Final Report

Characterization of CDTF Decontaminated Wastewater and the Estimated Risk of Transportation

Prepared for
U.S. Army Corps of Engineers,
Kansas City District

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February 1997

CHARACTERIZATION OF CDTF WASTEWATER
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CHARACTERIZATION OF CDTF DECONTAMINATED WASTEWATER AND THE ESTIMATED RISK OF TRANSPORTATION

1.0 Introduction

Recommendations of the 1995 Defense Base Realignment and Closure Commission require closing of Fort McClellan (FMC) in Alabama and relocation of essential missions to other installations. The U.S. Army's Chemical School at FMC is one of the training programs that will be relocated to Fort Leonard Wood (FLW), Missouri.

Training with toxic chemical agents is one of the missions that will be transferred to FLW. This training is currently conducted at the Chemical Defense Training Facility (CDTF) at FMC and involves the placement of small quantities of toxic chemical agents (GB and VX) on equipment props located in controlled atmosphere rooms. Students are taught personal protection, methods to locate and identify the small quantities of chemical agent on the equipment props, and methods to decontaminate the equipment.

The primary materials used for decontaminating toxic agents are sodium hypochlorite and DS2 (Decontamination Solution). DS2 composition, properties and safety precautions when handling are discussed in a Material Safety Data Sheet contained in Appendix D of this report. The decontamination materials are mixed with tap water and applied to equipment surfaces for the decontamination of toxic agents. The resulting wastewater from the decontamination process is tested to determine if residuals of the toxic agents are present at 20 parts per billion (ppb) detection level. Twenty ppb of toxic agent in water has been determined by the Army as a concentration that troops, in combat situations, can consume in drinking water for up to seven days; however, at this level, health effects are possible (DA, 1986). If no toxic agents are detected, the wastewater is thermally treated by an incinerator at the CDTF at FMC. The wastewater is not classified as a RCRA hazardous waste.

An alternative disposal method planned for FLW is shipment of the wastewater off-site to a commercially operated treatment facility as opposed to incineration which is currently practiced at the FMC CDTF. The decontamination process and alternatives used for disposal of the CDTF wastewater are detailed in subsections 5.2.2.8.5 and 5.2.2.15.B.6 of Volume I, and Appendix I of Volume 3

of the Environmental Impact Statement (EIS) conducted for the relocation of the U.S. Army Chemical School and U.S. Army Military Police School to FLW (FLW, 1997).

An evaluation was undertaken to determine the risks of transporting the wastewater from FLW to a hypothetical disposal site located in Ohio, over 600 miles from FLW. The transportation scenario used in this evaluation was selected for the following reasons: 1) The distance of transport (i.e., 600 miles) was considered the maximum, economically feasible for waste shipment and therefore provided a maximum chance for a ground transportation accident; 2) The route of travel was through areas of low (rural) and high (urban) population, thereby affording a reasonable chance of human exposure from an accidental release; and 3) weather conditions in the upper mid-west are moderately harsh (i.e., snow, ice, rain) and result in a higher than average possibility of transportation accidents.

The study presented in this report consisted of quantifying the toxic compounds in the wastewater, determining the acute aquatic toxicity of the wastewater, and estimating the risk associated with shipping the wastewater from FLW to an off-post disposal site. Transportation risk were estimated with the Chemical Accident Statistical Risk Assessment Statistical Model (CASRAM).

2.0 Wastewater Sampling

Decontamination wastewater was collected at the CDTF at FMC. The wastewater had been accumulating in a storage tank from October 1, 1996 to November 19, 1996 when it was sampled, and represented about 4,000 gallons of accumulated effluent. During this time period, 16 different live agent training exercises had been conducted involving 334 students.

The wastewater storage tank was stirred to insure homogeneity of the effluent before samples were taken. Samples were shipped in coolers at about 4^0 C to Commonwealth Technology, Inc. (CTI), Lexington, Kentucky for aquatic toxicity testing and to the Parsons Engineering Science Laboratory (Parsons ES) in Atlanta, Georgia for chemical characterization. A sample of the same effluent was tested for pH and for the toxic agents, GB and VX, at the chemical laboratory located at the FMC CDTF. Chain of custody was instituted for the samples shipped to CTI and Parsons ES laboratories.

3.0 Wastewater Analytical Methods and Results

The acute toxicity of CDTF effluent to the water flea (crustacean), *Ceriodaphnia dubia* and the fathead minnow, *Pimephales promelas,* was evaluated to provide insight on potential impacts from an accidental release to an aquatic environment. The laboratory toxicity report of the results is contained in Appendix A.

Diethylenetriamine and ethylene glycol monomethylether are the two active ingredients in DS2 decontamination solution. The two organics in DS2 combined with residuals of GB and VX comprise the main toxic organic chemicals in the CDTF wastewater. Analytical results for the two organics of DS2 and other physical/chemical parameters of the effluent are found in Appendix B. Results of the GB and VX analyses are in Appendix C. Material Safety Data Sheets for DS2, GB and VX are contained in Appendix D. Analytical parameters, methods, health criteria, and results are depicted in Table 1.

TABLE 1:
CHEMICAL CHARACTERIZATION OF CDTF WASTEWATER

PARAMETER	METHOD	HEALTH CRITERIA IN AIR	RESULT
Alkalinity, mg/L, $CaCO_3$	EPA 310.1	NA[a]	3,350 mg/L
Ignitability, degrees F	EPA 1010	NA	>180
Residual Chlorine, mg/L	EPA 330.5	NA	<0.50 mg/L
Total Dissolved Solids, mg/L	EPA 160.1	NA	7,390 mg/L
Total Organic Carbon, mg/L	EPA 415.1	NA	1,540 mg/L
Total Suspended Solids, mg/L	EPA 160.2	NA	2,480 mg/L
Diethylenetriamine, mg/L	EPA 8015 mod	[1]TLV-TWA 4.2 mg/m^3	300 mg/L
Ethylene glycol monomethylether, mg/L	EPA 8015 mod	[2]TLV-TWA 16 mg/m^3	680 mg/L
pH	501 Orion Meter	NA	10.23
GB Agent, $\mu g/L$	Gas Chromatograph	[3] AEL-TWA 0.0001 mg/m^3	< 20 $\mu g/L$
VX Agent, $\mu g/L$	Gas Chromatograph	[4]AEL-TWA 0.00001 mg/m^3	<20 $\mu g/L$
48 hr. Tox. to *Ceriodaphnia dubia*	EPA 600/4-90/027F	NA	1.5% LC50
96 hr. Tox. to *Pimephales promelas*	EPA 600/4-90/027F	NA	3.8% LC50

[a] NA = Not Applicable

[1]Threshold Limit Value-Time Weighted Average (TLV-TWA) of 4.2 mg/m^3 for diethylenetriamine ACGIH (1994).

[2]TLV-TWA of 16 mg/m^3 for ethylene glycol monomethylether ACGIH (1994).

[3] Atmospheric Exposure Limit-Time Weighted Average (AEL-TWA) of 0.0001 mg/m^3 for GB (DA, 1996b).

[4] (AEL-TWA) of 0.00001 mg/m^3 for VX (DA, 1996a).

4.0 Chemical Accident Statistical Risk Assessment Statistical Model Results

Chemical Accident Statistical Risk Assessment Statistical Model (CASRAM) is a statistical model which predicts the probability of transportation accidents, the probability of a release given an accident, and the probability of humans being affected given accidental releases. To predict risks, the model uses shipment attributes such as route traveled; container type; method of transportation (e.g., rail, truck, etc.); amount of material shipped and frequency; toxicity of the material; and concentration of the toxic ingredients.

The model contains an extensive meteorological database to statistically model chemical release rates and material dispersion through Monte Carlo sampling of accident scenarios. This information is combined with health criteria for the applicable chemicals to predict exposures from spills to populations along the route traveled. Appendix E contains the CASRAM model results and provides detail on the structure of the model and assumptions.

The following assumptions and data were used in the model:

- Shipment Origin - Fort Leonard Wood, Missouri
- Destination - Vickery, Ohio (606 miles from FLW)
- Type of Vehicle - Tank truck
- Number and Type of Container - One 5,000 gallon capacity tank per truck
- Quantity - 500 gallons per tank truck
- Time Horizon for Risk Assessment - 10 years
- Frequency of Shipment - Two, 5,000 gallon tank truck shipments per month

- Chemicals Shipped and Concentration - four chemicals in aqueous solution:
  (1) diethylenetriamine at 300 ppm,
  (2) ethylene glycol monomethylether at 680 ppm, and
  (3) VX at < 20 ppb, and
  (4) GB at < 20 ppb

- Health Criteria for the Chemicals Involved:
  (1) Threshold Limit Value-Time Weighted Average (TLV-TWA) of 4.2 mg/m^3 for diethylenetriamine ACGIH (1994),
  (2) TLV-TWA of 16 mg/m^3 for ethylene glycol monomethylether ACGIH (1994),
  (3) Atmospheric Exposure Limit-Time Weighted Average (AEL-TWA) of 0.00001 mg/m^3 for VX (DA, 1996a), and
  (4) AEL-TWA of 0.0001 mg/m^3 for GB (DA, 1996b).

As discussed in Appendix E, the probability of an accident occurring anywhere along the entire route examined in this analysis is one accident for every 2,671 shipments. The total number of shipments projected during a 10 year time frame is 240 shipments. The model predicted that a small fraction of the accidents would result in a product release. When accident probability is considered along with release probability, the chance of an accident involving a product release is one in 14,142 shipments or one release in 590 years of shipping.

The health criteria for the different chemicals were considered protective for long-term, occupational exposures, but not short term (acute) exposures that are more representative for accidental releases. For emergency response applications, Emergency Response Planning Guideline (ERPG) values are used because they represent acute exposure values. The ERPG values are more appropriate for use in a CASRAM risk assessment model, but ERPGs have not been established for GB and VX, and the two organic ingredients in DS2. By use of guidance recommended by Craig et al. (1995), and Woudenberg and van Der Torn (1992), the occupational values can be converted to acute (LC50) values by multiplying the occupational values by 5.

The probability that one or more persons will be exposed to a concentration exceeding the emergency response criteria, during any given year of operation, is 6.88×10^{-5}. This probability indicates that one person has a chance of being affected in 348,000 shipments. At this rate one can expect one person to be affected in 14,500 years of shipping.

Similarly, the probability that 100 or more persons will be exposed to concentrations exceeding emergency response criteria, during one spill event is 3.33×10^{-9}. This probability indicates that 100 people have a chance of being affected by one spill event in 7,200,000,000 shipments. At this rate one can expect 100 people to be affected by a release event in 300 million years of shipping.

5.0 Water Supply for the Chemical Defense Training Facility

Water supplied to the CDTF at FMC for purposes such as drinking water, and makeup water for agent decontamination training is provided by the Anniston Water Works and Sewer Board of the City of Anniston, Alabama. The Paul B. Krebs Water Treatment Plant and the Earl C. Knowlton Water Treatment Plant are the two drinking water treatment plants serving the City of Anniston and Fort McClellan. About 95 percent of the water supply for FMC comes from the Paul B. Krebs Water Treatment Plant which utilizes water from wells ("Coldwater Spring") as a source.

The water supply to the CDTF at FMC complies with drinking water standards and is monitored on an annual or more frequent basis for the activity of 9 radionuclides, over 42 different pesticides, 55 VOCs (mostly haloginated), 19 metals, 5 ions, alkalinity, hardness, pH, and TDS. The results of testing performed in 1996 are contained in Appendix F.

6.0 Summary and Conclusion

The study found that the CDTF decontaminated wastewater was high in dissolved solids (7,390 mg/L), and had 300 and 680 mg/L concentrations for the two organic compounds which are the active ingredients of DS2 decontamination solution. It had a pH of 10.23 and contained less than 20 ppb of GB nd VX.

The results of acute aquatic toxicity tests with fathead minnows, *Pimephales promelas* and the water flea (crustacean), *Ceriodaphnia dubia*, indicated the wastewater was moderately toxic. The 96 hour LC50 (Lethal Concentration estimated to cause 50 percent mortality to the exposed organisms over the time of exposure) for fathead minnows was 3.8 % concentrated effluent. The 48

hour, LC50 for the water flea was 1.5% concentrated effluent. These results indicate there is a potential for acute toxicity to aquatic organisms even if a 67 fold dilution of spilled effluent was realized.

The statistical probabilities predicted by the CASRAM model show the chance that a person or group of people will be affected by a transportation related spill of the CDTF wastewater is very remote. Based on a hypothetical disposal site located over 600 miles from FLW, the CASRAM model indicated one person has a chance to be exposed from a transportation spill to concentrations exceeding emergency response criteria in 14,500 years of shipping. The model further indicated 100 people have a chance to be exposed from a transportation spill to concentrations exceeding emergy response criteria in 300 million years of shipping.

Literature Cited

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Appendix A: Aquatic Toxicity of CDTF Wastewater

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TOXICITY ANALYSIS / LC_{50} DETERMINATION

EFFLUENT COLLECTED NOVEMBER 19, 1996 FROM THE CHEMICAL DEFENSE TRAINING FACILITY AT FORT MCCLELLAN, ALABAMA

INTRODUCTION

Based on recommendations of the 1995 Defense Base Realignment and Closure Commission, Fort McClellan, Alabama has been scheduled for closure as of 1999. Essential operations now being conducted at the base will be transferred to Fort Leonard Wood, Missouri. One such program which will be relocated is the training of personnel with toxic chemical agents. This training is currently conducted at Fort McClellan's Chemical Defense Training Facility (CDTF). After each training exercise, chemical agents used in the training are decontaminated with a solution containing DS2, a caustic, soap-like product. The resulting wash water is analyzed for residual toxics. If none are detected, the liquid is incinerated at the CDTF.

Once this training is transferred to Fort Leonard Wood, the Army is considering an alternative disposal method for the wastewater. Instead of being incinerated, the effluent would be shipped off-site for disposal or treatment. Therefore, personnel at Fort Leonard Wood are interested in gathering information on the effluent which could be used to determine possible environmental risks that might be posed by an accidental spill of the effluent during transport.

One type of information that is needed for such an assessment is aquatic toxicity data. Therefore, Parsons Engineering Science contracted Commonwealth Technology, Incorporated (CTI) to conduct acute toxicity tests of the effluent using *Pimephales promelas* (fathead minnow) and *Ceriodaphnia dubia* (water flea) in order to determine the LC_{50} value for each species. An LC_{50} is the concentration of an effluent which is predicted to result in the death of half of the test organisms exposed to an effluent for a given time period, such as 48 hours. An effluent sample was collected from the CDTF on November 19, 1996 and shipped via overnight courier to CTI's aquatic toxicology laboratory in Lexington, Kentucky. Once received at CTI, the sample was analyzed for toxicity. This report contains the results of that investigation.

METHODS

Preliminary tests with both species indicated that the LC_{50} values were less than 6.25 percent effluent (see data sheets in the appendix). Therefore, range-finding tests, utilizing a wide range of effluent concentrations, were initiated to determine the approximate level of toxicity in the sample. Based on the results of these tests, definitive toxicity tests, using a more narrow range of concentrations, were conducted.

Toxicity testing procedures generally followed EPA's acute effluent testing protocol (EPA 600/4-90/027F). When not being analyzed, samples were stored in polyethylene containers at 4°C in the dark. Moderately hard reconstituted water served as the dilution and control water. The tests were conducted at 25°C in a laboratory utilizing a 16-hour: 8-hour light-to-dark ratio. Test chambers were new polystyrene containers. Organisms were obtained from CTI's in-house

culture unit. A detailed summary of test conditions is presented in Table 1. Test organisms were not fed during the range-finding tests. See Table 1 for feeding regimes employed in the definitive tests.

Survival readings were recorded daily for each test. Dissolved oxygen, pH, and conductivity were measured in the pre- and post-exposure test solutions. Hardness, alkalinity, and ammonia were measured in the 100 percent effluent. All chemical/physical data are recorded on the data sheets in the appendix of this report.

RESULTS

Range-finding tests utilized effluent concentrations of 0.001, 0.01, 0.1, 1.0 and 10 percent. Results of these tests are presented in Table 2. All organisms exposed to 10 percent effluent in these tests were dead within 5 hours. In the *Pimephales* study, organisms in the other concentrations survived throughout the 24-hour test. In the *Ceriodaphnia* test, all organisms survived until the end of the test except in the 1 percent effluent, where 60 percent survived. This was the first indication that *Ceriodaphnia* were more sensitive to the effluent than were the minnows.

Based on the results of the range-finding tests, concentrations selected for the definitive tests were 0.25, 0.5, 1.0, 2.0, and 4.0 percent. Results of the definitive tests are presented in Table 3. All of the *Ceriodaphnia* exposed to 4 percent effluent died by the test's end, with partial mortality occurring in the 0.5, 1.0, and 2.0 percent solutions. This test yielded a 48-hour LC_{50} of 1.5 percent effluent,with a 95 percent confidence interval of 1.2 to 1.9 percent.

Results of the definitive tests confirmed that *Pimephales* was less sensitive to the effluent than was *Ceriodaphnia*. No mortality to the minnows was observed in 0.25, 0.5, 1.0, or 2.0 percent effluent. And in the highest concentration, there was only 55 percent mortality by the end of the test. Analysis of data from this test resulted in a 96-hour LC_{50} of 3.8 percent. The confidence interval around this value ranged from 2.9 to 4.9 percent.

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TABLE 1

SUMMARY OF ACUTE TOXICITY TEST CONDITIONS METHOD: EPA 600/4-90/027F

		Ceriodaphnia dubia	*Pimephales promelas*
1.	**Test Type:**	Static	Static-Renewal
2.	**Temperature:**	25.0 ± 1°C	25.0 ± 1°C
3.	**Light Quality:**	Ambient laboratory illumination (cool white)	Ambient laboratory illumination (cool white)
4.	**Light Intensity:**	Approx. 100 ft-c	Approx. 100 ft-c
5.	**Photoperiod:**	8 hrs. dark, 16 hrs. light	8 hrs. dark, 16 hrs. light
6.	**Test Chamber Size and Type:**	30 ml polystyrene	270 ml polystyrene
7.	**Test Solution Volume:**	15 ml/replicate	200 ml/replicate
8.	**Renewal of Test Solutions:**	Not renewed	At 48 hours
9.	**Age of Test Organism:**	Less than 24 hours	9-11 days
10.	**No. of Test Organisms per Chamber:**	5	10
11.	**No. of Replicate Chambers per Concentration:**	Range-finding: 1 Other: 4	Range-finding: 1 Other: 2
12.	**Definitive Test Feeding Regime:**	Not fed	Fed brine shrimp nauplii in a concentrated suspension prior to renewal at 48 hours
14.	**Dilution Water:**	Reconstituted water	Reconstituted water
15.	**Effluent Concentrations:**	See text of report	See text of report
16.	**Test Duration:**	Range-finding: 24 hours Other: 48 hours	Range-finding: 24 hours Other: 96 hours
17.	**Effects Measured:**	Death and immobility	Death and immobility
18.	**Test Acceptability:**	90% or greater survival in the control group	90% or greater survival in the control group

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TABLE 2

RANGE-FINDING TOXICITY TESTS
CHEMICAL DEFENSE TRAINING FACILITY EFFLUENT
FORT MCCLELLAN, ALABAMA

Species	Collection Date	Test Concentration (%)	Percent Survival[1] at End of Test	Test Duration
Ceriodaphnia dubia	11/19/96	Control 0.001 0.01 0.1 1.0 10	100 100 100 100 60 0	24 Hours
Pimephales promelas	11/19/96	Control 0.001 0.01 0.1 1.0 10	100 100 100 100 100 0	24 Hours

[1]All survival values were based on 5 organisms (n = 5).

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TABLE 3

DEFINITIVE TOXICITY TESTS
CHEMICAL DEFENSE TRAINING FACILITY EFFLUENT
FORT MCCLELLAN, ALABAMA

Species	Collection Date	Test Concentration (%)	Percent Survival[1] at End of Test	Test Duration	LC_{50}
Ceriodaphnia dubia	11/19/96	Control 0.25 0.5 1.0 2.0 4.0	100 100 85 80 45 0	48 Hours	1.5% (1.2-1.9%)[2]
Pimephales promelas	11/19/96	Control 0.25 0.5 1.0 2.0 4.0	95 100 100 100 100 45	96 Hours	3.8% (2.9-4.9%)[2]

[1]All survival values were based on 20 organisms (n = 20).
[2]Numbers in parentheses represent the 95 percent confidence interval.

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APPENDIX

TOXICITY ASSESSMENT DATA SHEETS
CUSTODY RECORD

CHEMICAL DEFENSE TRAINING FACILITY EFFLUENT
FORT MCCLELLAN, ALABAMA

FRESHWATER ACUTE TOXICITY BENCH SHEET

METHOD: EPA 600/4-90/027F

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Discharger: Parsons
Location:
Bio. Log Number: 4294
Date/Time Initiated: 11-20-96 4PM
Date/Time Terminated: 11-22-96 3:30 p.m.

Test Organism: ✓ *Ceriodaphnia dubia* ___ *Pimephales promelas* ___ *Daphnia pulex* ___ *Daphnia magna* Other:
Organism Age: <24 hrs Batch No.: B 1105
Dilution Water: 9:1 RW Batch No.: 230 E
Renewal Time: ___ At 48 Hours ✓ Not renewed

Sample	Replicate ID	Number of Live Organisms at Hour				pH (Standard Units)				Dissolved Oxygen (mg/L)				Specific Conductance (µmhos/cm)			
		24	48	72	96	I	P	R	T	I	P	R	T	I	P	R	T
Control	1	5	5			7.7	7.6		7.6	7.3	7.0		7.0	359			390
	2	5	5														
	3	5	5														
	4	5	5														
6.25	5	0	-			9.0			8.0	7.0			6.9	1043			1057
	6	0	-														
	7	0	-														
	8	0	-														
12.5	9	0	-			9.2			8.0	6.8			7.0	1796			1823
	10	0	-														
	11	0	-														
	12	0	-														
25	13	0	-			9.3			8.2	6.1			6.8	3770			3360
	14	0	-														
	15	0	-														
	16	0	-														
50	17	0	-			9.3			8.3	4.7			6.4	6600			6070
	18	0	-														
	19	0	-														
	20	0	-														
100	21	0	-			9.4			8.5	4.9			6.0	12930			11270
	22	0	-														
	23	0	-														
	24	0	-														
Analyst		SH	SH			LS			SH	LS			SH	LS			SH

Sample	Sample Collection Date/Time	As mg/L $CaCO_3$		Ammonia-N (mg/L)	Residual Chlorine (mg/L)	$DeCl_2$?	LC_{50}
		Alkalinity	Hardness				
Control		86	117				
100%	11-19-96	315	152	3.9	<.002	N/A	>6.25%
Analyst		SH	SH	KAW	LS	SH	SH

Comments: RP

I - Initial P - Prior to Renewal R - Renewal T - Termination

FRESHWATER ACUTE TOXICITY BENCH SHEET

METHOD: EPA 600/4-90/027F

Commonwealth Technology, Inc.
2520 Regency Road
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Discharger: Parsons
Location:
Bio. Log Number: 4295
Date/Time Initiated: 11-20-96 4PM
Date/Time Terminated: 11-24-96 2:45pm

Test Organism: ___ *Ceriodaphnia dubia* ✓ *Pimephales promelas*
___ *Daphnia pulex* ___ *Daphnia magna* Other:
Organism Age: 11 d 24 h Batch No.: B-74
Dilution Water: 9.1 RW Batch No.: 230E
Renewal Time: ✓ At 48 Hours ___ Not renewed

Sample	Replicate ID	Number of Live Organisms at Hour				pH (Standard Units)				Dissolved Oxygen (mg/L)				Specific Conductance (µmhos/cm)			
		24	48	72	96	I	P	R	T	I	P	R	T	I	P	R	T
Control	1	10	10	10	10	7.7	7.3	7.6	7.4	7.3	5.3	7.4	6.9	359	389	360	402
	2	10	10	10	10												
6.25	3	0	-	-	-	9.0			8.3	7.0			5.9	1043			1083
	4	0	-	-	-												
12.5	5	0	-	-	-	9.2			8.3	6.8			6.1	1796			1758
	6	0	-	-	-												
25	7	0	-	-	-	9.3			8.4	6.1			5.9	3770			4220
	8	0	-	-	-												
50	9	0	-	-	-	9.3			8.6	4.7			5.7	6600			6710
	10	0	-	-	-												
100	11	0	-	-	-	9.4			8.7	4.9			2.9	12930			~~11820~~
	12	0	-	-	-												11820
Analyst		SH	SH	SF	SH	LS			SH/SH	LS			SH/SH	LS			SH/SH

Sample	Sample Collection Date/Time	As mg/L $CaCO_3$		Ammonia-N (mg/L)	Residual Chlorine (mg/L)	$DeCl_2$?	LC_{50}
		Alkalinity	Hardness				
Control		86	117				
100%	11-19-96	315	152	3.9	<0.02	N/A	<6.25%
Analyst				KAH	LS	SH	SH

Comments:

I - Initial P - Prior to Renewal R - Renewal T - Termination

FRESHWATER ACUTE TOXICITY BENCH SHEET

METHOD: EPA 600/4-90/027F

Commonwealth Technology, Inc.
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Discharger: PARSONS
Location: CHEM SCHOOL
Bio. Log Number: 4308
Date/Time Initiated: 11-26-96 1030 AM
Date/Time Terminated: 11/27/96 1:46 PM

Test Organism: ✓ *Ceriodaphnia dubia* ___ *Pimephales promelas* ___ *Daphnia pulex* ___ *Daphnia magna* Other: ___
Organism Age: 24 HRS Batch No.: 1115
Dilution Water: 9.1 RW Batch No.: 2345
Renewal Time: ___ At 48 Hours ___ Not renewed

Sample (%)	Replicate ID	Number of Live Organisms at Hour				pH (Standard Units)				Dissolved Oxygen (mg/L)				Specific Conductance (µmhos/cm)			
		24	48	72	96	I	P	R	T	I	P	R	T	I	P	R	T
Control	1	5				8.0			7.6	7.4			7.6	398			395
0.001	2	5				7.9			7.7	7.9			7.6	400			412
0.01	3	5				7.9			7.7	7.6			7.8	406			415
0.1	4	5				7.9			7.7	7.8			7.6	413			424
1.0	5	3				8.2			7.7	7.6			7.4	513			536
10.0	6	0				8.8			8.1	7.2			7.7	~~550~~ ie 1510			575
	7																
	8																
Analyst		JS				SH			JS	SH			JS	SH			JS

Sample	Sample Collection Date/Time	As mg/L $CaCO_3$		Ammonia-N (mg/L)	Residual Chlorine (mg/L)	$DeCl_2$?	LC_{50}
		Alkalinity	Hardness				
Control		~~84~~ 94	~~88~~ 117 126				
100%	11-19-96	315	152	3.9	<0.02	N/A	—
Analyst				KAH	LS.	RP	

Comments: Organisms in 10% effluent were dead within 5 hours of test initiation RP

I - Initial P - Prior to Renewal R - Renewal T - Termination

FRESHWATER ACUTE TOXICITY BENCH SHEET

METHOD: EPA 600/4-90/027F

Commonwealth Technology, Inc.
2520 Regency Road
Lexington, Kentucky 40503-2921
(606) 276-3506

Discharger: PARSONS
Location: CHEM SCHOOL
Bio. Log Number: 4309
Date/Time Initiated: 11-26-96 1030AM
Date/Time Terminated: 11/27/96 2:00 PM

Test Organism: ___ *Ceriodaphnia dubia* ✓ *Pimephales promelas*
___ *Daphnia pulex* ___ *Daphnia magna* Other: _____
Organism Age: 9 DAYS Batch No.: 1017
Dilution Water: 9:1 RW Batch No.: 2345
Renewal Time: _____ At 48 Hours _____ Not renewed

Sample (%)	Replicate ID	Number of Live Organisms at Hour				pH (Standard Units)				Dissolved Oxygen (mg/L)				Specific Conductance (µmhos/cm)			
		24	48	72	96	I	P	R	T	I	P	R	T	I	P	R	T
Control	1	5				8.0			7.4	7.4			6.7	398			398
0.001	2	5				7.9			7.7	7.9			7.6	400			426
0.01	3	5				7.9			7.6	7.6			7.1	406			416
0.1	4	5				7.9			7.6	7.8			7.3	413			420
1.0	5	5				8.2			7.7	7.6			7.6	513			530
10.0	6	5				8.6			8.3	7.2			7.4	1510			1560
Analyst		KS				SH			KS	SH			KS	SH			KS

Sample	Sample Collection Date/Time	As mg/L $CaCo_3$		Ammonia-N (mg/L)	Residual Chlorine (mg/L)	$DeCl_2$?	LC_{50}
		Alkalinity	Hardness				
Control		94	126				
100%	11-19-96	315	152	3.9	<0.02	N/A	—
Analyst				KAH	LS	RP	

Comments: Organisms in 10% effluent were dead within 5 hours of test initiation. RP

I - Initial P - Prior to Renewal R - Renewal T - Termination

FRESHWATER ACUTE TOXICITY BENCH SHEET

METHOD: EPA 600/4-90/027F

Commonwealth Technology, Inc.
2520 Regency Road
Lexington, Kentucky 40503-2921
(606) 276-3506

Discharger: PARSONS
Location: CHEMICAL SCHOOL
Bio. Log Number: 4320
Date/Time Initiated: 12-3-96 2PM
Date/Time Terminated: 12-5-96 2pm.

Test Organism: ✓ *Ceriodaphnia dubia* ___ *Pimephales promelas* ___ *Daphnia pulex* ___ *Daphnia magna* Other: ___
Organism Age: <24 HRS Batch No.: 1120
Dilution Water: 236 9:1 Batch No.: 236
Renewal Time: ___ At 48 Hours ✓ Not renewed

Sample	Replicate ID	Number of Live Organisms at Hour				pH (Standard Units)				Dissolved Oxygen (mg/L)				Specific Conductance (µmhos/cm)			
		24	48	72	96	I	P	R	T	I	P	R	T	I	P	R	T
Control	1	5	5			7.7			7.5	7.9			7.9	372			368
	2	5	5														
	3	5	5														
	4	5	5														
0.25	5	5	5			7.8			7.5	7.9			7.9	401			400
	6	5	5														
	7	5	5														
	8	5	5														
0.5	9	5	5			7.9			7.5	7.7			8.0	433			437
	10	5	4														
	11	5	3														
	12	5	~~5~~														
1.0	13	5	4			8.0			7.5	7.7			8.0	489			494
	14	5	~~4~~														
	15	5	4														
	16	5	4														
2.0	17	5	2			8.2			7.6	7.9			8.0	590			604
	18	5	2														
	19	5	1														
	20	5	4														
4.0	21	5	0			8.5			7.7	7.6			8.0	849			881
	22	5	0														
	23	5	0														
	24	5	0														
Analyst		LS	SH			SH			SH	SH			SH	SH			SH

Sample	Sample Collection Date/Time	As mg/L CaCo$_3$		Ammonia-N (mg/L)	Residual Chlorine (mg/L)	DeCl$_2$?	LC$_{50}$
		Alkalinity	Hardness				
Control		86	113				
100%	11-19-96	~~140~~	~~118~~	3.9	<0.02	N/A	1.5%
4%		170	118				
Analyst		SH	SH	KAH	LS	BP	BP

Comments: BP

I - Initial P - Prior to Renewal R - Renewal T - Termination

Acute Daphnid Test-48 Hour Survival

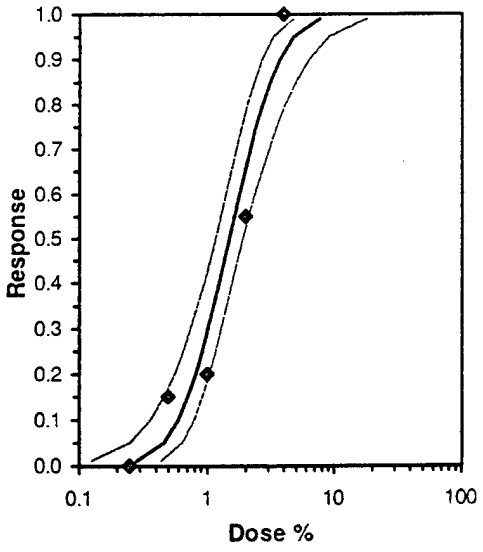
Start Date:	12/3/96 14:00	Test ID:	4320	Sample ID:	PARS-Parsons
End Date:	12/5/96 14:00	Lab ID:		Sample Type:	
Sample Date:		Protocol:	EA-EPA/600/4-90/027F	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-%	1	2	3	4
Control	1.0000	1.0000	1.0000	1.0000
0.25	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	0.8000	0.6000	1.0000
1	0.8000	0.8000	0.8000	0.8000
2	0.4000	0.4000	0.2000	0.8000
4	0.0000	0.0000	0.0000	0.0000

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.23175	0.53391	2.18529	4.27822	0	6.15028	11.3449	0.1	0.17252	0.30943	3
Intercept	4.44246	0.18333	4.08314	4.80178							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	0.28358	0.12585	0.44012
EC05	3.355	0.46084	0.25315	0.64743
EC10	3.718	0.59699	0.36499	0.80068
EC15	3.964	0.71091	0.46498	0.92846
EC20	4.158	0.81676	0.56135	1.0487
EC25	4.326	0.92005	0.6572	1.16877
EC40	4.747	1.24201	0.95518	1.57216
EC50	5.000	1.48771	1.17131	1.91894
EC60	5.253	1.78202	1.41237	2.38198
EC75	5.674	2.40562	1.87105	3.51526
EC80	5.842	2.70983	2.07691	4.13209
EC85	6.036	3.11331	2.33756	5.00619
EC90	6.282	3.7074	2.70205	6.39793
EC95	6.645	4.8027	3.33158	9.25229
EC99	7.326	7.80477	4.88683	18.6647



ToxCalc v5.0

Reviewed by: RP

FRESHWATER ACUTE TOXICITY BENCH SHEET

METHOD: EPA 600/4-90/027F

Commonwealth Technology, Inc.
2520 Regency Road
Lexington, Kentucky 40503-2921
(606) 276-3506

Discharger: PARSONS
Location: CHEMICAL SCHOOL
Bio. Log Number: 4321
Date/Time Initiated: 12-3-96 130 PM
Date/Time Terminated: 12-7-96 200 PM

Test Organism: ___ *Ceriodaphnia dubia* ✓ *Pimephales promelas*
___ *Daphnia pulex* ___ *Daphnia magna* Other: ___
Organism Age: 10 DAYS Batch No.: 1123
Dilution Water: 9:1 RW Batch No.: 236
Renewal Time: ✓ At 48 Hours ___ Not renewed

Sample	Replicate ID	Number of Live Organisms at Hour				pH (Standard Units)				Dissolved Oxygen (mg/L)				Specific Conductance (µmhos/cm)			
		24	48	72	96	I	P	R	T	I	P	R	T	I	P	R	T
Control	1	10	10	9	9	7.7	7.2	7.7	7.0	7.9	6.5	8.2	7.2	372	379	370	392
	2	10	10	10	10												
0.25	3	10	10	10	10	7.8	7.2	7.4	7.1	7.9	6.3	9.4	7.0	401	418	400	409
	4	10	10	10	10												
0.5	5	10	10	10	10	7.9	7.2	7.6	7.3	7.7	6.3	9.2	6.9	433	453	432	448
	6	10	10	10	10												
1.0	7	10	10	10	10	8.0	7.3	7.7	7.2	7.7	6.5	9.1	7.0	489	506	489	504
	8	10	10	10	10												
2.0	9	10	10	10	10	8.2	7.4	7.9	7.4	7.9	6.5	8.7	7.0	590	611	591	616
	10	9/10	10	10	10												
4.0	11	9	8	8	7	8.5	7.5	8.3	7.5	7.6	5.8	8.4	7.0	849	863	849	882
	12	3	3	3	2												
Analyst		LS	SH	SS	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH

Sample	Sample Collection Date/Time	As mg/L $CaCO_3$		Ammonia-N (mg/L)	Residual Chlorine (mg/L)	$DeCl_2$?	LC_{50}
		Alkalinity	Hardness				
Control		86	113				
100%	11-19 96			3.9	<0.02	N/A	3.8%
4:1		170	118				
Analyst		SH	SH	KAH	LS	PP	PP

Comments: PP

I - Initial P - Prior to Renewal R - Renewal T - Termination

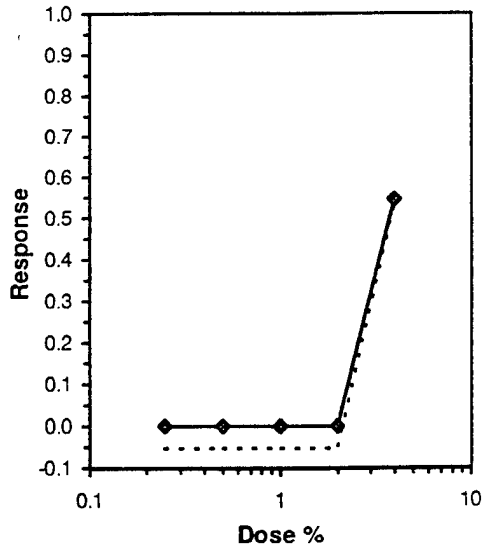
Acute Fish Test-96 Hour Survival

Start Date:	12/3/96 13:30	Test ID:	4321	Sample ID:	PARS-Parsons
End Date:	12/7/96 14:00	Lab ID:		Sample Type:	
Sample Date:		Protocol:	EA-EPA/600/4-90/027F	Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2
Control	0.9000	1.0000
0.25	1.0000	1.0000
0.5	1.0000	1.0000
1	1.0000	1.0000
2	1.0000	1.0000
4	0.7000	0.2000

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-45.5%	3.7755	2.9129	4.8936



ToxCalc v5.0

Reviewed by: PP

Bio-T 4294 + 4295

ENGINEERING-SCIENCE

425 WOODS MILL ROAD SOUTH, SUITE 150
CHESTERFIELD, MISSOURI 63017
(314) 576-7330 FAX (314) 576-2702

No. 01317

Chain-of Custody Record

PROJ. NO.	PROJECT NAME/LOCATION	NO. OF CONTAINERS	PARAMETER	REMARKS
	CDTF Effluent Testing Ft. McClellan Alabama			

SAMPLERS: (Signature)
John e Nicodemus — Ly Ly

STA. NO.	DATE	TIME	COMP.	GRAB.	STATION LOCATION	NO. OF CONTAINERS	PARAMETER	REMARKS
Influent Storage Tank					Ft. McClellan Alabama Influent Storage Tank CDTF Wastewater	1		Acute Tox Test - Ceriodaphnia & Fathead Minnow

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Bruce A. Cox	11/19/96 2:02PM ~~11:30 AM~~	Billy Bishop	Billy Bishop	11/19/96 1645	Charles E. Boothe
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Fed Ex	11/20/96 9:30				
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
		SHARON HAMILTON	11-20-96 1010AM		

Method of Shipment:
Airbill #:
Laboratory:
Cooler #:

Distribution Original Accompanies Shipment. Copy returned with Report.

LAB TEMP 6.8°C

Appendix B: Analysis of DS2 and Other Physical and Chemical Parameters in CDTF Wastewater

ANALYTICAL RESULTS SUMMARY

Date 12/11/96
Report No. 6772
Job No. 724295
Client Mr. Bruce Cox, Parsons ES St. Louis
Project CDTF Effluent, Ft Leonard Wood, 728615.2000
Date Collected 11/19/96
Date Received 11/20/96

Sample Matrix
[X] Water
[ ] Soil
[ ] Other

FIELD SAMPLE NO.: / LABORATORY SAMPLE NO.: / PARAMETER	Influent at Storage Tank (CDTFWW) 96111482	EPA METHOD NO.	DATE OF ANALYSIS
Alkalinity, mg/L $CaCO_3$	3,350	310.1	12/2/96
Ignitability, degrees F	>180	1010	12/10/96
Residual Chlorine, mg/L	<0.50	330.5	11/20/96
Total Dissolved Solids, mg/L	7,390	160.1	12/5/96
Total Organic Carbon, mg/L	1,540	415.1	12/9/96
Total Suspended Solids, mg/L	2,480	160.2	11/22/96
Diethylenetriamine, mg/L	300	8015 mod	11/21/96
Ethylene glycol monomethylether,mg/L	680	8015 mod	11/21/96

blank

QUALITY CONTROL RESULTS SUMMARY

Date 12/10/96
Report No. 6772
Job No. 724295
Client Mr. Bruce Cox, Parsons ES St. Louis
Project CDTF Effluent, Ft. Leonard Wood, 728615.2000

Sample Matrix
[X] Water
[ ] Soil
[ ] Other

Laboratory Supervisor Approval:

David Jones, Laboratory Manager

Analytical Parameter	Lab Sample No.	Blank	RPD	PR	Analytical Parameter	Lab Sample No	Blank	RPD	PR
Alkalinity, mg/L $CaCO_3$	96111482	<10.0	0.9%	--					
Ignitability, degrees F	96111482	--	NC	--					
Residual Chlorine, mg/L	11/20/96 LCS	< 0.050	3.6%	108%					
Total Dissolved Solids, mg/L	96111482	<10.0	1.1%	--					
Total Organic Carbon, mg/L	12/9/96 LCS	<1.00	6.3%	101%					
Total Suspended Solids, mg/L	11/22/96 LCS	<2.00	0%	89%					
Diethylenetriamine, mg/L	96111482	<50	24%	111%					
Ethylene glycol monomethylether, mg/L	96111482	<50	3.7%	88%					

RPD = Relative Percent Difference
PR = Percent Recovery
LCS = Laboratory Control Sample
NC = Not calculated, no reportable concentration or value.

ENGINEERING-SCIENCE

425 WOODS MILL ROAD SOUTH, SUITE 150
CHESTERFIELD, MISSOURI 63017
(314) 576-7330 FAX (314) 576-2702

No. 01316

Chain-of Custody Record

PROJ. NO. | PROJECT NAME/LOCATION: CDTF Effluent Anal. Ft. McClellan Alabama

SAMPLERS: (Signature) John P Nicodemus

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	PARAMETER	REMARKS
Influent Storage tank	11/19/96	9:30 Am			CDTF Wastewater Influent storage TANK (CDTFWW1)	1	Poly Container	Alkalinity, TSS, TDS Per Bruce Cox 11/20/96 1100 BJ
"	11/19/96	"			" (CDTFWW2)	1	Poly Container	" " " "
"	11/19/96	"			" (CDTFWW 3)	1	Poly Container	Agnitability
"	11/19/96	"			" (CDTFWW 4)	1	"	TOC, H_2SO_4 preservation
"	11/19/96	"			" (CDTFWW 5)	1	"	TOC, " "
"	11/19/96	"			" CDTFWW 6	1		Agnitability
"	11/19/96	"			" CDTFWW 7	1		Diethylene triamine and Ethylene Glycol monomethyl ether
"	11/19/96	"			" CDTFWW 8	1	Glass containers	"
"	11/19/96	"			" CDTFWW 9	1		"
"	11/19/96	"			" CDTFWW 10	1		"
						96114582		

LAB USE ONLY CHECKED BY: T. Horsley
TEMP ON RECEIPT: 2 °C
ICE PRESENT Yes No
CUSTODY SEALS Intact Broken NA
PRESERVATION CONFIRMED: Yes No (See Remarks)
Per personnel at lab
Acid residual Chlorine
Per Bruce Cox 11/20/96 1100 BJ

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Bruce A. Cox	11/19/96 1130 Am	Billy Bishop	Billy Bishop	11/19/96 1645	Charles E. Burton
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature) Theresa Horsley	Date / Time 11-20-96 1100	Remarks	Method of Shipment: Airbill #: Laboratory: Cooler #:

Distribution Original Accompanies Shipment. Copy returned with Report.

Appendix C: GB and VX Analysis in CDTF Wastewater

WATER ANALYSIS PAGE 1

DATE.....11-18-1996 TYPE OF SAMPLE.....WASTE WATER
ANALYST.....GREG PETERS BROUGHT BY.....JON NICODEMUS
LOT NUMBER.....96323WW RECEIVED BY.....SFC NEVILLE

SAMPLE WAS DONE ON INSTRUMENT.....KAREN

INITIAL pH OF MOCK SOLUTION ..... 11.06 pH
FINAL pH OF MOCK SOLUTION ..... 7 pH

INITIAL pH OF REAL SAMPLE ..... 10.23 pH
FINAL pH OF REAL SAMPLE ..... 7 pH

DATA...

	rt.vx	area vx	rt gb	area gb
MOCK SOLUTION SPIKED				
	1.699	1314770	2.123	2101730
	1.697	1338545	2.123	2108140
MOCK SOLUTION (UNSPIKED)				
	1.689	82410	2.115	137770
AVERAGE RESPONCE FOR MOCK SPIKED SAMPLE				
	1.698	1326657.5	2.123	2104935

RESPONCE FACTOR...
VX = 132931.6132264529
GB = 209654.8804780877

WATER ANALYSIS

DATA FOR REAL SAMPLES...			
RT VX	AREA VX	RT GB	AREA GB
REAL SAMPLE (SPIKED)...			
1.704	2677303	2.134	1612558
ADJUSTMENT OF REAL SAMPLE (SPIKED)...			
1.704	1350645.5	2.134	0
REAL SAMPLES (UNSPIKED)			
1.703	1263139	0	0
1.705	1612010	0	0

AVERAGE Rt. vx. 1.698
AVERAGE Area vx. 1326657.5
AVERAGE Rt. gb. 2.123
AVERAGE Area gb. 2104935

ppb REAL SAMPLE SPIKED...
VX = 10.16045368906443 ppb
GB = 0 ppb
ppb REAL SAMPLE UNSPIKED...
SAMPLE #1
VX = 9.502171600431913 ppb
GB = 0 ppb
SAMPLE #2
VX = 12.12661127683671 ppb
GB = 0 ppb
AVERAGE ppb VX 10.81439143863431
AVERAGE ppb GB 0

I hereby (DO/DO NOT) authorize the burning of lot no. 96323WW water sample.

signature

14 NOV 96
date

(Please return signed report to the CDTF Laboratory)

Appendix D: MSDSs For DS2, GB and VX

TB 43-0199

TECHNICAL BULLETIN

STORAGE, SHIPMENT, HANDLING, AND DISPOSITION OF DECONTAMINATING AGENT, DS2

Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENT OF THE ARMY

15 FEBRUARY 1995

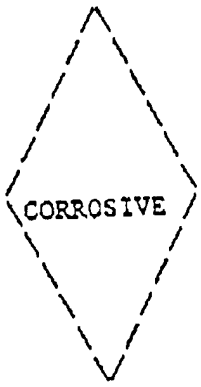
SECTION VI. NEUTRALIZATION

The installation on-scene coordinator for hazardous materials spills should be informed that DS2 is in a storage facility. Per AR 200-1, if a DS2 spill occurs, notify the installation spill response team immediately. They can use sodium bisulfate solution to neutralize DS2 spills. Check the pH with a meter or pH paper. Add more sodium bisulfate solution until the pH is brought down to 9.5 or less. Spills on porous surfaces (concrete, wood, etc.) should be cleaned and neutralized immediately. Otherwise DS2 will be absorbed and become an indefinite hazard. After neutralizing a spill with sodium bisulfate, absorb it on vermiculite (NSN 5640-01-324-2664), clay, or diatomaceous earth. Scoop up all material and any contaminated soil and place in an epoxy coated drum with a fully removable head and label as "corrosive" in accordance with EPA and DOT requirements. During spills, provide adequate ventilation and remove any ignition source. Equipment, grounds, and personnel must be cleaned to the point that no DS2 will be discharged into the environment.

SECTION VII. DISPOSITION

7-1. Disposition. All existing stockpiles of DS2 will be inspected to determine the condition of the material. There will be no disposing of serviceable DS2 containers. All serviceable DS2 will be reported to HQ AMCCOM (B14) using the Materiel Returns Program (see chapter 7 of AR 725-50). Leaking or badly rusted/dented containers will be segregated from serviceable stocks and reclassified as unserviceable. Unserviceable containers of DS2 are a hazardous waste and will be managed as such by all Department of Defense activities. Disposal methods for waste DS2 and accumulated spill cleanup residue must comply with the Resource Conservation Recovery Act, and state and local hazardous waste regulations. The wastes are corrosive, and have the EPA Hazardous Waste Number of D002. This number should be used to permit the use of off-site hazardous waste disposal facilities. For disposal of unserviceable stocks of DS2, coordinate with the Defense Reutilization Marketing Office (DRMO). Disposal methods at overseas military installations must be in accordance with host country laws. Any additional instructions required for proper disposal of DS2 will be provided by the installation or higher headquarters environmental office. Unserviceable DS2 can be reported to the servicing DRMO for inclusion in a hazardous waste disposal contract.

DATE: 31 July 1981
REVISED: 15 Sept 1994



U.S. ARMY EDGEWOOD
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

HCSDS NO: 20059A
Emergency Telephone #s:
ERDEC Safety Office
410-671-4411 0800-1630
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

DS2

SECTION I - GENERAL INFORMATION

MANUFACTURER'S ADDRESS: U.S. ARMY CHEMICAL BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 21010-5423

CAS Registry No: 111-40-0 (Diethylenetriamine)
1310-73-2 (Sodium Hydroxide)
109-86-4 (Ethylene Glycol Monomethyl Ether)

CHEMICAL NAME AND SYNONYMS:

MIXTURE OF:	SYNONYMS:
Diethylenetriamine (70%)	Bis (2-Aminoethyl) amine DETA
Sodium Hydroxide (2%)	Caustic soda
Ethylene Glycol Monomethyl Ether (28%)	Methyl Cellosolve 2-Methoxyethanol EGME

TRADE NAME AND SYNONYMS:

Decontaminating Agent, DS2
DS2
Decon Agent DS2

CHEMICAL FAMILY: Mixture

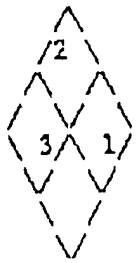
FORMULA/CHEMICAL STRUCTURE:

Diethylenetriamine - NH2 (CH2)2 NH (CH2)2 NH2
Sodium Hydroxide - NaOH
Ethylene Glycol Monomethyl Ether - CH3 OCH2 CH2 OH

NATIONAL STOCK NUMBER (NSN):

Decontaminating Agent DS2, 1-1/3 quart can, NSN: 6850-00-753-4827
Decontaminating Agent DS2, 5 gallon pail, NSN: 6850-00-753-4870
Decontaminating Apparatus, Portable, 14 liter, M13, NSN: 4230-01-133-4124
14 Liter Container, Fluid Filled, NSN: 6850-01-136-8888

NFPA 704 SIGNAL: Health - 3
Flammability- 2
Reactivity- 1



SECTION II - HAZARDOUS INGREDIENTS

Diethylenetriamine - 69-71%	TLV: 4.2 mg/m3 (1 ppm) (skin)
Sodium Hydroxide - 1.9-2.1%	TLV: 2 mg/m3 (ceiling)
Ethylene Glycol Monomethyl Ether - 26.9-29.1%	TLV: 16 mg/m3 (5 ppm) (skin)

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 380 (193.3)

SPECIFIC GRAVITY (H20 = 1): 0.97 - 0.98

APPEARANCE AND ODOR: Clear amber solution with ammonia-like odor.

VISCOSITY (centistokes): 9.9 @ 20 DEG C

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT: (Method Used): The flashpoint of the mixture has been determined to be 168 DEG F (75.5 DEG C) by the closed cup method. The lowest flashing component of the mixture (ethylene glycol monomethyl ether) has a flashpoint of 115 DEG F (46 DEG C) by the closed cup method.

EXTINGUISHING MEDIA: Carbon dioxide, alcohol foam, water

UNUSUAL FIRE AND EXPLOSION HAZARDS: Never mix or store acids, oxidizing agents, STB (Supertropical Bleach) or HTH (High Test Hypochlorite) together with DS2; fire or explosion may result.

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: DS2 is made of two major components (EGME & DETA) with different toxicities and physical properties. The TLV of the mixture (calculated) is 5.2 mg/m3 as an 8 hour time weighted average (TWA). To date the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure limit for DS2 per se nor has the value proposed been officially adopted as a part of a special occupational safety and health standard for DS2 in accordance with DOD 6055.1.

EFFECTS OF OVEREXPOSURE: No toxicity data are available on DS2 per se; however, the toxicity of each of the components has been partially determined.

(1) DS2 is an alkali and with direct contact will corrode tissue, e.g., skin, eye, respiratory mucosa or gastric mucosa. The effects exhibited depend on route of exposure, amount of substance present, and duration of exposure. Health effects can range from mild burns and primary irritation to corneal opacification, severe burns, and esophageal stricture.

(2) Sufficient exposure to EGME, a major component of DS2, may cause central nervous system depression and liver damage. Although not definitely established in humans, reproductive effects (including teratogenisis) are also a major concern with this substance. The National Institute for Occupational Safety and Health (NIOSH) recommends that EGME be regarded in the workplace as having the potential to cause adverse reproductive effects in male and female workers. Appropriate controls must be instituted to minimize worker exposure to EGME.

(3) Exposure to high vapor concentrations of DS2 can cause nausea, vomiting, and respiratory irritation as acute effects.

(4) Repeated skin and respiratory exposures to DETA can cause skin sensitization and asthma.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION: Remove to fresh air. If breathing has stopped, give artifical respiration. If breathing is difficult, give oxygen. Seek medical attention immediately. Additional supportive measures may be required.

EYE CONTACT: Immediately flush the eyes with copious amounts of water for at least 15 minutes. Seek medical attention immediately.

SKIN CONTACT: Flush away the DS2 from the skin with water until "soapiness" is no longer present. Seek medical attention immediately.

INGESTION: If the patient is conscious, give as much milk or water as possible. Do not induce vomiting. Seek medical attention immediately. Supportive measures may be required.

SECTION VI - REACTIVITY DATA

INCOMPATIBILITY: DS2 is a corrosive material and because of its content, it is incompatible with some metals (e.g., cadmium, tin and zinc); some plastics (e.g., Lexan, cellulose acetate, polyvinyl chloride, Mylar, and acrylic); some paints; wool; leather; oxidizing materials (e.g., Supertropical Bleach or High Test Hypochlorite); and acids.

REACTIVITY: DS2 will deteriorate in air. Exposure of 48 hours or more to open air will result in the formation of gelatin-like bodies on the surface of DS2.

SECTION VII- SPILL, LEAK AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Spills on porous surfaces (concrete, wood, etc.) should be cleaned and neutralized immediately. Otherwise, they will be absorbed and become an indefinite hazard. All spills must be contained, e.g., by covering with dry sodium bisulfate to neutralize and then absorbing them on vermiculite (NSN 5640-01-324-2664), clay or diatomaceous earth. Scoop up all this material and any contaminated soil or substrate and place in an epoxycoated drum with a fully removable head, and label as corrosive IAW EPA and DOT requirements. During spills provide adequate ventilation and remove any ignition source. During clean up, personnel should wear a full face respirator with an organic vapor cartridge effective against Diethylenetriamine and Methyl Cellosolve, rubber gloves long enough to protect hands and arms, and a full length rubber apron. Contaminated clothing and shoes should be removed immediately and washed thoroughly with water before reuse. Avoid contact with leaking liquid or vapor. All wash water should have pH measured. All material with a pH less than 2.0 or greater than 12.5 is hazardous waste with an EPA number of D002.

WASTE DISPOSAL METHOD: Waste DS2 has been tested and is a hazardous waste with an EPA waste number of D002. Disposal methods for waste DS2 and accumulated spill cleanup residues must comply with RCRA, state, and local hazardous waste regulations and procedures. If the wastes are corrosive, they have the EPA Hazardous Waste Number of D002. This number should be used when the waste is manifested, to permit the use of off-site hazardous waste disposal facilities. For disposal of excess stocks of pure DS2, coordinate with the Defense Reutilization and Marketing Office (DRMO). Disposal methods at overseas military installations must be in accordance with the laws of the host country.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration (mg/m3) 8 hour TWA	Respiratory Protection
Less than 5.2 (as mixture i.e., 3.7 mg/m3 DETA and 1.5 mg/m3 EGME)	Escape type respirators shall be available when necessary. o any NIOSH approved full facepiece respirator with an organic vapor canister. (i.e. gas mask) o any NIOSH approved escape type SCBA
Greater than 5.2 or unknown concentrations	o any NIOSH approved full facepiece pressure demand SCBA o any NIOSH approved full-face piece positive pressure, supplied-air respirator with auxiliary SCBA

NOTE: For military personnel engaged in training scenarios the M9, M17 or M40 series mask is acceptable. Filter elements and canisters should be changed after each use with DS2.

VENTILATION: Local exhaust - Necessary if TLV (TWA) exceeded.

PROTECTIVE GLOVES: Butyl Rubber

EYE PROTECTION: Splashproof chemical goggles. When there is potential for severe exposure, chemical goggles and face shield are recommended.

OTHER PROTECTIVE EQUIPMENT: Hooded chemical-resistant clothing (i.e., overalls & long sleeve jacket, or one- or two-piece chemical splash suit) and chemical resistant boots. Military personnel will use standard issue equipment during training operations.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Avoid extreme temperatures (e.g. 160 Deg F or higher) during storage.

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Caustic Alkali Liquids, n.o.s., UN 1719

DOT HAZARD CLASSIFICATION: Corrosive Material, Class 8, Packing Group II

DOT LABEL: Corrosive with an "8"

DOT MARKING: Caustic Alkali Liquids, n.o.s. (Diethylenetriamine, Ethylene Glycol Monomethyl Ether, Sodium Hydroxide) UN 1719

DOT PLACARD: Corrosive

EMERGENCY ACCIDENT PRECAUTIONS & PROCEDURES: See Sections IV, VII, and VIII.

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Shipping "on-deck" or "under-deck" is permitted in cargo and passenger vessels subject to the requirements of 49 CFR 176.63 (b) and (c). MSDS for DS2 will be placed with all shipments. DS2 is limited to 5 gallons per package when shipped by cargo aircraft. Bulk packaging of DS2 (1 1/3 quart, 5 gallons, and M13 Portable Decontaminating Apparatus) are not authorized for shipment on passenger carrying aircraft or rail cars. Shipment on passenger carrying aircraft or railcar is permitted in 1 quart packages. DS2 will be packed and shipped in accordance with 49 CFR 173.202. Packaging exceptions can be found in 49 CFR 173.154.

MATERIAL SAFETY DATA SHEET

LETHAL NERVE AGENT (GB)

SECTION I - GENERAL INFORMATION

DATE: 14 September 1988
REVISED: 28 February 1996

MANUFACTURER'S ADDRESS:

U.S. ARMY CHEMICAL BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH DEVELOPMENT, AND ENGINEERING CENTER
(ERDEC)
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 20101-5423

Emergency telephone #' s: 0700-1630 EST: 410-671-4411/4414
After: 1630 EST: 410- 278-5201, Ask for Staff Duty Officer

CAS REGISTRY NUMBERS: 107-44-8, 50642-23-4

CHEMICAL NAME:

Isopropyl methylphosphonofluoridate

ALTERNATE CHEMICAL NAMES:

O-Isopropyl Methylphosphonofluoridate

Phosphonofluoridic acid, methyl-, isopropyl ester

Phosphonofluoridic acid, methyl-, 1-methylethyl ester

TRADE NAME AND SYNONYMS:

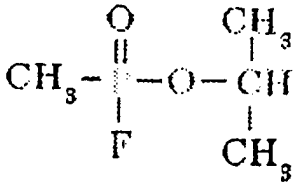
Isopropyl ester of methylphosphonofluoridic acid
Methylisopropoxfluorophosphine oxide
Isopropyl Methylfluorophosphonate
O-Isopropyl Methylisopropoxfluorophosphine oxide
Methylfluorophosphonic acid, isopropyl ester
Isopropoxymethylphosphonyl fluoride

Isopropyl methylfluorophosphate
Isopropoxymethylphosphoryl fluoride
GB
Sarin
Zarin

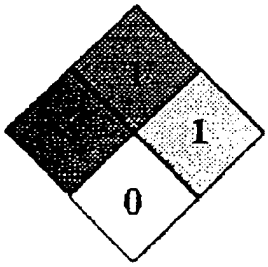
CHEMICAL FAMILY: Fluorinated organophosphorous compound

FORMULA/CHEMICAL STRUCTURE:

C4H10FO2P



NFPA 704 HAZARD SIGNAL:



Health - 4
Flammability - 1
Reactivity - 1
Special - 0

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
GB	C4H10FO2P	100	0.0001 mg/m3

SECTION III - PHYSICAL DATA

BOILING POINT: 158 C (316 F)

VAPOR PRESSURE (mm Hg): 2.9 @ 25 C

VAPOR DENSITY (AIR=1): 4.86

SOLUBILITY: Miscible with water. Soluble in all organic solvents.

SPECIFIC GRAVITY (H2O=1): 1.0887 @ 25 C

FREEZING/MELTING POINT: -56 C

LIQUID DENSITY (g/cc):

1.0887 @ 25 C
1.102 @ 20 C

PERCENTAGE VOLATILE BY VOLUME:

22,000 m/m3 @ 25 C
16,090 m/m3 @ 20 C

APPEARANCE AND ODOR: Colorless liquid. Odorless in pure form.

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT (METHOD USED): Did not flash to 280 F

FLAMMABLE LIMIT: Not applicable

LOWER EXPLOSIVE LIMIT: Not available

UPPER EXPLOSIVE LIMIT: Not available

EXTINGUISHING MEDIA: Water mist, fog, foam, CO2.

Avoid using extinguishing methods that will cause splashing or spreading of the GB.

SPECIAL FIRE FIGHTING PROCEDURES: GB will react with steam or water to produce toxic and corrosive vapors. All persons not engaged in extinguishing the fire should be evacuated. Fires involving GB should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, firefighting personnel should wear full firefighting protective clothing (without TAP clothing) during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes, they will wear appropriate levels of protective clothing (**See Section VIII**).

Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact

with the agent liquid or vapor can be fatal

UNUSUAL FIRE AND EXPLOSION HAZARDS: Hydrogen may be present.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMITS (AEL): The permissible airborne exposure concentration for GB for an 8-hour workday or a 40-hour work week is an 8-hour time weight average (TWA) of 0.0001 mg/m3. This value is based on the TWA of GB which can be found in "AR 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX." To date, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for GB.

GB is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

EFFECTS OF OVEREXPOSURE: GB is a lethal cholinesterase inhibitor. Doses that are potentially life threatening may be only slightly larger than those producing least effects.

GB

Route Dosage	Form	Effect	Type
ocular	vapor	ECt50	<2 mg-min/m3
inhalation	vapor	ECt50	<2 mg-min/m3
inhalation (15 l/min)	vapor	ICt50	35 mg-min/m3
inhalation	vapor	LCt50	70 mg-min/m3
percutaneous	liquid	LD50	1700 mg/70 kg man

Effective dosages for vapor are estimated for exposure durations of 2-10 minutes.

Symptoms of overexposure may occur within minutes or hours, depending upon dose. They include: miosis (constriction of pupils) and visual effects, headaches and pressure sensation, runny nose and nasal congestion, salivation, tightness in the chest, nausea, vomiting, giddiness, anxiety, difficulty in thinking and sleeping, nightmares, muscle twitches, tremors, weakness, abdominal cramps, diarrhea, involuntary urination and defecation. With severe exposure symptoms progress to convulsions and respiratory failure.

EMERGENCY AND FIRST AID PROCEDURES:

. INHALATION: Hold breath until respiratory protective mask is donned If severe signs of agent exposure appear (chest tightens, pupil constriction, incoordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by the local physician).

Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No

more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention IMMEDIATELY.

EYE CONTACT: Immediately flush eyes with water for at least 15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken IMMEDIATELY to the medical treatment facility for observation.

SKIN CONTACT: Don respiratory protective mask and remove contaminated clothing Immediately wash contaminated skin with copious amounts of soap and water, 10% sodium carbonate solution, or 5% liquid household bleach. Rinse well with water to remove decontaminant. Administer Nerve Agent Antidote Kit(s), MARK I injectors only if local sweating and muscular twitching symptoms are observed. Seek medical attention IMMEDIATELY.

INGESTION: Do not induce vomiting. First symptoms are likely to be gastrointestinal. IMMEDIATELY administer Nerve Agent Antidote Kit(s), MARK I injector(s). Seek medical attention IMMEDIATELY.

SECTION VI - REACTIVITY DATA

STABILITY: Stable when pure.

INCOMPATIBILITY: Attacks tin, magnesium, cadmium plated steel, and some aluminum. Slightly attacks copper, brass, and lead; practically no attack on 1020 steels, Inconel & K-monel.

HAZARDOUS DECOMPOSITION: Hydrolyzes to form HF under acid conditions and isopropyl alcohol & polymers under basic conditions.

HAZARDOUS POLYMERIZATION: Does not occur.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: If leaks or spills occur, only personnel in full protective clothing will remain in area (**See Section VIII**). In case of personnel contamination see **Section V** for emergency and first aid instructions.

RECOMMENDED FIELD PROCEDURES: Spills must be contained by covering with vermiculite, diatomaceous earth, clay, fine sand, sponges, and paper or cloth towels. Decontaminate with copious amounts of aqueous sodium hydroxide solution (a minimum 10 wt. %). Scoop up all material and place in a fully removable head drum with a high density polyethylene liner. Cover the contents of the drum with decontaminating solution as above before affixing the drum head. After sealing the head, the exterior of the drum will be

decontaminated and then labeled in accordance with EPA and DOT regulations. All leaking containers will be over packed with vermiculite placed between the interior and exterior containers Decontaminate and label in accordance with EPA and DOT regulations.

Dispose of the material in accordance with waste disposal methods provided below. Dispose of material used to decontaminate exteriorly of a drum in accordance with Federal, state and local regulations. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (**See Sections II and VIII**).

If 10 wt.% aqueous sodium hydroxide solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Decontamination Solution No. 2 (DS2), Sodium Carbonate, and Supertropical Bleach Slurry (STB).

RECOMMENDED LABORATORY PROCEDURES: A minimum of 56 grams of decon solution is required for each gram of GB. Decontaminant/agent solution is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour. At the end of the one hour, the resulting solution should be adjusted to a pH greater than 11.5. If the pH is below 11.5, NaOH should be added until a pH above 11.5 can be maintained for 60 minutes. An alternate solution for the decontamination of GB is 10 wt.% sodium carbonate in place of the 10% sodium hydroxide solution above. Continue with 56 grams of decon to 1 gram of agent. Agitate for one hour but allow three (3) hours for the reaction. The final pH should be adjusted to above zero. It is also permitted to substitute 5.25% sodium hypochlorite or 25 wt. % Monoethylamine (MEA) for the 10% sodium hydroxide solution above. MEA must be completely dissolved in water before addition of the agent. Continue with 56 grams of decon for each gram of GB and provide agitation for one hour. Continue with same ratios and time stipulations. Scoop up all material and place in a fully removable head drum with a high density polyethylene liner. Cover the contents of the drum with decontaminating solution as above before affixing the drum head. After sealing the head, the exterior of the drum will be decontaminated and then labeled in accordance with EPA and DOT regulations. All leaking containers will be over packed with vermiculite placed between the interior and exterior containers. Decontaminate and label in accordance with EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Dispose of material used to decontaminate exterior of the drum in accordance with Federal, state and local regulations. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (**See Sections II and VIII**).

WASTE DISPOSAL METHOD: Open pit burning or burying of GB or items containing

or contaminated with GB in any quantity is prohibited. The detoxified GB (using procedures above) can be thermally destroyed by incineration in EPA approved incinerators in accordance with appropriate provisions of Federal, state and local Resource Conservation and Recovery Act (RCRA) Regulations.

NOTE: Some states define decontaminated surety material as an RCRA Hazardous waste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

CONCENTRATION	RESPIRATORY PROTECTIVE EQUIPMENT
<0.0001 mg/m3	A full face piece, chemical canister, air purifying protective mask will be on hand for escape. (The M9-, M17-, or M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used)
> 0.0001 or =0.2 mg/m3	A NIOSH/MSHA approved pressure demand full face piece SCBA or supplied air respirators with escape air cylinder may be used. Alternatively, a full face piece, chemical canister air-purifying protective mask is acceptable for this purpose (See DA PAM 385-61 for determination of appropriate level)
>0.2 or unknown mg/m3	NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble (See DA PAM 385-61 for examples)

VENTILATION:

Local Exhaust: Mandatory. Must be filtered or scrubbed to limit exit concentration to < 0.0001 mg/m3. Air emissions will meet local, state and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke producing devices will be performed in the assessment of the hoods ability to contain agent GB.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection is allowed between agent areas and other areas through the ventilation system. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

PROTECTIVE GLOVES:

Butyl Glove M3 and M4

Norton, Chemical Protective Glove Set

EYE PROTECTION: As a minimum chemical goggles will be worn. For splash hazards use goggles and face shield.

OTHER PROTECTIVE EQUIPMENT: For general lab work, gloves and lab coat will be worn with M9, M17 or M40 mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

MONITORING: Available monitoring equipment for agent GB is the M8/M9 Detector paper, detector ticket, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automatic Continuous Air Monitoring System (ACAMS), real time monitoring (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A2, Hydrogen Flame Photometric Emission Detector (HYFED), CAM-M1, Miniature Chemical Agent Monitor (MINICAM) and the Real Time Analytical Platform (RTAP).

Real-time, low-level monitors (with alarm) are required for GB operations. In their absence, an IDLH atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: When handling agents, the buddy system will be incorporated. No smoking, eating and drinking in areas containing agents are permitted. Containers should be periodically inspected for leaks either visually or by a detector kit). 

Stringent control over all personnel practices must be exercised Decontamination equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and each worker will shower thoroughly with special attention given to hair, face, neck, and hands, using plenty of soap and water before leaving at the end of the work day.

OTHER PRECAUTIONS: GB must be double contained in liquid and vapor tight containers when in storage or outside a ventilation hood.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA PAM 385-61, Toxic Chemical Agent Safety Standards," and "AR 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX."

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquids, n.o.s.

DOT HAZARD CLASSIFICATION: 6.1, Packing Group I,

Hazard Zone A

DOT LABEL: Poison

DOT MARKING: Poisonous liquid, n.o.s. (Isopropyl methylphosphonofluoridate) UN2810, Inhalation Hazard

DOT PLACARD: Poison

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: **See Sections IV, VII and VIII.**

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded regardless of quantity. Drivers will be given full in formation regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipments of agent will be escorted in accordance with AR 740-32.

MATERIAL SAFETY DATA SHEET

LETHAL NERVE AGENT (VX)

SECTION I - GENERAL INFORMATION

DATE: 14 September 1988
REVISED: 28 February 1996

MANUFACTURER'S ADDRESS:

U.S. ARMY CHEMICAL BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH DEVELOPMENT, AND ENGINEERING CENTER
(ERDEC)
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 20101-5423

Emergency telephone #' s: 0700-1630 EST: 410-671-4411/4414
After: 1630 EST: 410- 278-5201, Ask for Staff Duty Officer

CAS REGISTRY NUMBERS: 50782-69-9, 51848-47-6, 53800-40-1, 70938-84-0

CHEMICAL NAME:

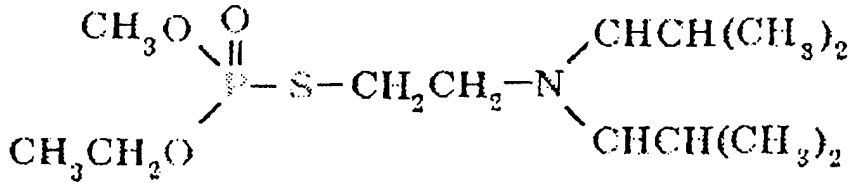
O-ethyl-S-(2-iisopropylaminoethyl) methyl phosphonothiolate

TRADE NAME AND SYNONYMS:

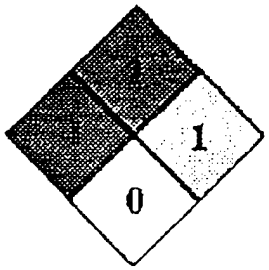
Phosphonothioic acid, methyl-, S-(2-bis(1-methylethylamino)ethyl) 0-ethyl ester
O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothiolate
S-2-Diisopropylaminoethyl O-ethyl methylphosphonothioate
S-2((2-Diisopropylamino)ethyl) O-ethyl methylphosphonothiolate
O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothioate
O-ethyl S-(2-diisopropylaminoethyl) methylthiolphosphonoate
S-(2-diisopropylaminoethyl) o-ethyl methyl phosphonothiolate
Ethyl- ;-dimethylaminoethyl methylphosphonothiolate
VX
EA 1701
TX60

CHEMICAL FAMILY: Sulfonated organophosphorous compound

FORMULA/CHEMICAL STRUCTURE:
C11H26NO2PS



NFPA 704 HAZARD SIGNAL:



Health - 4
Flammability - 1
Reactivity - 1
Special - 0

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENTS EXPOSURE	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
VX	C11H26NO2PS	100%	~~0.0001 mg/m3~~ 0.00001 AEL-TWA

SECTION III - PHYSICAL DATA

BOILING POINT : 298 C (568 F)

VAPOR PRESSURE (mm Hg): 0.0007 @ 20 C

VAPOR DENSITY (AIR=1): 9.2

FREEZING/MELTING POINT : Below -51 C

LIQUID DENSITY (g/cc): 1.0083 @ 20 C

PERCENTAGE VOLATILE BY VOLUME: 10.5 mg/m3 @ 25 C

SOLUBILITY: Slightly soluble in water at room temperature. Soluble in organic solvents.

APPEARANCE AND ODOR: Colorless to straw colored liquid & odorless, similar in appearance to motor oil.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT: 159 C (McCutchan - Young)

FLAMMABILITY LIMITS (% by volume): Not Available

LOWER EXPLOSIVE LIMIT: Not Applicable

UPPER EXPLOSIVE LIMIT: Not Applicable

EXTINGUISHING MEDIA: Water mist, fog, foam, CO2. Avoid using extinguishing methods that will cause splashing or spreading of the VX.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving VX should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing VX , fire fighting personnel should wear full firefighter protective clothing (without TAP clothing) during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief of chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing **(See Section VIII).**

Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminated other areas or sewers. Contact with liquid VX or vapors can be fatal.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None known.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMITS (AEL): The permissible airborne exposure concentration for VX for an 8-hour workday of a 40-hour work week is an 8-hour time weighted average (TWA) of 0.00001 mg/m3. This value can be found in "AR 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX." To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for VX.

VX is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and

Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

EFFECTS OF OVEREXPOSURE: VX is a lethal cholinesterase inhibitor. Doses which are potentially life-threatening may be only slightly larger than those producing least effects. Death usually occurs within 15 minutes after absorption of a fatal dosage.

VX

Route	Form	Effect	Type	Dosage
ocular	vapor	miosis	ECt50	<0.09 mg-min/m3
inhalation	vapor	runny nose	ECt50	<0.09 mg-min/m3
inhalation (15 l/min)	vapor	severe incapacitation	ICt50	25 mg-min/m3
inhalation (15 l/min)	vapor	death	LCt50	30 mg-min/m3
percutaneous	liquid	death	LD50	10 mg/70 kg man

Effective dosages for vapor are estimated for exposure durations of 2-10 minutes.

Symptoms of overexposure may occur within minutes or hours, depending upon the dose. They include: miosis (constriction of pupils) and visual effects, headaches and pressure sensation, runny nose and nasal congestion, salivation, tightness in the chest, nausea, vomiting, giddiness, anxiety, difficulty in thinking, difficulty sleeping, nightmares, muscle twitches, tremors, weakness, abdominal cramps, diarrhea, involuntary urination and defecation. With severe exposure symptoms progress to convulsions and respiratory failure.

EMERGENCY AND FIRST AID PROCEDURES:

, INHALATION: Hold breath until respiratory protective mask is donned. If severe signs of agent exposure appear (chest tightens, pupil constriction, incoordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by the local physician). Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention **IMMEDIATELY.**

EYE CONTACT: **IMMEDIATELY** flush eyes with water for 10-15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken **IMMEDIATELY** to a medical treatment facility for observation.

SKIN CONTACT: Don respiratory protective mask and remove contaminated clothing. Immediately wash contaminated skin with copious amounts of soap and water, 10% sodium

carbonate solution, or 5% liquid household bleach. Rinse well with water to remove excess decontaminant. Administer nerve agent antidote kit, Mark I, only if local sweating and muscular twitching symptoms are observed. Seek medical attention **IMMEDIATELY**

INGESTION: Do not induce vomiting. First symptoms are likely to be gastrointestinal. **IMMEDIATELY** administer Nerve Agent Antidote Kit, Mark I. Seek medical attention **IMMEDIATELY** .

SECTION VI - REACTIVITY DATA

STABILITY: Relatively stable at room temperature. Unstabilized VX of 95% purity decomposes at a rate of 5% a month at 71 C.

INCOMPATIBILITY: Negligible on brass, steel, aluminum.

HAZARDOUS DECOMPOSITION PRODUCTS: During a basic hydrolysis of VX up to 10% of the agent is converted to diisopropylaminoethyl methylphosphonothioic acid (EA2192). Based on the concentration of EA2192 expected to be formed during hydrolysis and its toxicity (1.4 mg/kg dermal in rabbit at 24 hours in a 10/90 wt.% ethanol/water solution), a Class B poison would result. The large scale decon procedure, which uses both HTH and NaOH, destroys VX by oxidation and hydrolysis. Typically the large scale product contains 0.2 - 0.4 wt.% EA2192 at 24 hours. At pH 12, the EA2192 in the large scale product has a half-life of about 14 days. Thus, the 90-day holding period at pH 12 results in about a 64-fold reduction of EA2192 (six half-lives). This holding period is sufficient to reduce the toxicity of the product below that of a Class B poison. Other less toxic products are ethyl methylphosphonic acid, methylphosphinic acid, diisopropyaminoethyl mercaptan, diethyl methylphosphonate, and ethanol. The small scale decontamination procedure uses sufficient HTH to oxidize all VX thus no EA2192 is formed.

HAZARDOUS POLYMERIZATION: Does not occur.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: If leaks or spills occur, only personnel in full protective clothing **(See Section VIII)** will remain in area. In case of personnel contamination see **(Section V)** for emergency and first aid instructions.

RECOMMENDED FIELD PROCEDURES (For Quantities greater than 50 grams): (NOTE: These procedures can only be used with the approval of the Risk Manager or qualified safety personnel). Spills must be contained by covering with vermiculite, diatomaceous earth, clay or fine sand. An alcoholic HTH mixture is prepared by adding 100 milliliters of denatured ethanol to a 900-milliliter slurry of 10% HTH in water. This mixture should be made just before use since the HTH can react with the ethanol. Fourteen grams of alcoholic HTH solution are used for each gram of VX. Agitate the decontamination mixture as the VX is added. Continue the agitation for a minimum of one hour. This reaction is reasonablely exothermic and evolves substantial off gassing. The evolved reaction gases should be routed through a decontaminate filled scrubber before

release through filtration systems. After completion of the one hour minimum agitation, 10% sodium hydroxide is added in a quantity equal to that necessary to assure that a pH of 12.5 is maintained for a period not less than 24 hours. Hold the material at a pH between 10 and 12 for a period not less than 90 days to ensure that a hazardous intermediate material is not formed **(See Section VI)** . After sealing the head, the exterior of the drum will be decontaminated and then labeled in accordance with EPA and DOT regulations. All leaking containers will be over packed with vermiculite placed between the interior and exterior containers. Decontaminate and label in accordance with EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits **(See Sections II and VIII).**

If the alcoholic HTH mixture is not available then the following decontaminants may be used instead and are listed in the order of preference: Decontamination solution No. 2 (DS2), Supertropical Bleach Slurry (STB), and Sodium Hypochlorite.

RECOMMENDED LABORATORY PROCEDURES (For Quantities less than 50 grams): If the active chlorine of the Calcium Hypochlorite (HTH) is at least 55%, then 80 grams of a 10% slurry are required for each gram of VX. Proportionally more HTH is required if the chlorine activity of the HTH is lower than 55%. The mixture is agitated as the VX is added and the agitation is maintained for a minimum of one hour. If phasing of the VX/decon solution continues after 5 minutes, an amount of denatured ethanol equal to a 10 wt.% of the total agent/decon will be added to help miscibility.

NOTE: ETHANOL SHOULD BE REDUCED TO PREVENT THE FORMATION OF A HAZARDOUS WASTE. Upon completion of the one hour agitation the decon mixture will be adjusted to a pH between 10 and 11. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits **(See Sections II and VIII)** .

WASTE DISPOSAL METHOD: Open pit burning or burying of VX or items

containing or contaminated with VX in any quantity is prohibited. The detoxified VX (using procedures above) can be thermally destroyed by in a EPA approved incinerator in accordance with appropriate provisions of Federal, State and/or local Resource Conservation and Recovery Act (RCRA) regulations.

NOTE: Some states define decontaminated surety material as a RCRA Hazardous Waste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

CONCENTRATION	RESPIRATORY PROTECTIVE EQUIPMENT

<0 00001 mg/m3	A full face piece, chemical canister, air-purifying protective mask will be on hand for escape. (The M9-, M17-, or M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used).
>0.00001 or = 0.02 mg/m3	A NIOSH/MSHA approved pressure demand full face piece SCBA or supplied air respirators with escape air cylinder may be used. Alternatively, a full face piece, chemical canister air-purifying protective mask is acceptable for this purpose (See DA PAM 385-61 for determination of appropriate level)
>0 02 mg/m3 or unknown	NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble (See DA PAM 385-61 for examples).

VENTILATION:

Local exhaust: Mandatory. Must be filtered or scrubbed to limit exit concentration to Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent VX.

Other: Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

PROTECTIVE GLOVES: Butyl glove M3 and M4 Norton, Chemical Protective Glove Set

EYE PROTECTION: At a minimum chemical goggles will be worn. For splash hazards use goggles and face shield.

OTHER PROTECTIVE EQUIPMENT: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

MONITORING: Available monitoring equipment for agent VX is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAMMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

Real-time, low-level monitors (with alarm) are required for VX operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

SECTION IX - SPECIAL PRECAUTIONS

. PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: When handling agents the buddy system will be incorporated. No smoking, eating, and drinking in areas containing chemicals is permitted. Containers should be periodically inspected for leaks (either visually 

or by a detector kit). Stringent control over all personnel practices must be exercised. Decontamination equipment will be conveniently located. Exits must be designed to permit rapid evacuation.Chemical showers, eyewash stations and personal cleanliness facilities must be provided. Wash hands before meals, each worker will shower thoroughly with special attention given to hair, face, neck, and hands, using plenty of soap and water before leaving at the end of the workday.

OTHER PRECAUTIONS: VX must be double contained in liquid and vapor tight containers when in storage or outside a ventilation hood.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA PAM 385-61, Toxic Chemical Agent Safety Standards," and "AR 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX."

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquids, n.o.s.

DOT HAZARD CLASS: 6.1 Packing Group I, Zone A

DOT LABEL: Poison

DOT MARKING: Poisonous liquids, n.o.s. (O-ethyl S-(2-diisopropylaminoethyl)methyl phosphonothiolate) UN 2810, Inhalation Hazard

DOT PLACARD: Poison

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: **See Sections IV, VII and VIII** .

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded, regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipments of agent will be escorted in accordance with AR 740-32.

Appendix E: CASRAM Transportation Model Report

CASRAM Modeling on Risk Assessment of CDFT Wastewater Transportation

Prepared by

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This letter report describes the application of CASRAM (Chemical Accident Statistical Risk Assessment Model) to estimate the risk involved in transporting CDTF wastewater from Fort Leonard Wood, Missouri to Chemical Waste Management in Vickery, Ohio two times per month. The report is broken into three sections: (a) Background on CASRAM, (b) Application of CASRAM to the CDTF Wastewater Risk Assessment, and (c) Results.

Background on CASRAM

CASRAM is a statistical, chemical accident, risk assessment model that predicts distributions of hazard zones (i. e., areas in which a threshold concentration of a specific chemical is exceeded) and exposed populations resulting from hazardous material shipments. The model utilizes shipment attributes such route traveled, container type, and container size along with an extensive meteorological database to statistically model chemical release rates and hazardous material dispersion through Monte Carlo sampling of accident scenarios. Combining this information with health criteria for the applicable chemicals allows distributions of exposed population to be generated.

We must emphasize that CASRAM is specifically designed for the *statistical* analysis of transportation risk. It is this feature, in particular, that separates CASRAM from other dispersion models (e.g., ALOHA and HGSYSTEM). Rather than providing a deterministic measure of risk, CASRAM provides the distribution of possible outcomes allowing the probability of various consequences to be analyzed.

The main analysis procedures within CASRAM are discussed in the following sections as the application of CASRAM to CDTF wastewater transportation risk assessment is reviewed. Additional technical information on CASRAM, including the source and dispersion models employed as well as the statistical analysis procedures used, is given in Brown et al., 1996.

Application of CASRAM to the CDTF Wastewater Risk Assessment

For this analysis, the general parameters governing the shipments as provided by Parsons Engineering are as follows:

(1) Origin and destination: Fort Leonard Wood, Missouri to Chemical Waste Management in Vickery, Ohio.

(2) Type of Vehicle: Tank truck

(3) Number and type of container(s): One 5000 gallon capacity tank per truck

(4) Quantity shipped: 5000 gallons

(5) Frequency of shipment: Two times per month

(6) Chemicals shipped: 4 chemicals in aqueous solution: (1) diethylenetriamine at 300 ppm, (2) ethylene glycol monomethyl ether at 680 ppm, (3) VX at < 20 ppb, and (4) GB at < 20 ppb.

(7) Health criteria for the chemicals involved: (1) ACGIH TLV-TWA of 4.2 mg/m^3 for diethylenetriamine, (2) ACGIH TLV-TWA of 16 mg/m^3 for ethylene glycol monomethyl ether, (3) an Atmospheric Exposure Limit of 0.00001 mg/m^3 for VX, and (4) an Atmospheric Exposure Limit of 0.0001 mg/m^3 for GB.

As discussed in the previous section, CASRAM uses the above input data to estimate the distribution of exposed population. The route employed in our analysis was generated using HIGHWAY 3.1 (Johnson et al., 1993), a standard highway routing program. Since Fort Leonard Wood, Missouri and Vickery, Ohio are not explicitly identified in HIGHWAY 3.1, the origin and destination used in the analysis were chosen to be Rolla, Missouri and Sandusky, Ohio. These cities are within 20 miles of the actual origin and destination thus yielding negligible error in estimating the risk. HIGHWAY 3.1 provided a route consisting of 42 segments with a total length of 606 miles. The population density information used in the analysis was also that provided by HIGHWAY 3.1. For each of the 42 segments, the fraction of that segment lying in each of 10 population density categories is provided. These data are then used to compute the exposed population.

Accident probabilities were based on the work of Harwood and Russell, 1990. These authors give values of 0.56, 0.79 and 1.01 accidents per million miles traveled depending on whether the location is rural, suburban or urban, respectively. The accident probability for each route segment is determined based on these probabilities and the population densities provided by the HIGHWAY program. Using this approach,

the probability of an accident occurring anywhere along the entire route examined in this analysis is 1 accident for every 2671 shipments. For the tanker truck considered in this analysis, the probability of a release given an accident is taken to be 0.188. This value is appropriate for bulk liquid shipments as discussed by Harwood and Russell (1990). Combining the accident probability with the release probability given an accident, we may expect one accident with a release in 14,142 shipments. It is important to note that the release probability used in this analysis does not include releases that occur as a result of loading and unloading accidents. Such accidents are more common than on-the-road or "enroute" accidents but, on average, involve much smaller release amounts and, therefore, typically pose less risk.

For each hypothetical accident with release, the release amount was determined by sampling a distribution of release fractions drawn from a database of more than 400 actual on-the-road tanker truck (DOT code TNKTRK) accidents involving releases. These accidents, all of which occurred between 1990 and 1995, were drawn from the Hazardous Materials Incident Reporting System (HMIRS) database.

The meteorology for each hypothetical accident is then obtained based on the location and time of the accident, both of which are statistically determined. Based on the release amount and the meteorology, the source model within CASRAM estimates the vapor release rates for the various chemicals. For this analysis, the solution properties were approximated as those of water, and the release rates of the four chemicals were taken as the solution evaporation rate scaled by the chemical concentrations. (The agent concentrations were taken to be 20 ppb.) Based on the meteorology, the chemical release rates and the health criteria, the dispersion model estimates the area of the hazard zone, which is then multiplied by the local population density to determine the exposed population for that particular accident.

In total, 500,000 releases along the route were simulated in the CASRAM analysis. Given that one release occurs every 14,142 shipments and that 24 shipments are made per year, this analysis effectively considers the consequences of approximately 7 billion shipments occurring over 300 million years. This large number of hypothetical accidents allows the characteristics of the probability distribution to be fully defined.

One last note concerns the health criteria used in this study. The health criteria provided by Parsons Engineering are occupational values which are based on long-term exposures at 40 hours per week for an entire working lifetime. For our purposes, emergency response values representing short-term, once-in-a-life-time exposures are more appropriate. Therefore, we have conducted the analysis using two sets of health criteria: (a) the occupational values provided and (b) emergency response values

estimated from these occupational values. For emergency response applications, ERPG (Emergency Response Planning Guideline) values are widely regarded as the best available. Unfortunately, ERPG values are lacking for the chemicals in question. Emergency response values for chemicals which do not have ERPG values, can be estimated from LC_{50} (lethal concentration for 50 % of the population) values or occupational values. Since consensus LC_{50} values are lacking for three of the four chemicals in question, the estimates based on occupational values were used. To this end, emergency response health criteria were estimated by multiplying the occupational values by a factor of five (5) as recommended by Craig et al. (1995) and Woudenberg and Van Der Torn (1992). We note that values estimated using this procedure are generally considered to be conservative.

Results

The results are presented in Table 1 for the two sets of health criteria (occupational and emergency response) discussed previously. Two forms are given. First, the probability that a specified number of persons is exposed to a concentration exceeding the corresponding health criteria in one year of operation is tabulated. For example, the probability that 1 or more persons will be exposed to a concentration exceeding the *emergency response criteria* during any given year of operation is 6.88×10^{-5}. Similarly, the probability that 100 or more persons will be exposed is 3.33×10^{-9}. These probabilities can be compared with other risks such as that of being struck by lightning, for example. This risk due to inhalation effects can also be compared with the risk posed by the operation of tank truck itself.

Second, the results are presented in terms of the expected number of years of operation for a given event to occur. For example, one may reasonable expect that, in 1.45E+04 or 14500 years of operation, one event will occur exposing 1 person to concentration levels exceeding the *emergency response criteria*. Similarly, one may expect one event exposing 100 persons in 3×10^8 or 300 million years of operation.

These probabilities show that accidents affecting 100 or more persons are possible, but their probability of occurrence is very low. Such accidents occur under the very unlikely combination of 100 % of contents released along with worst-case meteorological conditions (clear-sky, low-wind-speed, nighttime conditions) in highly populated areas.

Table 1. Probability of event and expected number of years of operation for CDFT wastewater shipments as function of number of persons exposed. Values are shown for both the occupational and emergency response health criteria.

	Occupational health criteria		Emergency response health criteria	
Exposed persons	Probability per year	Expected Years of Operation	Probability per year	Expected Years of Operation
1	1.69E-04	5.92E+03	6.88E-05	1.45E+04
2	5.48E-05	1.82E+04	1.33E-05	7.52E+04
5	2.61E-05	3.83E+04	3.10E-06	3.23E+05
10	1.31E-05	7.63E+04	1.08E-06	9.26E+05
20	4.29E-06	2.33E+05	1.92E-07	5.21E+06
50	8.57E-07	1.17E+06	6.67E-09	1.50E+08
100	1.18E-07	8.47E+06	3.33E-09	3.00E+08
200	6.67E-09	1.50E+08	< 3.33E-09	> 3.00E+08
500	3.33E-09	3.00E+08	< 3.33E-09	> 3.00E+08

References

Brown, D. F., W. E. Dunn, and M. Lazaro 1996: "CASRAM technical documentation - Beta Version 0.7," Argonne National Laboratory, Argonne IL.

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Appendix F: Chemistry of CDTF Water Supply

THM INPUT FORM [redacted]

PWS ID	TRANSCODE
0000133	03 (8-9)

CONTAMINANT ID 2950 (10-13)
ANAL.METH. 205 (14-15)

SAMPLE TYPE KEY:
M MAX. RETENTION TIME
D REG.DISTRIBUTION
R RAW WATER
P PLANT
S SPECIAL

PUBLIC WATER SYSTEM NAME & ADDRESS
Anniston Water Works & Sewer Board
P.O. Box 2268
Anniston, AL, 36202

1-16 ABOVE	LOCATION	Cl2 PPM	ANAL. RESULTS	MCL mg/l	21-27 BELOW	28-36 BELOW	SAMPLE TYPE	38-46 BELOW
DUP	131 WEST 11TH ST	0.690	<0.0050	0.10	DUP	DUP	D	DUP
"	FT. MCCLELLAN	0.420	0.0055		"	"	D	"
"	5801 HOLLY TRACE	0.610	<0.0050		"	"	D	"
"	EVLATON CHURCH	0.930	<0.0050		"	"	D	"
"					"	"		"
"					"	"		"
"					"	"		"
"	TRAVEL BLANK		<0.0050		"	"		"
			(17-20)				(37)	

SIGN. DEC. (21)	ANAL. DATE CODE MO.DA.YR. (22-27) (28-30)	SAMPLE DATE MO.DA.YR.	TIME (38-41)
1	08-27-96	08-21-96	1200

LAB ID # & NAME:
40160 MID-SOUTH TESTING, INC.
(42-46)

COLLECTED BY: Don Miller

FOR ADEM USE ONLY
LAB NO. _____ DATE REC'D

ADEM FORM 134 8/83

L25150

RADIOLOGICAL CONTAMINANT INPUT FORM

PWS ID (1–7): 0000133
TRANSCODE (8–9): 0 3

*MAXIMUM CONTAMINANT LEVEL
(RE:PL 93–523; SDWA)

SAMPLE TYPE KEY
C CHECK
D DISTRIBUTION
P PLANT TAP
R RAW WATER
S SPECIAL

PUBLIC WATER SYSTEM NAME & ADDRE

ANNISTON WATER & SEWER BOARD
P.O. BOX 2268
ANNISTON AL 36202

CALHOUN COUNTY

1–9 ABOVE	CONTAM ID (10–13)	CONTAMINANT NAME	ANAL METH (14–16)	ANALYSIS RESULTS (17–20)	(21)	MCL* (pCi/l)	ANAL DT. MO.DA.YR. (22–27)	28–46 BELOW
DUP	4000	GROSS ALPHA	401	<2	0	15	02–16–96	"
"	4100	GROSS BETA	401		0	50		"
"	4172	STRONTIUM 89	403		0	10		"
"	4174	STRONTIUM 90	403		0	2		"
"	4264	IODINE 131	415		0	1		"
"	4020	RADIUM 226	407		0	3		"
"	4030	RADIUM 228	417		0			"
"	4102	TRITIUM	409		0	1000		"
"	4270	CESIUM 134	411		0	10		"

LOCATION CODE (28–30)	LOCATION NAME	SAMP. DT. MO.DA.YR. (31–36)	TYPE TIME (1200) 37 (38–41)
	COLDWATER	01–30–96	

LAB ID & NAME

40190 C.E.P. (42–46)

COLLECTED BY: DON MILLER

ANALYZED BY: C.D.

FOR HEALTH DEPARTMENT USE ONLY

LA NO. _____ DATE REC'D _____

ADPH –F–PWS–9/REV.9–80

SOC ANALYSIS RESULTS

PWSID #: 0000133

PUBLIC WATER SYSTEM NAME: ANNISTON WATER & SEWER
SYSTEM ADDRESS: P.O. BOX 2268
ANNISTON AL 36202
COUNTY: CALHOUN

TYPE OF SYSTEM:
COMMUNITY X
NTNT
NC

SAMPLE TYPE: DRINKING WATER COLDWATER

COLLECTOR'S NAME: DON MILLER

SAMPLE DATE: 08-06-96

DISTRIBUTION X
CHECK
PLANT
RAW
SPECIAL
(NON-COMPLIANCE)

LAB ID # & NAME: SEE BELOW

LOG NUMBER: 24799-1

ANALYTICAL METHOD: 504, 507, 508, 515.1, 531.1, 525, 547, 548, 549

REGULATED SYNTHETIC ORGANIC CHEMICALS (SOC)

ALACHLOR*	<1.0 /ug/l	ENDRIN*	<0.02 /ug/l
ALDICARB#	<0.5 /ug/l	ETHYLENE DIBROMIDE*	<0.02 /ug/l
ALDICARB SULFONE#	<0.5 /ug/l	GLPHOSATE#	<150 /ug/l
ALDICARB SULFOXIDE#	<0.5 /ug/l	HEPTACHLOR*	<0.01 /ug/l
ATRAZINE*	<1.0 /ug/l	HEPTACHLOR EPOXIDE*	<0.02 /ug/l
BENZO (A) PYRENE*	<0.20 /ug/l	HEXACHLOROBENZENE*	<0.05 /ug/l
CARBOFURAN#	<1.0 /ug/l	HEXACHLOROCYCLOPENTADIENE*	<0.05 /ug/l
CHLORDANE*	<0.1 /ug/l	LINDANE*	<0.01 /ug/l
DALAPON*	<10.0 /ug/l	METHOXYCHLOR*	<0.5 /ug/l
DIBROMOCHLOROPROPANE*	<0.02 /ug/l	OXAMYL (VYDATE)#	<1.0 /ug/l
DI (2-ETHYLHEXYL) ADIPATE*	<2.0 /ug/l	PENTACHLOROPHENOL*	<1.0 /ug/l
DI (2-ETHYLHEXYL) PHTHALATE*	<2.0 /ug/l	PICLORAM*	<0.5 /ug/l
DINOSEB*	<0.50 /ug/l	POLYCHLORINATED BIPHENYLS*	<0.5 /ug/l
DIQUAT#	<1.0 /ug/l	SIMAZINE*	<1.0 /ug/l
2,4,-D*	<0.5 /ug/l	TOXAPHENE*	<1.0 /ug/l
ENDOTHALL#	<10.0 /ug/l	2,4,5-TP (SILVEX)*	<0.5 /ug/l

UNREGULATED SOC'S

ALDRIN*	<0.01 /ug/l	3-HYDROXYCARBOFURAN#	<1.0 /ug/l
BUTACHLOR*	<1.0 /ug/l	METHOMYL#	<1.0 /ug/l
CARBARYL#	<1.0 /ug/l	METOLACHLOR*	<1.0 /ug/l
DICAMBA*	<0.5 /ug/l	METRIBUZIN*	<1.0 /ug/l
DIELDRIN*	<0.02 /ug/l	PROPACHLOR*	<1.0 /ug/l

* ANALYZED BY: SAVANNAH LAB. MOBILE AL 40030 - 08-14-96, 08-16-96
# ANALYZED BY: SAVANNAH LAB. TALLAHASSEE FS 40360 - 08-12-96, 08-13-96, 08-15-96

CHEMICAL CONTAMINANT ANALYSIS . .SULTS

PWSID # 0000133

PUBLIC WATER SYSTEM NAME: ANNISTON WATER & SEWER BOARD
SYSTEM ADDRESS: P.O. BOX 2268
ANNISTON AL 36202

TYPE OF SYSTEM:
COMMUNITY X
NTNT
NC

COUNTY: CALHOUN

COLLECTOR'S NAME: DON MILLER

SAMPLE TYPE: DRINKING WATER well COLDWATER

SAMPLE DATE: 01-30-96

DISTRIBUTION X
CHECK
PLANT
RAW
SPECIAL

LAB ID # & NAME: 40160 MID-SOUTH TESTING, INC.

LOG NUMBER: 20046-2

(NON-COMPLIANCE)

CONTAMINANT	ANALYSIS		MCL MG/L	ANALYSIS DATE
ANTIMONY	<.006	mg/l	0.006	02-08-96
ARSENIC	<0.05	mg/l	0.05	02-08-96
BARIUM	0.018	mg/l	2.0	02-08-96
BERYLLIUM	<.0003	mg/l	0.004	02-08-96
CADMIUM	<.003	mg/l	0.005	02-08-96
CHROMIUM	<.011	mg/l	0.1	02-08-96
CYANIDE	<0.01	mg/l	0.2	02-07-96
FLUORIDE	1.10	mg/l	4.0	02-01-96
LEAD	<.003	mg/l	0.015	02-07-96
MERCURY	<.0002	mg/l	0.002	02-08-96
NICKEL	<.007	mg/l	0.1	02-08-96
NITRATE	<0.10	mg/l	10.0	02-01-96
NITRITE	<0.10	mg/l	1.0	02-01-96
SELENIUM	<0.05	mg/l	0.05	02-08-96
SODIUM	1.18	mg/l		02-08-96
SULFATE	1.03	mg/l	500	02-01-96
THALLIUM	<.002	mg/l	0.002	02-08-96
ALKALINITY	87.9	mg/l		02-07-96
ALUMINUM	0.013	mg/l	0.2	02-08-96
CALCIUM	17.1	mg/l		02-08-96
CARBON DIOXIDE	4.40	mg/l		01-31-96
CHLORIDE	2.84	mg/l	250	02-01-96
COLOR	<5.0		15 units	01-31-96
COPPER	0.018	mg/l	1	02-08-96
FOAMING AGENTS	<.025	mg/l	0.5	02-01-96
HARDNESS	77.2	mg/l		02-08-96
IRON	0.037	mg/l	0.3	02-08-96
MANGANESE	0.001	mg/l	0.05	02-08-96
MAGNESIUM	8.86	mg/l		02-08-96
pH	7.59	su		01-31-96
TDS	177	mg/l	500	02-06-96
ZINC	0.045	mg/l	5.0	02-08-96

CHEMICAL CONTAMINANT ANALYSIS RESULTS

PWSID # 0000133

PUBLIC WATER SYSTEM NAME: ANNISTON WATER & SEWER BOARD
SYSTEM ADDRESS: P.O. BOX 2268
ANNISTON AL 36202

TYPE OF SYSTEM:
COMMUNITY X
NTNT
NC

COUNTY: CALHOUN

COLLECTOR'S NAME: DON MILLER

SAMPLE TYPE: DRINKING WATER KNOWLTON

SAMPLE DATE: 01-30-96

DISTRIBUTION X
CHECK
PLANT
RAW
SPECIAL

LAB ID # & NAME: 40160 MID-SOUTH TESTING, INC.

LOG NUMBER: 20046-1

(NON-COMPLIANCE)

CONTAMINANT	ANALYSIS		MCL MG/L	ANALYSIS DATE
ANTIMONY	<.006	mg/l	0.006	02-08-96
ARSENIC	<0.05	mg/l	0.05	02-08-96
BARIUM	0.006	mg/l	2.0	02-08-96
BERYLLIUM	<.0003	mg/l	0.004	02-08-96
CADMIUM	<.003	mg/l	0.005	02-08-96
CHROMIUM	<.011	mg/l	0.1	02-08-96
CYANIDE	<0.01	mg/l	0.2	02-07-96
FLUORIDE	0.73	mg/l	4.0	02-01-96
LEAD	<.003	mg/l	0.015	02-07-96
MERCURY	<.0002	mg/l	0.002	02-08-96
NICKEL	<.007	mg/l	0.1	02-08-96
NITRATE	<0.10	mg/l	10.0	02-01-96
NITRITE	<0.10	mg/l	1.0	02-01-96
SELENIUM	<0.05	mg/l	0.05	02-08-96
SODIUM	1.43	mg/l		02-08-96
SULFATE	13.2	mg/l	500	02-01-96
THALLIUM	<.002	mg/l	0.002	02-08-96
ALKALINITY	11.8	mg/l		02-07-96
ALUMINUM	0.133	mg/l	0.2	02-08-96
CALCIUM	6.71	mg/l		02-08-96
CARBON DIOXIDE	<0.03	mg/l		01-31-96
CHLORIDE	3.41	mg/l	250	02-01-96
COLOR	<5.0		15 units	01-31-96
COPPER	0.003	mg/l	1	02-08-96
FOAMING AGENTS	<.025	mg/l	0.5	02-01-96
HARDNESS	19.5	mg/l		02-08-96
IRON	0.034	mg/l	0.3	02-08-96
MANGANESE	0.003	mg/l	0.05	02-08-96
MAGNESIUM	0.636	mg/l		02-08-96
pH	9.30	su		01-31-96
TDS	9.00	mg/l	500	02-06-96
ZINC	0.008	mg/l	5.0	02-08-96

RADIOLOGICAL CONTAMINANT INPUT FORM

PWS ID: 0000133 (1–7)
TRANSCODE: 0 3 (8–9)

*MAXIMUM CONTAMINANT LEVEL
(RE:PL 93–523; SDWA)

SAMPLE TYPE KEY
C CHECK
D DISTRIBUTION
P PLANT TAP
R RAW WATER
S SPECIAL

PUBLIC WATER SYSTEM NAME & ADDRE

ANNISTON WATER & SEWER BOARD
P.O. BOX 2268
ANNISTON AL 36202

CALHOUN COUNTY

1–9 ABOVE	CONTAM ID	CONTAMINANT NAME	ANAL METH	ANALYSIS RESULTS		MCL* (pCi/l)	ANAL DT. MO.DA.YR.	28–46 BELOW
DUP	4000	GROSS ALPHA	401	<2	0	15	02–16–96	"
"	4100	GROSS BETA	401		0	50		"
"	4172	STRONTIUM 89	403		0	10		"
"	4174	STRONTIUM 90	403		0	2		"
"	4264	IODINE 131	415		0	1		"
"	4020	RADIUM 226	407		0	3		"
"	4030	RADIUM 228	417		0			"
"	4102	TRITIUM	409		0	1000		"
"	4270	CESIUM 134	411		0	10		"
	(10–13)		(14–16)	(17–20)	(21)		(22–27)	

LOCATION CODE	LOCATION NAME	SAMP. DT. MO.DA.YR.	TYPE TIME (1200)
	KNOWLTON	01–30–96	37 (38–41)
(28–30)		(31–36)	

LAB ID & NAME

40190 C.E.P.
(42–46)

COLLECTED BY: DON MILLER

ANALYZED BY: C.D.

FOR HEALTH DEPARTMENT USE ONLY

LA NO. _____ DATE REC'D _____

ADPH –F–PWS–9/REV.9–80

SOC ANALYSIS RESULTS

PWSID #: 0000133

PUBLIC WATER SYSTEM NAME: ANNISTON WATER & SEWER
SYSTEM ADDRESS: P.O. BOX 2268
ANNISTON AL 36202
COUNTY: CALHOUN

TYPE OF SYSTEM:
COMMUNITY X
NTNT
NC

SAMPLE TYPE: DRINKING WATER; ENDWELTON

COLLECTOR'S NAME: DON MILLER

SAMPLE DATE: 08-06-96

DISTRIBUTION X
CHECK
PLANT
RAW
SPECIAL
(NON-COMPLIANCE)

LAB ID # & NAME: SEE BELOW

LOG NUMBER: 24799-2

ANALYTICAL METHOD: 504, 507, 508, 515.1, 531.1, 525, 547, 548, 549

REGULATED SYNTHETIC ORGANIC CHEMICALS (SOC)

ALACHLOR*	<1.0 /ug/l	ENDRIN*	<0.02 /ug/l
ALDICARB#	<0.5 /ug/l	ETHYLENE DIBROMIDE*	<0.02 /ug/l
ALDICARB SULFONE#	<0.5 /ug/l	GLPHOSATE#	<150 /ug/l
ALDICARB SULFOXIDE#	<0.5 /ug/l	HEPTACHLOR*	<0.01 /ug/l
ATRAZINE*	<1.0 /ug/l	HEPTACHLOR EPOXIDE*	<0.02 /ug/l
BENZO (A) PYRENE*	<0.20 /ug/l	HEXACHLOROBENZENE*	<0.05 /ug/l
CARBOFURAN#	<1.0 /ug/l	HEXACHLOROCYCLOPENTADIENE*	<0.05 /ug/l
CHLORDANE*	<0.1 /ug/l	LINDANE*	<0.01 /ug/l
DALAPON*	<10.0 /ug/l	METHOXYCHLOR*	<0.5 /ug/l
DIBROMOCHLOROPROPANE*	<0.02 /ug/l	OXAMYL (VYDATE)#	<1.0 /ug/l
DI (2-ETHYLHEXYL) ADIPATE*	<2.0 /ug/l	PENTACHLOROPHENOL*	<1.0 /ug/l
DI (2-ETHYLHEXYL) PHTHALATE*	<2.0 /ug/l	PICLORAM*	<0.5 /ug/l
DINOSEB*	<0.50 /ug/l	POLYCHLORINATED BIPHENYLS*	<0.5 /ug/l
DIQUAT#	<1.0 /ug/l	SIMAZINE*	<1.0 /ug/l
2,4,-D*	<0.5 /ug/l	TOXAPHENE*	<1.0 /ug/l
ENDOTHALL#	<10.0 /ug/l	2,4,5-TP (SILVEX)*	<0.5 /ug/l

UNREGULATED SOC'S

ALDRIN*	<0.01 /ug/l	3-HYDROXYCARBOFURAN#	<1.0 /ug/l
BUTACHLOR*	<1.0 /ug/l	METHOMYL#	<1.0 /ug/l
CARBARYL#	<1.0 /ug/l	METOLACHLOR*	<1.0 /ug/l
DICAMBA*	<0.5 /ug/l	METRIBUZIN*	<1.0 /ug/l
DIELDRIN*	<0.02 /ug/l	PROPACHLOR*	<1.0 /ug/l

* ANALYZED BY: SAVANNAH LAB. MOBILE AL 40030 - 08-14-96, 08-16-96
# ANALYZED BY: SAVANNAH LAB. TALLAHASSEE FS 40360 - 08-12-96, 08-13-96, 08-15-96

VOC ANALYSIS RESULTS

PWSID #: 0000133

TYPE OF SYSTEM:
COMMUNITY
NTNC
NC

SAMPLE TYPE: KNOWLTON

DISTRIBUTION X
CHECK
PLANT
RAW
SPECIAL
(NON-COMPLIANCE)

PUBLIC WATER SYSTEM NAME: Anniston Water Works & Sewer Board
SYSTEM ADDRESS: P.O. Box 2268
Anniston, AL, 36202

COUNTY:

COLLECTOR'S NAME: Don Miller

SAMPLE DATE: 10/15/96

LAB ID # & NAME: 40160 MID-SOUTH TESTING, INC.

LOG NUMBER: L26693-2

ANALYSIS DATE: 10/21/96

ANALYTICAL METHOD: EPA 524.2

OF CONTAINERS: 4

SAMPLE RESULTS AND DETECTION LIMITS ARE IN PPB(ug/l)

Benzene	<0.500 ug/l	Ethylbenzene	<0.500 ug/l
Carbon Tetrachloride	<0.500 ug/l	Monochlorobenzene	<0.500 ug/l
o-Dichlorobenzene	<0.500 ug/l	Styrene	<0.500 ug/l
p-Dichlorobenzene	<0.500 ug/l	Tetrachloroethylene	<0.500 ug/l
1,2-Dichloroethane	<0.500 ug/l	Toluene	<0.500 ug/l
1,1-Dichloroethylene	<0.500 ug/l	1,2,4-Trichlorobenzene	<0.500 ug/l
cis-1,2-Dichloroethylene	<0.500 ug/l	1,1,1-Trichloroethane	<0.500 ug/l
trans-1,2-Dichloroethylene	<0.500 ug/l	1,1,2-Trichloroethane	<0.500 ug/l
Dichloromethane	<0.500 ug/l	Trichloroethylene	<0.500 ug/l
1,2-Dichloropropane	<0.500 ug/l	Vinyl Chloride	<0.500 ug/l
Xylenes (total)	<0.500 ug/l		

Chloroform	27. ug/l	1,1,2,2-Tetrachloroethane	<0.500 ug/l
Bromodichloromethane	4.7 ug/l	1,2,3-Trichloropropane	<0.500 ug/l
Chlorodibromomethane	<0.500 ug/l	1,1,1,2-Tetrachloroethane	<0.500 ug/l
Bromoform	<0.500 ug/l	Chloroethane	<0.500 ug/l
Bromochloromethane	<0.500 ug/l	Chloromethane	<0.500 ug/l
Bromomethane	<0.500 ug/l	2,2-Dichloropropane	<0.500 ug/l
m-Dichlorobenzene	<0.500 ug/l	o-Chlorotoluene	<0.500 ug/l
Dichlorodifluoromethane	<0.500 ug/l	p-chlorotoluene	<0.500 ug/l
Fluorotrichloromethane	<0.500 ug/l	Bromobenzene	<0.500 ug/l
Dibromomethane	<0.500 ug/l	1,3-Dichloropropane	<0.500 ug/l
1,1-Dichloropropene	<0.500 ug/l	sec-Butylbenzene	<0.500 ug/l
1,3-Dichloropropene	<0.500 ug/l	1,2,4-Trimethylbenzene	<0.500 ug/l
Isopropylbenzene	<0.500 ug/l	n-Propylbenzene	<0.500 ug/l
n-Butylbenzene	<0.500 ug/l	Naphthalene	<0.500 ug/l
1,1-Dichloroethane	<0.500 ug/l	Hexachlorobutadiene	<0.500 ug/l
tert-Butylbenzene	<0.500 ug/l	1,3,5-Trimethylbenzene	<0.500 ug/l
p-Isopropyltoluene	<0.500 ug/l	1,2,3-Trichlorobenzene	<0.500 ug/l

VOC ANALYSIS RESULTS

PWSID #: 0000133

TYPE OF SYSTEM:
COMMUNITY
NTNC
NC

SAMPLE TYPE: COLDWATER

DISTRIBUTION X
CHECK
PLANT
RAW
SPECIAL
(NON-COMPLIANCE)

PUBLIC WATER SYSTEM NAME: Anniston Water Works & Sewer Board
SYSTEM ADDRESS: P.O. Box 2268
Anniston, AL, 36202

COUNTY:

COLLECTOR'S NAME: Don Miller

SAMPLE DATE: 10/15/96

LAB ID # & NAME: 40160 MID-SOUTH TESTING, INC.

LOG NUMBER: L26693-1

ANALYSIS DATE: 10/21/96

ANALYTICAL METHOD: EPA 524.2

OF CONTAINERS: 4

SAMPLE RESULTS AND DETECTION LIMITS ARE IN PPB(ug/l)

Benzene	<0.500 ug/l	Ethylbenzene	<0.500 ug/l
Carbon Tetrachloride	<0.500 ug/l	Monochlorobenzene	<0.500 ug/l
o-Dichlorobenzene	<0.500 ug/l	Styrene	<0.500 ug/l
p-Dichlorobenzene	<0.500 ug/l	Tetrachloroethylene	<0.500 ug/l
1,2-Dichloroethane	<0.500 ug/l	Toluene	<0.500 ug/l
1,1-Dichloroethylene	<0.500 ug/l	1,2,4-Trichlorobenzene	<0.500 ug/l
cis-1,2-Dichloroethylene	<0.500 ug/l	1,1,1-Trichloroethane	<0.500 ug/l
trans-1,2-Dichloroethylene	<0.500 ug/l	1,1,2-Trichloroethane	<0.500 ug/l
Dichloromethane	<0.500 ug/l	Trichloroethylene	3.0 ug/l
1,2-Dichloropropane	<0.500 ug/l	Vinyl Chloride	<0.500 ug/l
Xylenes (total)	<0.500 ug/l		

Chloroform	<0.500 ug/l	1,1,2,2-Tetrachloroethane	<0.500 ug/l
Bromodichloromethane	<0.500 ug/l	1,2,3-Trichloropropane	<0.500 ug/l
Chlorodibromomethane	<0.500 ug/l	1,1,1,2-Tetrachloroethane	<0.500 ug/l
Bromoform	<0.500 ug/l	Chloroethane	<0.500 ug/l
Bromochloromethane	<0.500 ug/l	Chloromethane	<0.500 ug/l
Bromomethane	<0.500 ug/l	2,2-Dichloropropane	<0.500 ug/l
m-Dichlorobenzene	<0.500 ug/l	o-Chlorotoluene	<0.500 ug/l
Dichlorodifluoromethane	<0.500 ug/l	p-chlorotoluene	<0.500 ug/l
Fluorotrichloromethane	<0.500 ug/l	Bromobenzene	<0.500 ug/l
Dibromomethane	<0.500 ug/l	1,3-Dichloropropane	<0.500 ug/l
1,1-Dichloropropene	<0.500 ug/l	sec-Butylbenzene	<0.500 ug/l
1,3-Dichloropropene	<0.500 ug/l	1,2,4-Trimethylbenzene	<0.500 ug/l
Isopropylbenzene	<0.500 ug/l	n-Propylbenzene	<0.500 ug/l
n-Butylbenzene	<0.500 ug/l	Naphthalene	<0.500 ug/l
1,1-Dichloroethane	<0.500 ug/l	Hexachlorobutadiene	<0.500 ug/l
tert-Butylbenzene	<0.500 ug/l	1,3,5-Trimethylbenzene	<0.500 ug/l
p-Isopropyltoluene	<0.500 ug/l	1,2,3-Trichlorobenzene	<0.500 ug/l

TTHM INPUT FORM

Typical Laboratory Form

PWS ID	TRANSCODE
0000133	03 (8-9)

CONTAMINANT	ANAL.METH.
ID 2 9 5 0 (10-13)	2 0 5 (14-15)

SAMPLE TYPE KEY:
M MAX. RETENTION TIME
D REG.DISTRIBUTION
R RAW WATER
P PLANT
S SPECIAL

PUBLIC WATER SYSTEM NAME & ADDRESS
Anniston Water Works & Sewer Board
P.O. Box 2268
Anniston, AL, 36202

1-16 ABOVE	LOCATION	Cl2 PPM	ANAL. RESULTS	MCL mg/l	21-27 BELOW	28-36 BELOW	SAMPLE TYPE	38-46 BELOW
DUP	FRIENDSHIP RD	1.49	0.025	0.10	DUP	DUP	D	DUP
"	SOD FARM	1.41	0.035		"	"	D	"
"	SKINNERS U-CARS	1.43	0.026		"	"	D	"
"	GOLDEN SPRG. CENTER	1.45	0.034		"	"	D	"
"					"	"		"
"					"	"		"
"					"	"		"
"	TRAVEL BLANK		<0.0050		"	"		"
			(17-20)				(37)	

SIGN. DEC.	ANAL. DATE CODE MO.DA.YR.	SAMPLE DATE MO.DA.YR.	TIME
1 (21)	08-27-96 (22-27) (28-30)	08-21-96	1200 (38-41)

LAB ID # & NAME:
40160 MID-SOUTH TESTING, INC.
(42-46)

COLLECTED BY: Don Miller

FOR ADEM USE ONLY
LAB NO. _____ DATE REC'D

ADEM FORM 134 8/83

L25150