

ENCLOSURE 3

PROBABILITY OF TOXIC GAS HAZARD

TRUCK ACCIDENTS

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TRUCK ACCIDENT ANALYSIS

OVERVIEW

- ANALYTICAL APPROACH
 - PROBABILISTIC
 - PLUME DISPERSION
 - SOURCE TERM ESTIMATES
- EVALUATE FREQUENCY
- DATA SOURCES
- MATERIALS CONSIDERED
- INPUT DATA
 - PROBABILITIES
 - SOURCE TERMS
- RESULTS
- CONCLUSIONS
- CONSERVATISMS

ANALYSIS BASIS

- FREQUENCY OF UNACCEPTABLE CONCENTRATION
- FOR EACH POTENTIALLY SIGNIFICANT TOXIC SUBSTANCE (FSAR 6.4.4.2)
- SIGNIFICANT HAZARD IS GREATER THAN 10^{-7} /YEAR (SRP 2.2.3, REALISTIC)
- PASQUILL F WEATHER STABILITY AT ALL TIMES (REGULATORY GUIDE 1.78)
- A GAUSSIAN PLUME MODEL WITH CORRECTION FOR DENSITY
- TOXICITY DATA, SHIPMENT FREQUENCY AND SHIPMENT SIZE DATA FROM DAMES AND MOORE

CONSISTENT WITH PAST ANALYSES
AND REGULATORY GUIDELINES

POTENTIALLY HAZARDOUS MATERIALS EVALUATED
USING PROBABILISTIC METHODOLOGY

- CHLORINE
- AMMONIA (ANHYDROUS)
- BUTANE
- PROPANE
- CARBON DIOXIDE
- METHYL BROMIDE
- VIKANE
- GASOLINE
- JET FUEL (JP4/JP5)
- DIESEL FUEL
- BENZENE
- FORMALDEHYDE
- MURIATIC ACID (BULK)
- METHYL ETHYL KETONE
- ETHYLENE DICHLORIDE
- BUTYL ACETATE
- DIACETONE
- HYDROCARBON DISTILLATE
- METHANOL
- METHYL BUTYL KETONE
- NAPTHALENE
- PENTACHLOROPHENOL
- XYLENE
- METHYLENE CHLORIDE
- HYDROCHLORIC ACID
- SULFURIC ACID

COMPONENTS OF QUANTIFICATION METHODOLOGY

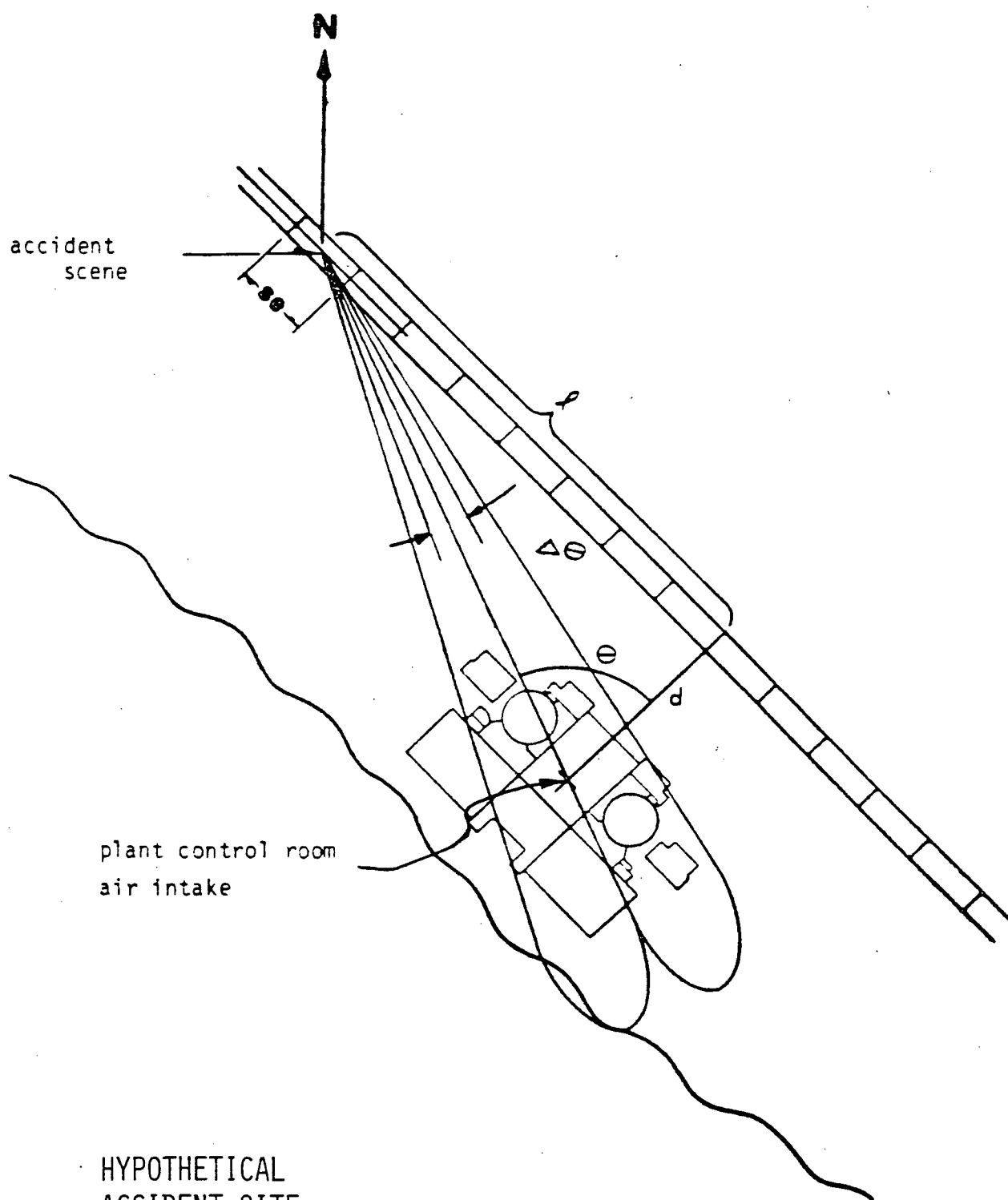
- LIKELIHOOD OF TOXIC SOURCE
 - TRUCKS PASSING PLANT D & M
 - ACCIDENT OCCURENCE RATE ACCEPTED
 - LIKELIHOOD OF COMPLETE SPILL CONSIDERED
- LIKELIHOOD OF TOXIC HAZARD, GIVEN A SOURCE
 - DISPERSION GAUSSIAN
 - WIND DIRECTION AND SPEED FSAR
 - BUOYANCY CONSIDERED
 - PASQUILL CONDITION REG. GUIDE 1.78
 - CLOUD DURATION REG. GUIDE 1.78

HAZARD EXPOSURE DATA

CHEMICAL NAME	Q, GALLONS	ANNUAL SHIPMENTS	DESCRIPTION
GASOLINE	4500	17,000	LIQUID
DIESEL OIL	4500	650	LIQUID
JET FUEL	4500	910	LIQUID
DIACETONE	2600	43	LIQUID
XYLENE	3750	24	LIQUID
SHELL SOL M-75	2000	43	LIQUID
METHANOL	2000	18	LIQUID
MS-20-H (NAPHTHALENE)	4000	43	LIQUID
PENTACHLOROPHENOL	2000	43	LIQUID
BENZENE	50	43	LIQUID
FORMALDEHYDE	6000	14	LIQUID
METHYL-BUTYL-KETONE	2000	43	LIQUID
METHYLENE CHLORIDE	2000	43	LIQUID
METHYL ETHYL KETONE	2000	43	LIQUID
ETHYLENE DICHLORIDE	1000	43	LIQUID
BUTYL ACETATE	2000	43	LIQUID
BUTANE	8485	2,200	LIQUIFIED GAS
PROPANE	8485	2,200	LIQUIFIED GAS
CO ₂	1500	260	LIQUIFIED GAS
CHLORINE	153	754	LIQUIFIED GAS
ANHYDROUS AMMONIA	2950	108	LIQUIFIED GAS
METHYL BROMIDE	125	48	LIQUIFIED GAS
VIKANE	10.7	43	LIQUIFIED GAS
HYDROCHLORIC ACID	4600	133	LIQUID
SULFURIC ACID	6000	130	LIQUID
MURIATIC ACID	5000	43	LIQUID

TOXICITY LIMITS

CHEMICAL NAME	Q, GALLONS	$X_{TL}, \text{MG/M}^3$	ANNUAL SHIPMENTS	DESCRIPTION
GASOLINE	4500	4000	17,000	LIQUID
DIESEL OIL	4500	1355	650	LIQUID
JET FUEL	4500	1000	910	LIQUID
DIACETONE	2600	360	43	LIQUID
XYLENE	3750	655	24	LIQUID
SHELL SOL M-75	2000	750	43	LIQUID
METHANOL	2000	310	18	LIQUID
MS-20-H (NAPHTHALENE)	4000	75	43	LIQUID
PENTACHLOROPHENOL	2000	1.5	43	LIQUID
BENZENE	50	30	43	LIQUID
FORMALDEHYDE	6000	3	14	LIQUID
METHYL-BUTYL-KETONE	2000	150	43	LIQUID
METHYLENE CHLORIDE	2000	900	43	LIQUID
METHYL ETHYL KETONE	2000	740	43	LIQUID
ETHYLENE DICHLORIDE	1000	300	43	LIQUID
BUTYL ACETATE	2000	950	43	LIQUID
BUTANE	8485	1750	2,200	LIQUIFIED GAS
PROPANE	8485	1750	2,200	LIQUIFIED GAS
CO ₂	1500	87400	260	LIQUIFIED GAS
CHLORINE	153	43	754	LIQUIFIED GAS
ANHYDROUS AMMONIA	2950	27	108	LIQUIFIED GAS
METHYL BROMIDE	125	60	48	LIQUIFIED GAS
VIKANE	10.7	40	43	LIQUIFIED GAS
HYDROCHLORIC ACID	4600	7	133	LIQUID
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MURIATIC ACID	5000	10	43	LIQUID



HYPOTHETICAL
ACCIDENT SITE
GEOMETRY

METHODOLOGY

$$\begin{array}{ccccc} \text{PROBABILITY} & & \text{PROBABILITY} & & \text{PROBABILITY} \\ \text{OF} & & \text{OF} & & \text{OF} \\ \text{TOXIC HAZARD} & = & \text{SPILL} & \times & \text{SPILL REACHING PLANT} \end{array}$$

SUMMATION PROCESS USED:

$$P(x > x_M) = \sum_{\ell} \sum_Q \sum_P \sum_{\phi + \bar{U}} P_{\ell} P_Q P_P P_{\phi \bar{U}}$$

P_{ℓ} = ACCIDENT OCCURS IN SEGMENT OF HIGHWAY

P_Q = QUANTITY Q IS RELEASED IN ACCIDENT

P_P = PASQUILL CONDITION

$P_{\phi \bar{U}}$ = WIND BLOWING AT PLANT @ SPEED SUFFICIENT FOR PLUME TO REACH PLANT

PLUME MODEL

- GAUSSIAN PLUME
- GROUND LEVEL CONCENTRATION AND DOSE ESTIMATES
- PUFF RELEASE "DOSE" @ GROUND LEVEL AS WELL AS CONTINUOUS RELEASE CONCENTRATION DETERMINED
- σ_y FOR PASQUILL F USED
- BUOYANCY INCLUDED
- CONSISTENT WITH NRC PLUME MODEL AS PER REG. GUIDE 1.78

STANDARD TREATMENT PER REGULATORY GUIDELINES
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SOURCE TERMS

- CONTINUOUS SOURCES
 - EVAPORATIVE, LIQUIDS @ LESS THAN B.P.
 - BOILING, LIQUIDS @ GREATER THAN B.P.
- "PUFF" SOURCE
 - FLASHING, LIQUIDS @ GREATER THAN B.P.,
INITIAL CLOUD
- STANDARD FORCED CONVECTION FROM POOL MODELS USED FOR
EVAPORATIVE AND BOILING SOURCES
- FOR LIQUIDS @ GREATER THAN B.P., BOILING AND FLASH
CONTRIBUTIONS TO TOXIC HAZARD ARE SUMMED
- TOTAL QUANTITY OF SHIPMENT AVAILABLE FOR RELEASE SOURCE

PLUME MODEL INPUT DATA

Substance	Release Type(s) Expected	Source Terms				$x[\text{mg}/\text{m}^3]$	Frequency of Shipments[1/yr]
		Flash		Boil	Evap.		
		f	$Q_{fa}[\text{mg}]$ (1)	$Q_b[\text{mg}/\text{sec}]$	$Q_e[\text{mg}/\text{sec}]$		
Butane	F+B (2)	0.118	1.9×10^{10}	1.7×10^6		1750	2200
Carbon Dioxide	F+B	0.294	9.9×10^9	3.4×10^6		87400	260
Chlorine	F+B	0.175	9.0×10^8	1.3×10^6		43	754
Ammonia	F+B	0.152	7.5×10^9	5.9×10^6		27	108
Methyl Bromide	F+B	0.059	8.2×10^8	5.8×10^5		60	48
Vikane	F+B	0.62	9.1×10^7	3.8×10^4		40	43
Propane	F+B	0.33	1.6×10^{10}	3.7×10^6		1750	2200
Gasoline	E				1.6×10^7	4000	17,000
Jet Fuel	E				4.8×10^6	1355	910
Benzene	E				9.8×10^4	30	430
Formaldehyde	E				1.9×10^6	3	14
Hydrochloric Acid	E				1.0×10^5	7	43
Muriatic Acid	E				1.6×10^5	7	43
Methyl Ethyl-ketone	E				1.5×10^6	740	43
Ethylene Dichloride	E				5.1×10^6	300	43
Butyl acetate	E				4.9×10^5	950	43
Diacetone	E				3.6×10^4	3,000	43
Distillates	E				6.1×10^5	750	43
Methanol	E				2.5×10^6	310	18
Diesel Fuel	E				4.8×10^6	1,355	650
Methyl Butyl-ketone	E				2.8×10^5	150	43
Napthalene	E				3.6×10^4	75	43
Pentachlorophenol	E				3.0×10^4	1.5	43
Xylene	E				6.0×10^5	655	24
Methylene Chloride	E				1.24×10^7	900	43
Sulfuric Acid	E				8.93×10^1	1	43

(1) This is the assumed total amount of material available for flashing per shipment.

(2) For puff release a 120 second exposure time @ this concentration was assumed to constitute a hazard. The 120 second exposure is from Reference 3.

PROBABILISTIC DATA

- PROBABILITY OF A SPILL 1.0×10^{-8} /TRUCK MILE
 - A. DATA PRESENTED PREVIOUSLY IN EXPLOSIVE HAZARD ANALYSIS
 - 1.3×10^{-7} ACCIDENTS/TRUCK MILE
 - .06 RELEASE/ACCIDENT, FROM COMPRESSED LIQUID SPILL DATA
 - B. INDEPENDENT ASSESSMENT BY SAI - 8.2×10^{-9} /TRUCK MILE
 - CLASS B NUCLEAR PACKAGE DATA - SANDIA
 - SIMILARITY BETWEEN COMPRESSED LIQUID CONTAINERS AND CLASS B PACKAGES IN TERMS OF STRENGTH UNDER IMPACT LOADS
- PROBABILITY OF A COMPLETE SPILL .4
 - NUS-1942

PROBABILITY OF A HAZARD

CHEMICAL NAME	Q, GALLONS	X _{TL} , MG/M ³	ANNUAL SHIPMENTS	YEARLY PROBABILITY OF HAZARD	DESCRIPTION
GASOLINE	4500	4000	17,000	9.0×10^{-7}	LIQUID
DIESEL OIL	4500	1355	650	3.0×10^{-8}	LIQUID
JET FUEL	4500	1000	910	4.3×10^{-8}	LIQUID
DIACETONE	2600	360	43	$< 10^{-10}$	LIQUID
XYLENE	3750	655	24	$< 10^{-10}$	LIQUID
SHELL SOL M-75	2000	750	43	$< 10^{-10}$	LIQUID
METHANOL	2000	310	18	1.5×10^{-9}	LIQUID
MS-20-H (NAPHTHALENE)	4000	75	43	$< 10^{-10}$	LIQUID
PENTACHLOROPHENOL	2000	1.5	43	6.3×10^{-9}	LIQUID
BENZENE	50	30	43	1.8×10^{-8}	LIQUID
FORMALDEHYDE	6000	3	14	8.3×10^{-9}	LIQUID
METHYL-BUTYL-KETONE	2000	150	43	8.0×10^{-10}	LIQUID
METHYLENE CHLORIDE	2000	900	43	4.1×10^{-9}	LIQUID
METHYL ETHYL KETONE	2000	740	43	9.6×10^{-10}	LIQUID
ETHYLENE DICHLORIDE	1000	300	43	5.6×10^{-9}	LIQUID
BUTYL ACETATE	2000	950	43	$< 10^{-10}$	LIQUID
BUTANE	8485	1750	2,200	3.5×10^{-7}	LIQUIFIED GAS
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HYDROCHLORIC ACID	4600	7	133	5.1×10^{-9}	LIQUID
SULFURIC ACID	6000	1	130	$< 10^{-10}$	LIQUID
MURIATIC ACID	5000	10	43	7.0×10^{-9}	LIQUID

MAJOR TOXIC HAZARD CONTRIBUTORS

<u>CHEMICAL NAME</u>	<u>FREQUENCY OF HAZARD PER YEAR</u>	<u>DESCRIPTION</u>
GASOLINE	9×10^{-7}	FLAMMABLE
BUTANE	4×10^{-7}	COMPRESSED, FLAMMABLE
PROPANE	3×10^{-7}	COMPRESSED, FLAMMABLE
CHLORINE	2×10^{-7}	COMPRESSED
AMMONIA	6×10^{-8}	COMPRESSED
JET FUEL	4×10^{-8}	FLAMMABLE
DIESEL FUEL	3×10^{-8}	FLAMMABLE
BENZENE	2×10^{-8}	
FORMALDEHYDE	8×10^{-9}	

CONCLUSIONS

- RISK OF TOXIC HAZARD IS LOW.
- SMALL NUMBER OF SUBSTANCES IN EXCESS OF 10^{-7} /YR.
FOR TOXIC HAZARD, ALL SUBSTANCES LESS THAN 10^{-6} /YR.
- CONSERVATISMS IMPLY THAT TOXIC HAZARD ESTIMATES
ARE STILL HIGH.
- ALL SIGNIFICANT IDENTIFIED TOXIC HAZARDS ARE BEING
MONITORED.
- IMPACT ON EXISTING PLANT RISK IS VERY SMALL.