as guides, as they sometimes may not be appropriate for the less serious occurrences of each event.

Table 5. Emergency Action Levels

EAL	As Indicated By	Emergency Class
Rupture of four drums of methylene chloride in Building 1040	Direct Observation	SAE
Rupture of 5,000-gallon liquid waste storage tank, NO FIRE	Direct Observation	Alert
Rupture of 5,000-gallon liquid waste storage tank, WITH FIRE	Direct Observation	SAE
Release due to rank falling to Building 1040, Bay No. 3	Direct Observation	Alert
Rupture of loaded hazardous waste tank truck at Belcher Gate	Direct Observation	GE
Release of 250 gallons of chemical from chemical transport	Direct Observation	SAE

4.2 Protective Actions

All Chemical Spills: In the event of a large spill of any chemical whose vapor pressure is sufficient to create an airborne hazard which could jeopardize the health of plant personnel or the public (such as methylene chloride), the HAZMAT (Hazardous Material) Team could utilize acid-compatible vapor suppressing foam to blanket the spill and minimize the airborne release.

When the chemical has been spilled inside a building, immediate evacuation is warranted, as life-threatening levels can occur within minutes. To slow the release of chemical outside the building, the bay doors should be shut immediately after the spill.

Evacuation of areas surrounding a spill, whether inside a building or outside, could be necessary, depending on the size of the spill. The levels set forth in the EALs, as well as the results in the Consequences section, Table 4, should be used as guides in predicting the consequences of any spill and determining the size of the evacuation area. Since the distance to ERPG-2 levels given in Table 4 are the results of worst-case scenarios, these levels can immediately be used as conservative evacuation radii until the exact severity of the accident is determined.

When atmospheric releases threaten the Child Development Center, shelter-in-place procedures should be taken to avoid contact with the plume. These procedures have already been developed for the school.

5.0 MAINTENANCE AND REVIEW OF THIS HAZARDS ASSESSMENT

The Manager, Emergency Management shall ensure a periodic review of the Hazards Assessment is performed. 29 CFR 1910.119 (e)(6) requires that hazard assessments to be updated and revalidated at least once every five (5) years. **Thus, this document will require a full review by April 1999.**

The Manager, Risk and Emergency Management shall be responsible for maintaining all Hazard Assessments and ensuring that they are current.

6.0 REFERENCES

MMSC-SA-94132, Safety Assessment - Building 600, March 1994.

DOE 5500.3A, Planning and Preparedness for Operational Emergencies, revised February 27, 1992.

DOE 5500.2B, Emergency Categories, Classes, and Notification and Reporting Requirements, February 27 1992.

DOE Emergency Management Guide, Guidance for Hazards Assessment, June 26, 1992.

American Industrial Hygiene Association, Emergency Response Planning Guide, March 1989.

7.0 DISTRIBUTION

DOE

R. Glass	MS 015 (2 Copies)
G. Schmidtke	MS 015
OSTI (2)	

Pinellas Plant

D. Corbett	MS 040
D. Delaneuville	MS 001
J. Fox	MS 012
K. Hall	MS 012
E. Hand	MS 040
D. Hopkins	MS 001
J. Kroll	MS 040
T. Ramsay	MS 040
P. Sacco	MS 050
Record Management (MASTER)	MS 002

APPENDIX A

EPICODE OUTPUT DATA

This page left blank intentionally.

OUTPUT FROM EPICODE

220-Gallon Spill Inside Bay No. 1, Building 1040

Release Height: 1 Meter

Temperature: 32 Celcius

Surface Area: 50 Meters^2

Methylene Chloride		CAS Number: [75-09-2]		Lib-92	
TWA: 50 ppm		TWA: 174 mg/m^3		EPIcode 5.0 4/14/94 9:17	
IDLH: 5000 ppm					
Downwind		Concentration		Arrival Time	
X-km	Y-km	mg/m^3	ppm	Hours:Minutes	Stability Class
0.01	0.000	7500	2200	0:00	D
0.02	0.000	6200	1800	0:00	E
0.03	0.000	6400	1800	0:01	E
0.04	0.000	5400	1600	0:01	F
0.05	0.000	5800	1700	0:01	F
0.10	0.000	3700	1100	0:02	F
0.20	0.000	1500	430	0:03	F
0.30	0.000	780	230	0:05	F
0.40	0.000	490	140	0:07	F
0.50	0.000	330	96	0:08	F
1.00	0.000	100	29	0:17	F

OUTPUT FROM EPICODE

5,000-Gallon Spill Into Dike

Release Height: 1 Meter

Temperature: 32 Celcius

Surface Area: 20 meters ^ 2

Methylene Chloride		CAS Number: [75-09-2]		Lib-92	
TWA: 50 ppm		TWA: 174 mg/m ^ 3		EPIcode 5.0 4/14/94 9:10	
IDLH: 5000 ppm					
Downwind		Concentration		Arrival Time	
X-km	Y-km	mg/m ^ 3	ppm	Hours:Minutes	Stability Class
0.01	0.000	4100	1200	0:00	C
0.02	0.000	3400	970	0:00	D
0.03	0.000	3400	980	0:01	E
0.04	0.000	2900	820	0:01	E
0.05	0.000	3100	880	0:01	F
0.10	0.000	1800	530	0:02	F
0.50	0.000	140	41	0:08	F
1.00	0.000	42	12	0:17	F

OUTPUT FROM EPICODE

7.15-Gallon Phosgene Release, Windspeed = 1 Meter/Second

Windspeed: 1 Meter/Sec

Release Height: 95 Meters

Phosgene		CAS Number: [75-44-5]		Lib-92	
TWA: 10 ppm		TWA: 0.40 mg/m^3		EPIcode 5.0 4/14/94 9:52	
ERPG-2:0.200 ppm ERPG-3: 1 ppm					
Downwind		Maximum Concentration		Arrival Time	
X-km	Y-km	mg/m^3	ppm	Hours:Minutes	Stability Class
0.10	0.000	1.5E-04	3.6E-05	0:00	A
0.20	0.000	0.17	0.043	0:00	A
0.30	0.000	0.37	0.091	0:01	A
0.40	0.000	0.36	0.089	0:01	A
0.50	0.000	0.31	0.076	0:01	B
1.00	0.000	0.25	0.062	0:02	C
2.00	0.000	0.13	0.032	0:04	C

OUTPUT FROM EPICODE

7.15-Gallon Phosgene Release, Windspeed = 6 Meters/Second

Windspeed: 6 Meter/Sec

Release Height: 24 Meters

Phosgene		CAS Number: [75-44-5]		Lib-92	
TWA: 0.10 ppm		TWA: 0.40 mg/m^3		EPIcode 5.0 4/14/94 10:01	
ERPG-2:0.200 ppm ERPG-3: 1 ppm					
Downwind		Concentration		Arrival Time	
X-km	Y-km	mg/m^3	ppm	Hours:Minutes	Stability Class
0.03	0.000	0.0079	0.0019	0.00	A
0.04	0.000	0.15	0.036	0.00	A
0.05	0.000	0.47	0.12	0:00	A
0.06	0.000	0.79	0.20	0:00	A
0.07	0.000	1.0	0.24	0:00	A
0.08	0.000	1.1	0.26	0:00	A
0.09	0.000	1.1	0.26	0:00	A
0.10	0.000	1.0	0.25	0:00	A
0.20	0.000	0.78	0.19	0:00	C
0.30	0.000	0.67	0.16	0:00	C

OUTPUT FROM EPICODE

55-Gallon Spill in Bay No. 3, Building 1040

Release Height: 1 Meter

Temperature: 32 Celcius

Surface Area: 10 meters^2

Methylene Chloride		CAS Number: [75-09-2]		Lib-92	
TWA: 50 ppm		TWA: 174 mg/m^3		EPIcode 5.0 4/14/94 10:36	
IDLH: 5000 ppm					
Downwind		Concentration		Arrival Time	
X-km	Y-km	mg/m^3	ppm	Hours:Minutes	Stability Class
0.01	0.000	2600	740	0:00	C
0.02	0.000	2100	600	0:00	D
0.03	0.000	2100	590	0:01	E
0.50	0.000	73	21	0:08	F
1.00	0.000	22	6.2	0:17	F

This page left blank intentionally.

OUTPUT FROM EPICODE

220 Gallon Spill inside Bay No. 1, Building 1040

Release Height: 1 meter
Temperature: 32 Celcius
Surface Area: 50 meters^2

METHYLENE CHLORIDE CAS Number: [75-09-2] Lib-92
TWA : 50 ppm TWA : 174 mg/m^3 EPIcode 5.0 4-14-1994 9:17
IDLH : 5000 ppm

DOWNWIND		CONCENTRATION		ARRIVAL TIME	Stability
X-km	Y-km	mg/m^3	ppm	hours:minutes	Class
0.01	0.000	7500	2200	0:00	D
0.02	0.000	6200	1800	0:00	E
0.03	0.000	6400	1800	0:01	E
0.04	0.000	5400	1600	0:01	F
0.05	0.000	5800	1700	0:01	F
0.10	0.000	3700	1100	0:02	F
0.20	0.000	1500	430	0:03	F
0.30	0.000	780	230	0:05	F
0.40	0.000	490	140	0:07	F
0.50	0.000	330	96	0:08	F
1.00	0.000	100	29	0:17	F

OUTPUT FROM EPICODE

5,000 Gallon Spill into Dike

Release Height: 1 meter
Temperature: 32 Celcius
Surface Area: 20 meters^2

METHYLENE CHLORIDE CAS Number: [75-09-2] Lib-92
TWA : 50 ppm TWA : 174 mg/m^3 EPIcode 5.0 4-14-1994 9:10
IDLH : 5000 ppm

DOWNWIND		CONCENTRATION		ARRIVAL TIME	Stability
X-km	Y-km	mg/m^3	ppm	hours:minutes	Class
0.01	0.000	4100	1200	0:00	C
0.02	0.000	3400	970	0:00	D
0.03	0.000	3400	980	0:01	E
0.04	0.000	2900	820	0:01	E
0.05	0.000	3100	880	0:01	F
0.10	0.000	1800	530	0:02	F
0.50	0.000	140	41	0:08	F
1.00	0.000	42	12	0:17	F

OUTPUT FROM EPICODE

7.15 Gallon Phosgene Release, Windspeed = 1 Meter/Second

Windspeed: 1 meter/sec

Release Height: 95 meters

PHOSGENE CAS Number: [75-44-5] Lib-92

TWA : 0.10 ppm TWA : 0.40 mg/m^3 EPIcode 5.0 4-14-1994 9:52

ERPG-2:0.200 ppm ERPG-3: 1 ppm

DOWNWIND		MAXIMUM CONCENTRATION		ARRIVAL TIME	Stability
X-km	Y-km	mg/m^3	ppm	hours:minutes	Class
0.10	0.000	1.5E-04	3.6E-05	0:00	A
0.20	0.000	0.17	0.043	0:00	A
0.30	0.000	0.37	0.091	0:01	A
0.40	0.000	0.36	0.089	0:01	A
0.50	0.000	0.31	0.076	0:01	B
1.00	0.000	0.25	0.062	0:02	C
2.00	0.000	0.13	0.032	0:04	C

OUTPUT FROM EPICODE

7.15 Gallon Phosgene Release, Windspeed = 6 Meters/Second

Windspeed: 6 meter/sec
Release Height: 24 meters

PHOSGENE CAS Number: [75–44–5] Lib–92
TWA : 0.10 ppm TWA : 0.40 mg/m^3 EPIcode 5.0 4–14–1994 10:01
ERPG-2:0.200 ppm ERPG-3: 1 ppm

DOWNWIND		MAXIMUM CONCENTRATION		ARRIVAL TIME	Stability
X–km	Y–km	mg/m^3	ppm	hours:minutes	Class
0.03	0.000	0.0079	0.0019	0:00	A
0.04	0.000	0.15	0.036	0:00	A
0.05	0.000	0.47	0.12	0:00	A
0.06	0.000	0.79	0.20	0:00	A
0.07	0.000	1.0	0.24	0:00	A
0.08	0.000	1.1	0.26	0:00	A
0.09	0.000	1.1	0.26	0:00	A
0.10	0.000	1.0	0.25	0:00	A
0.20	0.000	0.78	0.19	0:00	C
0.30	0.000	0.67	0.16	0:00	C

OUTPUT FROM EPICODE

55–Gallon Spill in Bay No. 3, Building 1040

Release Height: 1 meter
Temperature: 32 Celcius
Surface Area: 10 meters^2

METHYLENE CHLORIDE CAS Number: [75–09–2] Lib–92
TWA : 50 ppm TWA : 174 mg/m^3 EPIcode 5.0 4–14–1994 10:36
IDLH : 5000 ppm

DOWNWIND		CONCENTRATION		ARRIVAL TIME	Stability
X–km	Y–km	mg/m^3	ppm	hours:minutes	Class
0.01	0.000	2600	740	0:00	C
0.02	0.000	2100	600	0:00	D
0.03	0.000	2100	590	0:01	E
0.50	0.000	73	21	0:08	F
1.00	0.000	22	6.2	0:17	F