Air Quality Technical Reference Document

Relocation of U.S. Army Chemical School
and U.S. Army Military Police School
to
Fort Leonard Wood, Missouri

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March 1997

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Air Quality Technical Reference Document

The Air Quality Technical Reference Document has been prepared to provide pertinent information and supporting documentation that is used for the air quality analysis in the Environmental Impact Statement for the Relocation of U.S. Army Chemical School and U.S. Army Military Police School to Fort Leonard Wood, Missouri. This document is not a report, it merely provides supporting reference documentation for the EIS. Most of this document supports subsection 5.2.2.3. It will be placed in the repositories. The Air Quality Technical Reference Document contains the following sections:

- Fog Oil Air Permit
- Fog Oil Air Permit Review and Modeling Report
- Fog Oil Air Permit Modeling Report
- Example Fog Oil Model Output
- Chemical Defense Training Facility Air Permit
- Emission Calculations
- Cumulative Analysis Summary
- Fog Oil Training Ambient Air Monitoring Plan Summary
- Fog Oil Training Soil and Vegetation Plan Summary

Fog Oil Air Permit. This section provides a copy of air quality permit (#0695-010) which allows the Army to conduct obscurant (fog oil) training at Fort Leonard Wood, Missouri (FLW). The purpose of providing the permit in the EIS is to signify the importance of the permit, the relevance of the permit for the air quality analysis, and to illustrate the commitment by FLW to comply with this permit. The air permit is a Prevention of Significant Deterioration (PSD) permit and was issued by the Missouri Department of Natural Resources (MDNR) on June 7, 1995 pursuant to 10 CSR 10-6.060. Compliance with this air permit ensures that the National Ambient Air Quality Standards (NAAQS) are met at the installation boundary. The permit is designed to ensure that the obscurant (fog oil) training is carried out in a manner that protects environmental resources and human health. This air permit is the foundation for ensuring regulatory compliance at FLW. The permit contains 37 different conditions with which FLW must comply. Fort Leonard Wood fully intends to comply with the conditions of this permit as further discussed in subsections 5.2.2.3.7 and 5.5.3.3, Volume I of the Environmental Impact Statement.

Fog Oil Air Permit Review and Modeling Report. This report was prepared by the Missouri Department of Natural Resources and is the basis for preparing the fog oil air permit, including the permit conditions. The reports includes the following: review summary; project description; emissions/controls evaluation; permit rule applicability; applicable requirements; Best Available Control Technology (BACT) analysis; modeling and monitoring; Class I impact analysis; analysis of impact on visibility, soils, animals, and vegetation; growth impacts; and the MDNR staff recommendation.

Fog Oil Air Permit Modeling Report. This report is Appendix A to the fog oil permit. Obtaining the fog oil permit required extensive dispersion modeling to determine ambient air quality impacts (as required by 10 CSR 10-6.060). The dispersion modeling is the basis for the restrictions on fog oil quantities and for the meteorological conditions under which training can occur. The report was prepared by the MDNR to summarize the modeling and results.

Example Fog Oil Model Output. Approximately 1,000 pages of dispersion model output reports were generated for the fog oil permit. Due to the volume of pages, this section only provides example output reports from the fog oil dispersion model. It is merely presented to show the complexity of the reports and the level of analysis that is required for dispersion modeling.

Chemical Defense Training Facility (CDTF) Air Permit. This section provides a copy of the air permit (#0495-013) which allows the Army to construct and operate the thermal treatment unit (TTU), standy generator, standby package boiler, and waste heat boiler at the CDTF. The TTU would be used for treatment/destruction of decontaminated waste by-products of toxic agent training, including both liquid and solid wastes. It should be noted that the Optimum Training Method (OPTM) described in the EIS no longer includes the TTU. If the OPTM is implemented, either the existing permit would be used or a modification to the existing permit would be pursued with MDNR that excludes the TTU.

Emission Calculations. This section contains the emission calculations which were completed to support the air quality analysis. Methodologies, emission factors, and references are also provided where applicable. The emission calculations are referenced in Volume I of the EIS.

Cumulative Analysis Summary. Dispersion modeling was conducted for particulate matter (10 microns or less) to complete the cumulative analysis described in Volume I, subsection 5.5.3.3. This section contains a letter which summarizes the dispersion modeling. The letter contains the following information: summary; justification for using the ISCST3 model; derivation of the emission parameters; modeling inputs; modeling methodology; fog oil modeling; insignificant sources; and cumulative impacts.

Fog Oil Training Ambient Air Monitoring Plan Summary. The Table of Contents of the Fog Oil Ambient Air Monitoring Plan is provided as an overview as to the type of information and level of detail that is required in this plan. The plan is approximately 300 pages and is currently in draft status (anticipated approval is February, 1997). A summary of this plan is provided in the Monitoring Plan and Adaptive Management Strategy Summary, Appendix K, Volume III. A copy of the draft plan is provided in the repositories.

Fog Oil Training Soil and Vegetation Plan Summary. The Table of Contents of the Fog Oil Soil and Vegetation Monitoring Plan is provided as an overview as to the type of information and level of detail that is required in this plan. The plan is currently in draft status and is being reviewed by the Missouri Department of Natural Resources. A summary of this plan is provided in the Monitoring Plan and Adaptive

Management Strategy Summary, Appendix K, Volume III. A copy of the draft plan is provided in the repositories.

FOG OIL AIR PERMIT

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI AIR CONSERVATION COMMISSION

PERMIT TO CONSTRUCT

Under the authority of RSMo 643 and the Federal Clean Air Act the applicant is authorized to construct the facility described below, in accordance with the laws, rules, and conditions as set forth herein.

Permit Number: 0695-010 Facility I.D. Number: 3860-0004-015

Owner: U. S. Army Engineer Center and Fort Leonard Wood

Owner's Address: Department of Defense

Facility Name: U. S. Army Engineer Center and Fort Leonard Wood

Facility Address: ATTN: ATZT-DPW-EE; Ft. Leonard Wood, MO 65473

Legal Description: Pulaski County, All or parts of T33, 34, 35N, R10, 11, 12W

Application for Authority to Construct was made for:

**** Permission to construct a static and mobile fog oil smoke training facility. This review was conducted in accordance with Section (8), Missouri State Rule 10 CSR 10-6.060, "Construction Permits Required." ****

☐ Special Conditions are not applicable to this permit.

☒ Special Conditions do apply to this permit and are listed as attachments starting on page 2.

June 7, 1995
EFFECTIVE DATE

John A. Young
DIRECTOR
DIVISION OF ENVIRONMENTAL QUALITY

RECYCLED PAPER

STANDARD CONDITIONS:

Permission to construct may be revoked if you fail to begin construction or modification within two (2) years from the date of this letter.

You must construct, modify, and operate your installation in the manner proposed in your application. You will be in violation of 10 CSR 10-6.060 if you fail to adhere to the specifications listed in this permit or in your application.

You must notify the Air Pollution Control Program of the anticipated date of start up of this facility. The information must be made available not more than sixty (60) days but at least thirty (30) days in advance of this date. Also, you must notify the Air Pollution Control Program within fifteen (15) days after the actual start up of this facility.

A copy of this permit and permit review shall be kept at the facility address and be made available to Department of Natural Resources' personnel upon request.

You may appeal this permit or any of the listed special conditions as provided in RSMo 643.075. If you choose to appeal, the Air Pollution Control Program must receive your written declaration within thirty (30) days of this letter.

If you do not choose to appeal, this certificate, your application, and associated correspondence constitutes your permit to construct. The permit allows you to construct and operate the facility, but in no way relieves you of the obligation to meet the air pollution control regulations, other Department of Natural Resources' regulations, or other federal, state, or local agencies' regulations.

If you have any questions regarding this air pollution permit, contact the New Source Review Section Chief, Air Pollution Control Program, (314) 751-4817. Correspondence should be addressed to the Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102.

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

Emissions Limitations

1. *Annual Throughput*. The U.S. Army Engineering Center, Fort Leonard Wood, (the "Permittee") shall process no more than 65,000 gallons of SGF-2 fog oil for smoke training during any 12-month period. This total shall include the fog oil used in the mobile (valley) operations and the static (introductory) operations.

2. *Daily Throughput*. The Permittee shall process no more than 3700 pounds of SGF-2 fog oil during any 24-hour period. This total shall include the fog oil used in the mobile (valley) operations and the static (introductory) operations. Fog oil shall not be processed at a rate in excess of 3700 pounds per hour.

3. *SGF-2 Fog Oil Material Requirements*. The Permittee shall only use the fog oil designated SGF-2 (CAS# 64742-52-5) to generate smoke during smoke training. The fog oil shall contain no additives nor any rerefined oils.

   In addition, the fog oil shall have the following properties and characteristics:

   a. The fog oil shall be severely hydrotreated to remove polycyclic aromatic hydrocarbons (PAHs) and their nitrogen and oxygen analogues, and

   b. The fog oil shall contain no carcinogenic or potentially carcinogenic constituents as defined under the Hazard Communication Standard (HCS) 29 CFR 1910.1200, and

   c. The fog oil shall contain no more than 0.5% (one-half percent) by weight of any single hazardous air pollutant (HAP) as defined by 10 CSR 10-6.020(2)(C), "Table 3 – Hazardous Air Pollutants." The combination of all HAPs in the fog oil shall comprise no more than 1% (one percent) by weight of the fog oil.

   The Permittee is prohibited from using to create smoke for

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

smoke training any fog oil designated PY8035000 on the Registry of Toxic Effects of Chemical Substances (RTECS) of the National Institute for Occupational Safety and Health (NIOSH).

The Permittee may not introduce any other substance into the fog oil used to generate smoke, e.g., kerosene to reduce viscosity in cold temperatures, graphite or brass to change or enhance obscurant effectiveness, etc.

4. *Fog Oil Material Certification*. The Permittee shall maintain fog oil Military Specifications, Material Safety Data Sheets (MSDS), and records of quantitative analytical chemical test data demonstrating compliance with Condition 3.

Said military specifications, test data, MSDSs, and certifications shall be maintained by the Permittee and made available to Missouri Department of Natural Resources (MDNR) personnel on request.

The Permittee shall certify in writing no less frequently than annually that all fog oil used in smoke training complies with Condition 3.

5. *Reporting of Violations*. The Permittee shall report to the Enforcement Section, Air Pollution Control Program (APCP), MDNR, no later than ten days after any fog oil not complying with Condition 3 or not certified in compliance with Condition 4 is used to create smoke for smoke training.

6. *Smoke Generating Equipment*. The Permittee shall use only the pulse jet mechanical smoke generator, Model M3A3 ("emm-three-A-three"). The smoke generators shall only be fueled with unleaded gasoline. The Permittee shall only generate smoke with smoke generators maintained in good working condition and operated in accordance with the manufacturer's specifications.

7. *Emissions Limitation*. The Permittee shall not emit particulate matter less than 10 microns (PM_{10}) at a rate in

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

excess of 2600 pounds per hour. This rate corresponds to processing fog oil at the maximum rate of 3700 pounds per hour with a particulate conversion factor of 70%.

8. *Recordkeeping*. The Permittee shall record the amount of fog oil processed by the smoke generators during the previous month and the previous twelve months. During any month in which smoke training occurs, the Permittee shall record daily and hourly consumption of fog oil. The Permittee shall maintain said records and provide them to MDNR personnel on request.

9. *Reporting of Violations*. The Permittee shall report to the Enforcement Section, APCP, no later than ten days after the end of each month during which the preceding 12-month cumulative total of fog oil processed exceeds 65,000 gallons of fog oil (Condition Number 1).

10. *Reporting of Violations*. The Permittee shall report to the Enforcement Section, APCP, no later than ten days after an exceedance of the 3700 pound daily limit or the 3700 pound/hour maximum rate limit of fog oil (Condition 2).

Ambient Air Monitoring

11. *Quality Assurance Project Plan*. The Permittee shall file two copies of a Quality Assurance Project Plan (QAPP) within 90 days of issuance of this permit for review and approval by the Staff Director, APCP. The QAPP shall describe the method and manner for collecting air quality monitoring data for PM_{10} and ozone required by this permit.

12. *Pre-Startup Monitoring*. Beginning as soon as possible after this permit is issued, the Permittee shall collect at least one year of continuous air quality monitoring data for PM_{10} and ozone in a manner and at locations to be determined by the Permittee with review and approval by the APCP. Collection of monitoring data shall begin no later than eighteen months immediately prior to the beginning of smoke training. Ozone monitoring is only required from April 1

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

through October 31.

13. *Reporting*. The Permittee shall submit to the APCP no less frequently than quarterly the air quality monitoring data collected pursuant to Condition 12. All air quality monitoring data collected pursuant to Condition 12 shall be submitted to APCP no later than 60 days prior to the commencement of smoke training.

14. *Corrective Action*. If the air quality monitoring data of Condition 12 does not substantially conform with the assumptions and conclusions of air quality modeling or if the smoke training is shown to cause or contribute to a violation of National Ambient Air Quality Standards (NAAQS), the Director, MDNR, may require the Permittee to take corrective action or may revoke the permit.

15. *Post-Startup Monitoring*. Beginning with the commencement of smoke training, the Permittee shall collect at least two years of continuous air quality monitoring data for PM_{10} and ozone in a manner and at locations to be determined by the Permittee with review and approval by the APCP. Ozone monitoring is only required from April 1 through October 31.

16. *Reporting*. The Permittee shall submit to the APCP no less frequently than quarterly the air quality monitoring data collected pursuant to Condition 15.

Meteorological Monitoring

17. *Observers*. At all times during the operation of the smoke generators, a network of observers shall be stationed at locations from which they can observe the behavior of generated smoke and whether smoke crosses the Fort Leonard Wood property boundary. The observers shall maintain continuous electronic or visual communications with the smoke generator operators.

18. *Meteorological Monitoring*. For the entire period beginning no less than one hour prior to generating smoke and ending

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

no less than one hour after ceasing generating smoke, the Permittee shall measure and record no less frequently than every sixty seconds meteorological data including ambient air temperature, atmospheric pressure, relative humidity, atmospheric stability, mixing height, and wind speed and direction at each training site at which smoke training is conducted. The monitoring records shall indicate those periods during which smoke is generated. Meteorological monitoring records shall be maintained by the Permittee and made available to the MDNR personnel on request.

19. *Limitations on Operations*. Smoke training shall only be conducted at the locations and under the meteorological conditions as described in Attachment A.

The Permittee may conduct smoke training operations at more than one location listed in Attachment A during any 24-hour period. However, smoke training operations may not occur at more than one location simultaneously, and the smoke training operations at multiple sites may not exceed the limitations of Condition 2.

20. *Meteorologist*. Meteorological monitoring and forecasting activities required by this permit shall be coordinated and supervised by a person (the "Meteorologist") with at least a Bachelor of Science degree in meteorology or atmospheric science from an accredited university or college.

21. *Forecasting Acceptable Conditions*. Smoke training may take place only if the Meteorologist forecasts no earlier than two hours prior to each smoke training exercise that the approved meteorological conditions described in Attachment A will exist throughout the anticipated smoke training exercise.

22. *Forecast Certification*. Prior to each smoke training exercise, the Meteorologist shall certify in writing the pre-exercise forecast required by Condition 21. Said forecast certification shall be maintained by the Permittee and made available to MDNR personnel on request.

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

23. *Pre-Exercise Computer Modeling*. Prior to each smoke training exercise, the Permittee shall use the Tactical Smoke computer model, TACSMK, or equivalent, to perform pre-exercise predictions of smoke behavior during anticipated smoke training exercises. Printouts of the TACSMK pre-exercise predictions shall be maintained by the Permittee and made available to MDNR personnel upon request.

24. *Prohibitions*. Generation of smoke shall cease if:

a) Meteorological conditions are not within those approved for smoke training as described in Attachment A, or

b) Smoke behavior differs significantly from the pre-exercise predictions of Condition 23 so as to indicate a reasonable likelihood that visible smoke will drift beyond the Fort Leonard Wood property boundary, or

c) Conditions or smoke behavior are such so as to create a reasonable likelihood that visible smoke will cross the Fort Leonard Wood property boundary or that National Ambient Air Quality Standards at the Fort Leonard Wood property boundary will be exceeded, or

d) There is an interruption for 2 minutes in the meteorological monitoring required by Condition 18, or

e) Under other conditions as may be determined by the Director, MDNR.

For the purposes of determining compliance with Condition 24a, meteorological conditions shall be deemed outside the approved conditions when three consecutive measurements recorded at one-minute intervals are outside approved conditions.

Soil and Vegetation Sampling

25. *Soil and Vegetation Sampling Plan (SVSP)*. Within 180 days of the issuance of this permit, the Permittee shall submit

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

two copies of a SVSP to the Staff Director, APCP, for review and approval.

The SVSP shall describe the method and manner of collecting and analyzing soil and vegetation samples and of monitoring the impact of smoke training activities on soils and vegetation. The SVSP shall include an inventory of vegetation found within the impact area that has any recreational or commercial value and shall identify any of the vegetation which may be sensitive to elevated ozone or particulate levels. The SVSP shall also include descriptions of operational or seasonal restrictions that could be used to minimize emissions and any accompanying deposition effects.

26. *Pre-Startup Sampling*. For no less than one year prior to the commencement of smoke training, the Permittee shall collect and analyze soil and vegetation samples no less frequently than quarterly at each location described in Attachment A and at other locations described in the SVSP.

27. *Reporting*. The Permittee shall report the results of the sampling and analysis required by Condition 26 to the APCP within 60 days of the date the samples are collected. All soil and vegetation sampling data collected pursuant to Condition 26 shall be submitted to APCP no later than 60 days prior to the commencement of smoke training.

28. *Post-Startup Sampling*. Upon commencement of smoke training, the Permittee shall collect and analyze soil and vegetation samples no less frequently than monthly at each location described in Attachment A and at other locations described in the SVSP. After two years of sampling, the Permittee may petition the Staff Director, APCP, for modification of the sampling schedule and frequency.

29. *Reporting*. The Permittee shall report to the APCP no less frequently than quarterly the soil and vegetation sampling data collected pursuant to Condition 28.

30. *Corrective Action*. MDNR may reevaluate the Best Available

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

Control Technology (BACT) analysis in support of this permit, establish any necessary operational restrictions, e.g., restricting smoke training to only the summer months, or require the Permittee to take any necessary corrective action, if the results of the soil, vegetation, or ambient air sampling indicate adverse deposition effects.

Other Special Conditions

31. *Record Retention*. All records required by this permit shall be maintained by the Permittee and made available for inspection by MDNR personnel for no less than ten years from the date the record is created.

32. *Public Information*. The Permittee shall cooperate with the APCP in presenting the air quality monitoring data of Condition 12 and soil and vegetation sampling data of Condition 26 to the public at an informational meeting to be convened by the APCP.

33. *Effects on Visibility*. Smoke training shall not be conducted so as to constitute or contribute to a safety hazard to air traffic or vehicular traffic on highways accessible to the public during smoke training exercises.

34. *Reporting of Violations*. Unless a different requirement is expressly provided for in this permit, the Permittee shall report to the Enforcement Section, APCP, MDNR, no later than ten days after any noncompliance with any condition or requirement of this permit.

35. *Corrective Action*. If in the opinion of the Director, MDNR, the presence of PM_{10} or ozone in the ambient air exists in quantities and durations that directly or proximately cause or contribute to injury to human, plant, or animal life or health, or to property, or that unreasonably interferes with the enjoyment of life or the use of property, the Director, MDNR, may require the Permittee to submit a corrective action plan adequate to timely and significantly mitigate the emission or the impact of PM_{10} or ozone. The Permittee

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

shall implement any such plan immediately upon its approval by the Director, MDNR. Failure to either submit or implement such a plan shall be a violation of the permit.

36. *Compliance With Other MDNR Permits*. The Permittee shall comply with the sampling and monitoring conditions of Missouri State Operating Permit No. MO-0117251 granted by the Missouri Department of Natural Resources, Missouri Clean Water Commission.

37. *Notification of Commencement of Smoke Training*. The Permittee shall not commence smoke training activities subject to this permit without first providing written notification of such commencement to the Director, MDNR, no later than 30 days prior thereto. Said notification shall include the certification by the Responsible Official that the Permittee has satisfied all conditions precedent to the commencement of smoke training as described in this permit.

Attachment A

WIND DIRECTIONS (θ) SUITABLE FOR SMOKE TRAINING

Site	Stability Class (Notes 1, 2, and 3)				
	A	B	C	D	E
Musgrave	$130 \leq \theta \leq 220$	$150 \leq \theta \leq 220$	$160 \leq \theta \leq 215$	$170 \leq \theta \leq 215$ (Note 4)	$150 \leq \theta \leq 225$
Ballard	$340 \leq \theta \leq 35$	$340 \leq \theta \leq 35$	$340 \leq \theta \leq 35$	$350 \leq \theta \leq 35$	$340 \leq \theta \leq 35$
Mush Paddle	$195 \leq \theta \leq 275$	$195 \leq \theta \leq 275$	$195 \leq \theta \leq 270$	$195 \leq \theta \leq 240$ (Note 5)	$195 \leq \theta \leq 270$
Bailey	$125 \leq \theta \leq 115$	$340 \leq \theta \leq 40$ $175 \leq \theta \leq 325$	$340 \leq \theta \leq 40$ $175 \leq \theta \leq 325$	None	$230 \leq \theta \leq 240$ (Note 6)

Notes:

1. Allowable wind directions are indicated by an angular interval. Wind directions are expressed as an angle measured clockwise from north indicating direction wind is coming from. E.g., 0 means wind is coming from due north (wind is coming from zero degrees clockwise from north), 225 means wind is coming from southwest (wind is coming from 225 degrees clockwise from north). Thus, "$130 \leq \theta \leq 220$" means allowable wind directions are generally from the south, i.e., from 130 degrees (approximately southeast) clockwise to 220 degrees (approximately southwest); "$340 \leq \theta \leq 35$" means allowable wind directions are generally from the north, i.e., from 340 degrees (approximately north-northwest) clockwise to 35 degrees (approximately northeast).
2. Stability classes A - D are limited to wind speeds of at least 1 meter/second, and stability class E is limited to wind speeds of at least 4 meters/second. No smoke may be generated during stability condition F.
3. Mixing height of 200 meters is necessary for stability classes A - C. Mixing height of 320 meters is necessary for stability classes D - E.
4. Forty-five (45) minute limit on smoke training for wind directions $190 \leq \theta \leq 210$ degrees.
5. Forty-five (45) minute limit on smoke training for wind directions $220 \leq \theta \leq 240$ degrees.
6. Commencement and continuation of smoke training is discouraged at Bailey Hollow during stability class E due to the narrow range of allowed wind directions.

FOG OIL AIR PERMIT REVIEW AND MODELING REPORT

REVIEW OF APPLICATION FOR AUTHORITY TO CONSTRUCT AND OPERATE
SECTION (8) REVIEW
Project/Facility No: 3860-0004-015
Permit No: 0695-010

U. S. Army Engineering Center
Fort Leonard Wood
ATTN: ATZT-DPW-EE
Fort Leonard Wood, MO 65473

Complete: March 31, 1995
Reviewed: June 7, 1995

Parent Company:
U. S. Army Engineering Center
Fort Leonard Wood
ATTN: ATZT-DPW-EE
Fort Leonard Wood, MO 65473

Pulaski County, All or parts of T33, 34, 35N,
R10, 11, 12W

REVIEW SUMMARY

- This review is conducted in accordance with Section (8) of Missouri State Rule 10 CSR 10-6.060, "Construction Permits Required."
- Prevention of Significant Deterioration (PSD) regulations apply to this facility.
- Emissions of particulate matter less than ten microns (PM_{10}) at the facility will be greater than 15 tons per year; therefore, this is a major modification at a major facility.
- No Hazardous Air Pollutants (HAP) above *de minimis* amounts are emitted in this process.
- No federal New Source Performance Standards (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAP) apply to this operation.
- Special conditions are imposed by this permit.

PROJECT DESCRIPTION

Fort Leonard Wood (the "Applicant") is an existing major source and has applied for permission to operate an obscurant (smoke) training school. The smoke training school will use M3A3 smoke generators (or equivalent) to train soldiers in the operation of the smoke generators and in the tactical use of obscurants during simulated battlefield operations.

To generate the smoke, SGF-2 fog oil (a severely hydrotreated heavy naphthenic petroleum distillate mineral oil) is vaporized, recondensed, and dispersed into the air. The fog oil is emitted as liquid droplets with diameters of 0.5 to 1.0 micron. This diameter size is close to the wavelength of visible light, making this oil the choice for smoke training.

Fort Leonard Wood shall only use the fog oil designated SGF-2 (CAS# 64742-52-5) to generate smoke during smoke training. The fog oil shall contain no additives nor any rerefined oils.

In addition, the fog oil shall have the following properties and characteristics:

a. The fog oil shall be severely hydrotreated to remove polycyclic aromatic hydrocarbons (PAHs) and their nitrogen and oxygen analogues, and

b. The fog oil shall contain no carcinogenic or potentially carcinogenic constituents as defined under the Hazard Communication Standard (HCS) 29 CFR 1910.1200, and

c. The fog oil shall contain no more than 0.5% (one-half percent) by weight of any single hazardous air pollutant (HAP) as defined by 10 CSR 10-6.020(2)(C), "Table 3 – Hazardous Air Pollutants." The combination of all HAPs in the fog oil shall comprise no more than 1% (one percent) by weight of the fog oil.

Fort Leonard Wood shall maintain Material Safety Data Sheets (MSDS) and test data demonstrating compliance with the fog oil material specifications.

Fort Leonard Wood is prohibited from using to create smoke for smoke training any fog oil designated PY8035000 on the Registry of Toxic Effects of Chemical Substances (RTECS) of the National Institute for Occupational Safety and Health (NIOSH).

Fort Leonard Wood may not introduce any other substance into the fog oil used to generate smoke, e.g., kerosene to reduce viscosity in cold temperatures, graphite or brass to change or enhance obscurant effectiveness, etc.

The M3A3 smoke generators are driven by gasoline-powered pulse jet engines. Each generator consumes 4 gallons of unleaded gasoline per hour and processes 40 gallons of fog oil per hour.

There will typically be about 12 generators operating each time the training is conducted. However, there will be no limitations on the number of generators; rather, limits are imposed on the amount of fog oil which may be processed. The smoke training will occur at several sites at Fort Leonard Wood. Smoke training can not be used at some sites during certain meteorological conditions because such conditions could cause an exceedance of the PM_{10} ambient air quality standards (10 CSR 10-6.010, "Ambient Air Quality Standards") or the ambient air increment (10 CSR 10-6.060(11)(A), "Table 1 – Ambient Air Increment Table").

The air quality impact due to the smoke training is evaluated by considering the fog oil as a volatile organic compound (VOC) and as PM_{10}. There is no ambient air quality standard for VOCs. In lieu of preapplication air quality analysis, pre- and post-operation ambient air monitoring for ozone will be required.

The air ambient quality impact of the emission of PM_{10} is evaluated using the ambient air quality model ISC2 (Industrial Source Complex), draft version dated December 6, 1994. This version of ISC2 is recommended by the EPA for use in this study to estimate the effect on the ambient air quality of the operation of equipment which emits air contaminants. This permit has conditions that prohibit smoke training operations at those locations when meteorological conditions exist that could cause an exceedance of the PM_{10} National Ambient Air Quality Standards (NAAQS) or the PM_{10} increment. The constraints have been developed based on wind direction, atmospheric stability, and distance from the site to the property line. Attachment A describes the acceptable sites under various meteorological conditions. Fort Leonard Wood agrees to maintain a minimum of 3 kilometers visibility at property boundary as related to the smoke training school.

The total amount of fog oil processed by the smoke generators is limited to 65,000 gallons during any 12-month period. Since this construction triggers the federal PSD regulations, a Best Available Control Technology (BACT) analysis must be performed. Adding a PM_{10} control device to the smoke generators would defeat the purpose of the mission. Other smoke generation systems were evaluated, and the proposed method is the most feasible.

EMISSIONS/CONTROLS EVALUATION

Most of the fog oil will disperse as PM_{10}, but some will evaporate as VOC. According to information provided by the applicant, 30% of the fog oil will evaporate before reaching the property boundary.

Additional emissions are expected from the combustion of gasoline in the pulse-jet engines. Emission rates for the combustion of gasoline from the smoke generators are calculated using emission factors from the U.S. Environmental Protection Agency document AP-42, "Compilation of Air Pollutant Emission Factors: Volume II: Mobile Sources," and from Material Safety Data Sheets supplied by Fort Leonard Wood.

Table 1 below lists the annual emissions expected when Fort Leonard Wood vaporizes 65,000 gallons of fog oil, including the combustion of unleaded gasoline in the pulse-jet engine.

Table 1: Pollutants Emissions in Tons per Year

	VOC	PM_{10}	SO_2	NO_x	CO	HAPs (Note 1)
Fog Oil	250	175	0.0	0.0	0.0	$\leq$ 2.5
Combustion	0.7	0.0	0.0	0.2	11.3	0.0
Totals	251	175	0.0	0.2	11.3	$\leq$ 2.5

Note 1: Emissions from all HAPs combined is limited to 2.5 tpy. Emissions from any single HAPs is limited to 1.25 tpy.

PERMIT RULE APPLICABILITY

This PSD review is conducted under Section (8) of Missouri State Rule 10 CSR 10-6.060, "Construction Permits Required." Compliance with this section of the rule means that the proposed source will not interfere with the attainment or maintenance of ambient air quality standards, will not cause or contribute to ambient air concentrations in excess of any applicable maximum allowable increase as listed in 10 CSR 10-6.060 Subsection (11)(A) Table 1, will not violate any applicable emission control regulations or the Air Conservation Law, and will not cause an adverse impact on visibility in any Class 1 area.

APPLICABLE REQUIREMENTS

I. Installation Level: Fort Leonard Wood
  A. General
    1. Applicable Requirements: Submission of Emission Data, Emission Fees and Process Information
      a. Regulatory Authority: 10 CSR 10-6.110
      b. Emission Limitation: $25.70 per ton of pollutant
      c. Recordkeeping Requirement: Emissions Inventory Questionnaire (EIQ)
      d. Reporting Requirement: April 1 for previous year's emissions (EIQ)
    2. Applicable Requirements: Operating Permits
      a. Regulatory Authority: 10 CSR 10-6.065
      b. Emission Limitation: None
      c. Recordkeeping Requirement: None
      d. Monitoring Requirement: None
      e. Reporting Requirement: Submission of Future Operating Permit Application

II. Emission Point Level: Smoke Training Sites
  A. PM_{10} Emissions
    1. Applicable Requirements: Construction Permits Required
      a. Regulatory Authority: 10 CSR 10-6.060
      b. Emission Limitations: 65,000 gallons of SGF-2 fog oil per 12-month period; 3700 pounds of SGF-2 fog oil per day; 2600 pounds/hour of PM_{10}
      c. Recordkeeping Requirement: Annual and daily throughput; emissions rate
      d. Monitoring Requirements: Pre-startup and post-startup ambient air quality monitoring data; meteorological data; soil and vegetation sampling;
      e. Reporting Requirement: Violations of emission limitations; monitoring data
  B. VOC Emissions
    1. Applicable Requirements: Construction Permits Required
      a. Regulatory Authority: 10 CSR 10-6.060
      b. Emission Limitation: 65,000 gallons of SGF-2 fog oil per 12-month period.
      c. Recordkeeping Requirement: Annual and daily

throughput.
d. Monitoring Requirements: Pre-startup and post-startup ambient air quality monitoring data.
e. Reporting Requirement: Violations of emissions limitations.

C. Hazardous Air Pollutants (HAPs)
1. Applicable Requirements: Construction Permits Required
a. Regulatory Authority: 10 CSR 10-6.060
b. Emission Limitation: 2.5 tpy, Single HAPs. 1.25 tpy, Combination of HAPs. Below 25 tpy/10 tpy *de minimis* limit. Emissions are constrained by fog oil material specification, i.e., 1%/0.5% by weight HAPs.
c. Recordkeeping Requirement: None.
d. Monitoring Requirements: None.
e. Reporting Requirement: Violations of emissions limitations.

BACT ANALYSIS

A "top-down" BACT analysis is required to be submitted with this application. BACT is defined as an emission limitation based on the maximum degree of reduction for each pollutant which would be emitted from any proposed installation or major modification which the Director, on a case-by-case basis, taking into account energy, environmental and economic impacts, and other costs, determines is achievable for such an installation or major modification. BACT may be achieved through application of production processes, or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of the pollutant.

Applying any control device defeats the purpose of the generating smoke for smoke training. Smoke training is conducted so as to simulate various battlefield conditions as realistically as possible. Large open areas are required for the movement of troops and equipment participating in smoke training exercises. There are no available control options with practical potential for application to the emissions unit and the regulated pollutants under evaluation.

The only BACT option is to examine the other methods available to produce smoke. According to the U. S. Army Medical Research and

Development Laboratory's publication, "Smokes and Obscurants: A Guidebook of Environmental Assessment, Volume 1. Method of Assessment and Appended Data," there are several methods to produce smoke.

Phosphorous Smokes and Hexachloroethane Smokes are both delivered in a pyrotechnic setting. In other words, they involve the use of cannons, mortars, smoke grenades, tank guns, rockets, and bombs. Diesel Fuels and Fog Oils are delivered by Smoke Pots, Vehicle Engine Exhaust Smoke Systems, M3A3 Generators, and Jet-Turbine Helicopters. Infrared Smokes are delivered by grenades. They contain powdered brass, which is an alloy of copper and zinc.

The purpose of smoke training is to train soldiers on the use of the M3A3 fog oil smoke generator and to allow them to observe the behavior of fog oil smoke under field conditions. The other methods of generating smoke produce significant Hazardous Air Pollutants (HAP) or are delivered in a more dangerous manner than the M3A3 generator.

There are no technically feasible control options, and the use of the M3A3 smoke generators and SGF-2 fog oil does not result in the emission of hazardous air pollutants above *de minimis* levels, nor employ the use of pyrotechnics. Therefore, the M3A3/SGF-2 option as described herein is chosen as BACT.

MDNR may reevaluate this BACT analysis, establish any necessary operational restrictions, e.g., restricting smoke training to only the summer months, or require the Permittee to take any necessary corrective action, if the results of the soil, vegetation, or ambient air sampling indicate adverse deposition effects.

MODELING AND MONITORING

Fort Leonard Wood, in compliance with Missouri State Rule 10 CSR 10-6.060(8)(C), has conducted ambient air quality modeling. The review of the modeling is included as a memo from the Technical Support Section of APCP (Appendix A). The modelling showed compliance with the NAAQS and PSD increments. The modeled maximum concentrations exceeded the *de minimis* level for PM_{10}. Fort Leonard Wood will be required to conduct post-construction monitoring For PM_{10}.

Existing PM_{10} monitoring data was determined to be representative of conditions at Fort Leonard Wood (Appendix B attached) and was used to demonstrate compliance with the NAAQS. However, to check this data, Fort Leonard Wood is required to conduct one year of preconstruction monitoring for PM_{10} and ozone prior to the beginning of smoke training. Fort Leonard Wood shall take appropriate corrective action should this later air monitoring data not substantially conform with the assumptions and conclusions of the air quality modelling or if the smoke training is show to cause or contribute to a violation of NAAQS.

Air monitoring of PM_{10} and ozone will continue for two years after smoke training begins. Because of concerns about the air quality in the area, Fort Leonard Wood will present the air monitoring data at a public informational meeting to be convened by the APCP prior to commencement of smoke training.

CLASS I AREA IMPACT ANALYSIS

The federal PSD regulations as adopted in 10 CSR 10-6.060 require an ambient air quality impact analysis to be done on all Class I areas within 100 kilometers in order to assure that no adverse ambient air quality impact will occur within the Class I area. There are no Class I areas within 100 kilometers of the proposed plant. Therefore, no Class I impact analysis is required.

ANALYSIS OF IMPACT ON VISIBILITY, LOCAL SOILS, ANIMALS AND VEGETATION

The Applicant analyzed the projected impairment to visibility, soils, animals and vegetation.

Fort Leonard Wood submitted soil and vegetation sampling conducted during test smoke training exercises in 1993. Results of sampling for total petroleum hydrocarbons (TPH) indicated significant deposition with high levels of TPH which decreased over several weeks. However, Fort Leonard Wood indicated that the sampling protocol was flawed (e.g., samples were collected in plastic bags) which resulted in contaminated samples and the overestimation of TPH levels.

The procedures listed in the EPA document, "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and

-Animals," were examined. Since there is no simple procedure for estimating the impact of ozone from a single source, and since PM_{10} is not one of the regulated pollutants for which screening is done in the EPA screening guidance, no further analysis of the impact of smoke training on visibility, local soils, animals and vegetation is required.

However, to more accurately assess the impact of smoke training on soil and vegetation, Fort Leonard Wood is required to conduct soil and vegetation sampling at the training sites. Quarterly sampling will be performed at each training site for at least one year prior to commencement of smoke training. Monthly sampling will continue after smoke training begins. Fort Leonard Wood shall cooperate with APCP to present the results of pre-startup soil and vegetation sampling at a public informational meeting to be convened by the APCP prior to the commencement of smoke training.

In addition, prior to commencement of smoke training, Fort Leonard Wood shall inventory vegetation found within the smoke training impact area that has any recreational or commercial value and shall identify any of the vegetation which may be sensitive to elevated ozone or particulate levels. Fort Leonard Wood should consider the following documents in performing said inventory: *Air Quality Criteria Documents*, U.S. Environmental Protection Agency, *A Screening Procedure to Evaluate Air Pollution Effects on Class I Wilderness Areas*, U.S. Forest Service, and *Air Quality in the National Parks*, National Park Service. Fort Leonard Wood shall also describe operational or seasonal restrictions that could be used to minimize emissions and any accompanying deposition effects.

The EPA's "Workbook for Plume Visual Impact Screening and Analysis," was used to determine the visual quality of the area and assess the visual impact of the proposed facility. The model indicates that the visibility in the area would not be adversely affected. Appendix B contains the result of the visibility analysis.

Fort Leonard Wood shall also comply with water sampling required by MDNR, Water Pollution Control Program.

GROWTH IMPACTS

The Applicant analyzed the air quality impact projected for the area as a result of general commercial, residential, industrial growth, as well as growth associated with this installation. The installation is expected to increase by 7900 persons. This includes civilian/permanent party military increase of 1600 and a trainee increase of 6300. All of the permanent party and military trainees will be served by the facility on-post. Increased fuel use for space heating and air conditioning could result in some increased emissions. However, the expected increase in personnel would merely bring Fort Leonard Wood back to the same level of personnel as served in 1990. Therefore, no additional growth-related air pollution impacts are anticipated.

STAFF RECOMMENDATION

On the basis of this review conducted in accordance with Section (8), Missouri State Rule 10 CSR 10-6.060, "Construction Permits Required," the undersigned recommend this permit be granted with conditions.

Sharon Turpin — 6/7/95
Sharon Turpin
Environmental Engineer
Date

Glenn A. Carlson — 6/7/95
Glenn A. Carlson, P.E.
Environmental Engineer
Date

FOG OIL AIR PERMIT MODELING REPORT

APPENDIX A

Fort Leonard Wood Smoke Training PSD Modeling

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MEMORANDUM

DATE: June 7, 1995

TO: Glenn Carlson, Acting Unit Chief
Permit Section

FROM: Calvin Ku, Section Chief CK
Technical Support Section

Chris Smith, Meteorologist CS
Technical Support Section

SUBJECT: Fort Leonard Wood Smoke Training PSD Modeling (Revised)

I. Introduction

Fort Leonard Wood is proposing to conduct smoke training at several locations within their property. Due to the emission rates of the smoke generators to be used in the training, this project is subject to PSD (Prevention of Significant Deterioration) permit review including modeling requirements.

A modeling report entitled 'Predicted Air Quality Impacts for Fort Leonard Wood Smoke Training School' was submitted by Burns & McDonnell on April 9, 1995(attached). This report includes two separate analyses, the PSD increment analysis and the NAAQS (National Ambient Air Quality Standard) analysis. These analyses indicate that the smoke training can be conducted during specific meteorological conditions in order to meet the necessary standards. The following report summarizes the modeling review and the resulting recommendations for permit requirements.

II. Modeling Procedures

The modeling procedures used in this study follow PSD and air quality modeling guidelines. The selected model for this application is the draft version of the new ISC2 (Industrial Source Complex) model dated Dec. 6, 1994. This version of the ISC2 includes simple and complex terrain algorithms and

incorporates EPA's intermediate terrain policy. Additionally, the new version includes new area source and deposition algorithms. This model was recommended by EPA for use in this study.

The source information differs in the PSD increment modeling and the NAAQS modeling. For the PSD increment model, only the smoke generator sources are included. These generators will be placed on vehicles and may be moved during their operation. The vehicles will be spaced by at least 20 meters and will be oriented in a line or a 'v'. For modeling purposes, worst case is assumed to be a line of volume sources with an interval of 20 meters. The smoke generators are evaluated based on an emission rate of 2600 pounds per hour of PM_{10}. The smoke sources are modeled at all possible locations of operation within the fort. The NAAQS modeling includes all major sources within 50 kilometers of Fort Leonard Wood. A major source list was generated from the state's emission inventory databases and additional quality assurance was conducted prior to modeling to verify emission rates and source locations. These sources are modeled as continuous operations for worst case impacts.

The meteorological data sets are also different in the PSD increment and NAAQS runs. Because the smoke generators will be allowed to operate only during specific meteorological conditions, user-generated meteorological data sets are used for the PSD increment modeling. Varying meteorological conditions based on wind speed, stability, mixing height, and temperature are used in the model. Wind direction is considered by placing all receptors in a straight line at the proper downwind distance. Using this method, it is possible to model direct path wind directions to all fence line receptors in one model run. The NAAQS runs use five years of actual meteorological data from Springfield and Monett, Missouri.

III. PSD Increment Results

Because the baseline has not been established in this area, the entire PSD increments are available. These values are 30 ug/m^3 and 17 ug/m^3 for the 24-hour and annual average, respectively. The one-hour averages produced by the model are divided by 24 to obtain a representative 24-hour average. These results are then compared to the 24-hour increment of 30 ug/m^3 to identify receptors along the property boundary that will not exceed the increment. Corresponding wind directions are identified as acceptable conditions for operation. This procedure is duplicated for each possible training location. From these runs, a list of acceptable meteorological conditions is derived for each smoke training site (see Table II of the modeling report).

Because the smoke training will not be conducted more than 135 days per year, the annual increment does not require an evaluation. Even if a 30 ug/m^3 maximum 24-hour concentration occurs at the same receptor all 135 days, the annual concentration will only be 11 ug/m^3, well below the annual increment.

IV. NAAQS Results

PSD guidelines require that a NAAQS demonstration be conducted for the area that will be significantly impacted by the new source. For this study, a 50 kilometer radius is used. The model predicts several violations of the NAAQS due to sources beyond the Fort Leonard Wood property boundary. These locations are listed in Table III of the attached modeling report. Due to these potential exceedances of the NAAQS, the smoke training will not be allowed to occur under meteorological conditions which will result in a significant contribution. Several of the sites will not impact any of these potential exceedances already. However, under certain meteorological conditions stipulated in the PSD increment review as being acceptable, there is a significant contribution. Therefore, the fort is further restricted in their operation of the smoke generators. The resulting meteorological conditions which are acceptable for the PSD increment and the NAAQS are given in Table II of the modeling report.

V. Recommendations

Basis on the modeling analysis, we recommend the following conditions that should be required with the issuance of the smoke training permit:

1) The smoke generators shall be operated no more than 135 days per year.

2) The total emissions of PM10 from the smoke generators shall be limited at a rate of 2600 pounds per hour. This emission rate is based on the use of 3700 pounds per hour of fog oil and assumes a 70% conversion rate to particulate matter.

3) The smoke training emissions are found to be acceptable for the PSD increment and the NAAQS for the wind directions, stabilities, and durations listed in Table II of the smoke training modeling report provided by Fort Leonard Wood.

4) In addition to the wind direction and stability requirements, the model indicates that a wind speed of at least 1 m/s is necessary for stabilities A-D and at least 4 m/s for

stability E. Also, a mixing height of 200 meters is necessary for stabilities A-C and a mixing height of 320 meters is required for stabilities D-E.

5) Under no circumstance should the smoke training be conducted during F stability.

6) No smoke training should occur at any locations other than those specified in Table II of the modeling report.

7) The model predicts concentrations during very specific meteorological conditions. Special attention should be given to the measurement and monitoring of these parameters before, during, and after the smoke training occurs. This requires not only appropriate instrumentation, but qualified personnel as well. Fort Leonard Wood should be required to secure these instruments and trained personnel.

VI. Conclusion

Based on the modeling analysis, the proposed smoke training at Fort Leonard Wood, if operated under the requirements listed in Section V, will not cause or contribute to a violation of the PSD increment or NAAQS for PM10.

APPENDIX B

Background Concentration for the Fort Leonard Wood Smoke Training

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MEMORANDUM

DATE: June 1, 1995

TO: Randy Raymond, Chief, Permitting Section
Air Pollution Control Program

FROM: Calvin Ku, Chief, Technical Support Section
Air Pollution Control Program

SUBJECT: Background Concentration for the Fort Leonard Wood Smoke Training

Background concentration determination is an important part of the ambient air quality impact analysis. In multi-source areas, two components of background should be considered. The first component is due to the nearby major sources which are expected to affect the area air quality. The impact of the nearby sources was modeled and areas of the maximum impact (hot spots) were identified in a report "Predicted Air Qality Impacts for Fort Leonard Wood Smoke Training School" prepared by the Army's Consultant, Burns and McDonnell.

The second component of the background is attributable to other sources such as natural sources and minor sources. Because no ambient monitors are located in the vicinity of Fort Leonard Wood, air quality data collected at the Mark Twain site was used to determine the natural and minor source background. The Mark Twain site was considered because it has a similar environmental setting as Fort Leonard Wood.

Attached is a report which shows three year PM_{10} data collected at the Mark Twain site between 1992 and 1994. The first and second maximum 24-hour concentrations collected in 1994 are 54 and 39 ug/m^3, respectively. The annual average is 15 ug/m^3. The maximum 24-hour concentration was recorded on June 19, 1994. This maximum concentration should not be used for background because the wind speed recorded was less than 1 m/s for all 24 hours in the day except two. The wind speed data for June 19, is also attached. As specified in the draft permit, the smoke training should not be conducted when the wind speed is 1 m/s or less.

It is recommended that a 24-hour background of 39 ug/m^3 and an annual background of 15 ug/m^3 be used in the air quality analysis for the smoke training. In addition, a 12-month pre-construction monitoring should start immediately after approval of the monitoring plan by the Missouri Department of Natural Resources to verify the background concentrations.

CK:sj

Attachment

QUICK LOOK REPORT

PM-10 TOTAL 0-10UM (81102) MISSOURI UNITS: 001 UG/CU METER (25 C)

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	YR	REP ORG	SCHEDULED NUM OBS	NUM OBS	% OBS	NUM REQ	MAXIMUM VALUES 1ST	2ND	3RD	4TH	VALS MEAS	> 150 EST	WTD ARITH MEAN
29-007-0009	2	2	MEXICO	AUDRAIN CO	AUDRAIN COUNTY MEDICA	92	001	58	58	91	64	57	38	37	35	0	0.00	19
29-007-0009	2	2	MEXICO	AUDRAIN CO	AUDRAIN COUNTY MEDICA	93	001	60	59	94	63	37	35	31	31	0	0.00	17
29-007-0009	2	2	MEXICO	AUDRAIN CO	AUDRAIN COUNTY MEDICA	94	001	61	60	95	63	59	41	40	40	0	0.00	19
29-021-0005	1	3	ST JOSEPH	BUCHANAN C	SOUTH 759 HIGHWAY, PU	92	001	132	46	96	138	110	93	88	86	0	0.00	42
29-021-0005	2	2	ST JOSEPH	BUCHANAN C	SOUTH 759 HIGHWAY, PU	92	001	225	134	96	64	91	89	88	87	0	0.00	39
29-021-0005	2	2	ST JOSEPH	BUCHANAN C	SOUTH 759 HIGHWAY, PU	93	001	177	163	97	63	130	100	100	81	0	0.00	32
29-021-0005	2	2	ST JOSEPH	BUCHANAN C	SOUTH 759 HIGHWAY, PU	94	001	176	146	95	63	96	77	74	74	0	0.00	34
29-043-0004	1	3		CHRISTIAN	JOURNAGAN CLEVER QUAR	94	001	3	3	19	92	31	10	10		0	0.00	17
29-051-0003	1	3	JEFFERSON	COLE CO	MO STATE PENITENTIARY	94	001	15	15	94	16	24	19	17	17	0	0.00	11
29-077-0026	2	1	SPRINGFIEL	GREENE CO	5012 S. CHARLESTON S	92	005	61	61	95	64	49	44	38	35	0	0.00	19
29-077-0026	2	1	SPRINGFIEL	GREENE CO	5012 S. CHARLESTON S	93	005	61	61	97	63	40	37	34	31	0	0.00	17
29-077-0026	2	1	SPRINGFIEL	GREENE CO	5012 S. CHARLESTON S	94	005	61	61	97	63	51	36	31	29	0	0.00	17
29-077-0032	1	2	SPRINGFIEL	GREENE CO	S.W.MISSOURI STATE UN	92	005	58	58	91	64	50	42	41	38	0	0.00	19
29-077-0032	1	2	SPRINGFIEL	GREENE CO	S.W.MISSOURI STATE UN	93	005	59	59	94	63	38	34	33	31	0	0.00	18
29-077-0032	1	2	SPRINGFIEL	GREENE CO	S.W.MISSOURI STATE UN	94	005	61	61	97	63	58	39	32	30	0	0.00	18
29-077-0036	1	2	SPRINGFIEL	GREENE CO	HILLCREST HIGH SCHOOL	92	005	61	61	95	64	60	41	40	34	0	0.00	19
29-077-0036	1	2	SPRINGFIEL	GREENE CO	HILLCREST HIGH SCHOOL	93	005	61	61	97	63	42	39	37	33	0	0.00	18
29-077-0036	1	2	SPRINGFIEL	GREENE CO	HILLCREST HIGH SCHOOL	94	005	61	61	97	63	55	38	33	32	0	0.00	17
29-095-0009	1	2	INDEPENDEN	JACKSON CO	MOPAC RR RIGHT OF WAY	92	001	57	56	88	64	50	39	38	36	0	0.00	20
29-095-0009	1	2	INDEPENDEN	JACKSON CO	MOPAC RR RIGHT OF WAY	93	001	60	60	95	63	40	35	34	34	0	0.00	18
29-095-0009	1	2	INDEPENDEN	JACKSON CO	MOPAC RR RIGHT OF WAY	94	001	57	57	90	63	63	41	40	38	0	0.00	22
29-099-0005	2	2		JEFFERSON	DUNKLIN HIGH SCHOOL,	92	001	58	58	91	64	59	47	47	46	0	0.00	23
29-099-0005	2	2		JEFFERSON	DUNKLIN HIGH SCHOOL,	93	001	57	57	90	63	74	70	41	38	0	0.00	21
29-099-0005	2	2		JEFFERSON	DUNKLIN HIGH SCHOOL,	94	001	61	61	97	63	92	65	52	46	0	0.00	23
29-127-0004	2	2	HANNIBAL	MARION CO	ST ELIZABETH HOSPITAL	92	001	50	50	78	64	63	35	34	32	0	0.00	19
29-127-0004	2	2	HANNIBAL	MARION CO	ST ELIZABETH HOSPITAL	93	001	54	54	86	63	36	34	33	32	0	0.00	19
29-127-0004	2	2	HANNIBAL	MARION CO	ST ELIZABETH HOSPITAL	94	001	59	59	94	63	59	52	43	41	0	0.00	23
29-137-0001	1	3		MONROE CO	HWYS V & 107 MARK TWA	92	001	45	45	70	64	34	33	27	23	0	0.00	14
29-137-0001	1	3		MONROE CO	HWYS V & 107 MARK TWA	93	001	58	58	92	63	33	30	27	26	0	0.00	13
29-137-0001	1	3		MONROE CO	HWYS V & 107 MARK TWA	94	001	56	56	89	63	54	39	39	29	0	0.00	15
29-183-1002	1	2		ST CHARLES	GENERAL ELECTRIC STOR	92	001	47	47	73	64	63	43	36	31	0	0.00	19
29-183-1002	1	2		ST CHARLES	GENERAL ELECTRIC STOR	93	001	30	30	97	31	38	36	36	35	0	0.00	20
29-183-1002	1	2		ST CHARLES	GENERAL ELECTRIC STOR	94	001	41	41	85	48	56	54	51	44	0	0.00	25
29-215-0002	1	3		TEXAS CO	645 MAPLE	92	001	31	16	100	16	46	45	43	42	0	0.00	21

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA

06-01-1995
08:53:46

MET - AIR QUALITY DAILY DATA REPORT

Site: MTSP Date: 6/19/94

Hour	WINDS
0	1.00
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	1.00
9	1.00
10	1.00
11	2.00
12	3.00
13	1.00
14	3.00
15	1.00
16	0.00
17	0.00
18	0.00
19	1.00
20	0.00
21	0.00
22	0.00
23	0.00

EXAMPLE FOG OIL MODEL OUTPUT

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 STARTING
 TITLEONE ft wood screening met-BAILEY HOLLOW
 MODELOPT DFAULT CONC RURAL
 AVERTIME 1
 POLLUTID PM
 TERRHGTS ELEV
 ELEVUNIT METERS
 RUNORNOT RUN
 FINISHED
 STARTING
 LOCATION SRC1 VOLUME  571880.00 4170000.00     340.00
 SRCPARAM SRC1 35.85000        2.44      1.00       1.00
 LOCATION SRC2 VOLUME  571900.00 4170000.00     340.00
 SRCPARAM SRC2 35.85000        2.44      1.00       1.00
 LOCATION SRC3 VOLUME  571920.00 4170000.00     340.00
 SRCPARAM SRC3 35.85000        2.44      1.00       1.00
 LOCATION SRC4 VOLUME 571940.00 4170000.00     340.00
 SRCPARAM SRC4 35.85000        2.44      1.00       1.00
 LOCATION SRC5 VOLUME  571960.00 4170000.00     340.00
 SRCPARAM SRC5 35.85000        2.44      1.00       1.00
 LOCATION SRC6 VOLUME  571980.00 4170000.00     340.00
 SRCPARAM SRC6 35.85000        2.44      1.00       1.00
 LOCATION SRC7 VOLUME  572000.00 4170000.00     340.00
 SRCPARAM SRC7 35.85000        2.44      1.00       1.00
 LOCATION SRC8 VOLUME  572020.00 4170000.00     340.00
 SRCPARAM SRC8 35.85000        2.44      1.00       1.00
 LOCATION SRC9 VOLUME  572040.00 4170000.00     340.00
 SRCPARAM SRC9 35.85000        2.44      1.00       1.00
 LOCATION SRC10 VOLUME  572060.00 4170000.00     340.00
 SRCPARAM SRC10 35.85000        2.44     1.00       1.00
 LOCATION SRC11 VOLUME  572080.00 4170000.00     340.00
 SRCPARAM SRC11 35.85000        2.44     1.00       1.00
 LOCATION SRC12 VOLUME  572100.00 4170000.00     340.00
 SRCPARAM SRC12 35.85000        2.44     1.00       1.00

 EMISUNIT 1000000.000000 GRAMS/SEC MICROGRAMS/M**3
 SRCGROUP ALL
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PROPERTY BOUNDARY
 DISCCART 572000.00 4180600.00   370.00
 DISCCART 572000.00 4180000.00   389.00
 DISCCART 572000.00 4179400.00   370.00
 DISCCART 572000.00 4178900.00   350.00
 DISCCART 572000.00 4178500.00   340.00
 DISCCART 572000.00 4178200.00   360.00
 DISCCART 572000.00 4178100.00   358.00
 DISCCART 572000.00 4178000.00   380.00
 DISCCART 572000.00 4178100.00   380.00
 DISCCART 572000.00 4177100.00   360.00
 DISCCART 572000.00 4177300.00   350.00
 DISCCART 572000.00 4176700.00   320.00
 DISCCART 572000.00 4176400.00   360.00
 DISCCART 572000.00 4175700.00   347.00
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 DISCCART 572000.00 4177600.00   341.00
 DISCCART 572000.00 4177300.00   350.00
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RE DISCCART 572000.00 4177100.00 360.00
RE DISCCART 572000.00 4177300.00 370.00
IE DISCCART 572000.00 4177600.00 340.00
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RE DISCCART 572000.00 4179500.00 350.00
IE DISCCART 572000.00 4180800.00 360.00
IE DISCCART 572000.00 4181700.00 380.00
RE DISCCART 572000.00 4183000.00 390.00
RE DISCCART 572000.00 4184300.00 350.00
IE DISCCART 572000.00 4184800.00 350.00
RE DISCCART 572000.00 4185300.00 320.00
RE DISCCART 572000.00 4185000.00 334.00
IE DISCCART 572000.00 4184900.00 280.00
IE DISCCART 572000.00 4184100.00 290.00
RE DISCCART 572000.00 4183400.00 330.00
IE DISCCART 572000.00 4183600.00 330.00
IE DISCCART 572000.00 4184400.00 320.00
RE DISCCART 572000.00 4185300.00 310.00
RE DISCCART 572000.00 4184800.00 320.00
IE DISCCART 572000.00 4184300.00 335.00
IE DISCCART 572000.00 4183900.00 320.00
RE DISCCART 572000.00 4183600.00 300.00
IE DISCCART 572000.00 4183300.00 360.00
IE DISCCART 572000.00 4183200.00 330.00
RE DISCCART 572000.00 4183000.00 300.00
IE DISCCART 572000.00 4183000.00 350.00
.E DISCCART 572000.00 4183200.00 340.00
RE DISCCART 572000.00 4182200.00 320.00
RE DISCCART 572000.00 4181200.00 330.00
IE DISCCART 572000.00 4180200.00 300.00
IE DISCCART 572000.00 4179100.00 350.00
RE DISCCART 572000.00 4178100.00 320.00
.E DISCCART 572000.00 4177300.00 330.00
.E DISCCART 572000.00 4176700.00 300.00
RE DISCCART 572000.00 4175800.00 280.00
IE DISCCART 572000.00 4175700.00 350.00
IE DISCCART 572000.00 4175000.00 320.00
RE DISCCART 572000.00 4174500.00 330.00
RE DISCCART 572000.00 4174100.00 320.00
E DISCCART 572000.00 4174000.00 340.00
E DISCCART 572000.00 4174100.00 320.00
RE DISCCART 572000.00 4174500.00 300.00
E DISCCART 572000.00 4175400.00 350.00
E DISCCART 572000.00 4176300.00 354.00
RE DISCCART 572000.00 4176700.00 365.00
RE DISCCART 572000.00 4177200.00 350.00
E DISCCART 572000.00 4177800.00 360.00
RE DISCCART 572000.00 4178500.00 350.00
RE DISCCART 572000.00 4179200.00 380.00
E DISCCART 572000.00 4179000.00 370.00

**OFF PROPERTY RECEPTORS
IE DISCCART 572000.00 4186000.00 340.00
E DISCCART 572000.00 4187000.00 340.00
RE DISCCART 572000.00 4188000.00 340.00
RE DISCCART 572000.00 4189000.00 340.00
E DISCCART 572000.00 4190000.00 340.00
RE DISCCART 572000.00 4191000.00 340.00

```
 DISCCART 572000.00 4192000.00   340.00
 DISCCART 572000.00 4193000.00   340.00
 DISCCART 572000.00 4194000.00   340.00
 DISCCART 572000.00 4195000.00   340.00
 DISCCART 572000.00 4196000.00   340.00
 DISCCART 572000.00 4197000.00   340.00
 DISCCART 572000.00 4198000.00   340.00
 DISCCART 572000.00 4199000.00   340.00
 DISCCART 572000.00 4200000.00   340.00
 DISCCART 572000.00 4201000.00   340.00
 DISCCART 572000.00 4202000.00   340.00
 DISCCART 572000.00 4203000.00   340.00
 DISCCART 572000.00 4204000.00   340.00
 DISCCART 572000.00 4205000.00   340.00
 DISCCART 572000.00 4206000.00   340.00
 DISCCART 572000.00 4207000.00   340.00
 DISCCART 572000.00 4208000.00   340.00
 DISCCART 572000.00 4209000.00   340.00
 DISCCART 572000.00 4210000.00   340.00
 DISCCART 572000.00 4211000.00   340.00
 DISCCART 572000.00 4212000.00   340.00


ON BASE HOUSING
 DISCCART 572000.00 4178400.00   330.00
 DISCCART 572000.00 4178900.00   330.00
 DISCCART 572000.00 4179600.00   330.00
 DISCCART 572000.00 4180000.00   330.00
 DISCCART 572000.00 4180600.00   330.00
 DISCCART 572000.00 4180800.00   330.00
 DISCCART 572000.00 4181400.00   330.00
 DISCCART 572000.00 4180800.00   330.00
 DISCCART 572000.00 4181700.00   330.00
 DISCCART 572000.00 4182100.00   330.00
 DISCCART 572000.00 4182100.00   330.00
 DISCCART 572000.00 4182600.00   330.00
 DISCCART 572000.00 4183000.00   330.00



 FINISHED
 STARTING
 INPUTFIL FT1.MET
 ANEMHGHT   10.000 METERS
 SURFDATA 0 1999 SURFNAME
 UAIRDATA 0 1999 UAIRNAME
 STARTEND 1999 1 1 1 1999 12 31 24
 FINISHED
 STARTING
 RECTABLE 1 FIRST SECOND THIRD
 FINISHED


** Message Summary For ISC2 Model Setup ***

-------- Summary of Total Messages --------

Total of          0 Fatal Error Message(s)
Total of          1 Warning Message(s)
Total of          0 Informational Message(s)
```

```
******** FATAL ERROR MESSAGES ********
            *** NONE ***


********   WARNING MESSAGES   ********
:O W151     7 COCARD: CO ELEVUNIT card obsolescent: use RE ELEVUNIT card instead

************************************
*** SETUP Finishes Successfully ***
************************************
```

** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** MODEL SETUP OPTIONS SUMMARY ***

Intermediate Terrain Processing is Selected

Model Is Setup For Calculation of Average CONCentration Values.

-- SCAVENGING/DEPOSITION LOGIC --
Model Uses NO DRY DEPLETION. DDPLETE = F
Model Uses NO WET DEPLETION. WDPLETE = F
NO WET SCAVENGING Data Provided.
Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

Model Uses RURAL Dispersion.

Model Uses Regulatory DEFAULT Options:
1. Final Plume Rise.
2. Stack-tip Downwash.
3. Buoyancy-induced Dispersion.
4. Use Calms Processing Routine.
5. Not Use Missing Data Processing Routine.
6. Default Wind Profile Exponents.
7. Default Vertical Potential Temperature Gradients.
8. "Upper Bound" Values for Supersquat Buildings.
9. No Exponential Decay for RURAL Mode

Model Accepts Receptors on ELEV Terrain.

Model Assumes No FLAGPOLE Receptor Heights.

Model Calculates 1 Short Term Average(s) of: 1-HR

This Run Includes: 12 Source(s); 1 Source Group(s); and 111 Receptor(s)

The Model Assumes A Pollutant Type of: PM

Model Set To Continue RUNning After the Setup Testing.

Output Options Selected:
Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
m for Missing Hours
b for Both Calm and Missing Hours

Misc. Inputs: Anem. Hgt. (m) = 10.00 ; Decay Coef. = .0000 ; Rot. Angle = .0
Emission Units = GRAMS/SEC ; Emission Rate Unit Factor = .10000E+07
Output Units = MICROGRAMS/M**3

Input Runstream File: BAILA.DAT ; **Output Print File: BAIL.D-E

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (USER UNITS)	X (METERS)	Y (M	BASE ELEV.	RELEASE HEIGHT	INIT. SY	INIT. SZ	EMISSION RATE SCALAR VARY

S) (METERS)	(METERS)	(METERS)	(METERS)	BY			
RC1	0	:35850E+02	571880.0	4170000.0	340.0	2.44	1.00	1.00
RC2	0	.35850E+02	571900.0	4170000.0	340.0	2.44	1.00	1.00
RC3	0	.35850E+02	571920.0	4170000.0	340.0	2.44	1.00	1.00
RC4	0	.35850E+02	571940.0	4170000.0	340.0	2.44	1.00	1.00
RC5	0	.35850E+02	571960.0	4170000.0	340.0	2.44	1.00	1.00
RC6	0	.35850E+02	571980.0	4170000.0	340.0	2.44	1.00	1.00
RC7	0	.35850E+02	572000.0	4170000.0	340.0	2.44	1.00	1.00
RC8	0	.35850E+02	572020.0	4170000.0	340.0	2.44	1.00	1.00
RC9	0	.35850E+02	572040.0	4170000.0	340.0	2.44	1.00	1.00
RC10	0	.35850E+02	572060.0	4170000.0	340.0	2.44	1.00	1.00
RC11	0	.35850E+02	572080.0	4170000.0	340.0	2.44	1.00	1.00
RC12	0	.35850E+02	572100.0	4170000.0	340.0	2.44	1.00	1.00

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ALL	SRC1 , SRC2 , SRC3 , SRC4 , SRC5 , SRC6 , SRC7 , SRC8 , SRC9 , SRC10 , SRC11 , SRC12 ,

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(572000.0, 4180600.0,	370.0,	.0);	(572000.0, 4180000.0,	389.0,	.0);
(572000.0, 4179400.0,	370.0,	.0);	(572000.0, 4178900.0,	350.0,	.0);
(572000.0, 4178500.0,	340.0,	.0);	(572000.0, 4178200.0,	360.0,	.0);
(572000.0, 4178100.0,	358.0,	.0);	(572000.0, 4178000.0,	380.0,	.0);
(572000.0, 4178100.0,	380.0,	.0);	(572000.0, 4177100.0,	360.0,	.0);
(572000.0, 4177300.0,	350.0,	.0);	(572000.0, 4176700.0,	320.0,	.0);
(572000.0, 4176400.0,	360.0,	.0);	(572000.0, 4175700.0,	347.0,	.0);
(572000.0, 4176400.0,	330.0,	.0);	(572000.0, 4177200.0,	350.0,	.0);
(572000.0, 4178100.0,	370.0,	.0);	(572000.0, 4177600.0,	341.0,	.0);
(572000.0, 4177300.0,	350.0,	.0);	(572000.0, 4177100.0,	330.0,	.0);
(572000.0, 4177000.0,	340.0,	.0);	(572000.0, 4177100.0,	360.0,	.0);
(572000.0, 4177300.0,	370.0,	.0);	(572000.0, 4177600.0,	340.0,	.0);
(572000.0, 4178500.0,	360.0,	.0);	(572000.0, 4179500.0,	350.0,	.0);
(572000.0, 4180800.0,	360.0,	.0);	(572000.0, 4181700.0,	380.0,	.0);
(572000.0, 4183000.0,	390.0,	.0);	(572000.0, 4184300.0,	350.0,	.0);
(572000.0, 4184800.0,	350.0,	.0);	(572000.0, 4185300.0,	320.0,	.0);
(572000.0, 4185000.0,	334.0,	.0);	(572000.0, 4184900.0,	280.0,	.0);
(572000.0, 4184100.0,	290.0,	.0);	(572000.0, 4183400.0,	330.0,	.0);
(572000.0, 4183600.0,	330.0,	.0);	(572000.0, 4184400.0,	320.0,	.0);
(572000.0, 4185300.0,	310.0,	.0);	(572000.0, 4184800.0,	320.0,	.0);
(572000.0, 4184300.0,	335.0,	.0);	(572000.0, 4183900.0,	320.0,	.0);
(572000.0, 4183600.0,	300.0,	.0);	(572000.0, 4183300.0,	360.0,	.0);
(572000.0, 4183200.0,	330.0,	.0);	(572000.0, 4183000.0,	300.0,	.0);
(572000.0, 4183000.0,	350.0,	.0);	(572000.0, 4183200.0,	340.0,	.0);
(572000.0, 4182200.0,	320.0,	.0);	(572000.0, 4181200.0,	330.0,	.0);
(572000.0, 4180200.0,	300.0,	.0);	(572000.0, 4179100.0,	350.0,	.0);
(572000.0, 4178100.0,	320.0,	.0);	(572000.0, 4177300.0,	330.0,	.0);
(572000.0, 4176700.0,	300.0,	.0);	(572000.0, 4175800.0,	280.0,	.0);
(572000.0, 4175700.0,	350.0,	.0);	(572000.0, 4175000.0,	320.0,	.0);
(572000.0, 4174500.0,	330.0,	.0);	(572000.0, 4174100.0,	320.0,	.0);
(572000.0, 4174000.0,	340.0,	.0);	(572000.0, 4174100.0,	320.0,	.0);
(572000.0, 4174500.0,	300.0,	.0);	(572000.0, 4175400.0,	350.0,	.0);
(572000.0, 4176300.0,	354.0,	.0);	(572000.0, 4176700.0,	365.0,	.0);
(572000.0, 4177200.0,	350.0,	.0);	(572000.0, 4177800.0,	360.0,	.0);
(572000.0, 4178500.0,	350.0,	.0);	(572000.0, 4179200.0,	380.0,	.0);
(572000.0, 4179000.0,	370.0,	.0);	(572000.0, 4186000.0,	340.0,	.0);
(572000.0, 4187000.0,	340.0,	.0);	(572000.0, 4188000.0,	340.0,	.0);
(572000.0, 4189000.0,	340.0,	.0);	(572000.0, 4190000.0,	340.0,	.0);
(572000.0, 4191000.0,	340.0,	.0);	(572000.0, 4192000.0,	340.0,	.0);
(572000.0, 4193000.0,	340.0,	.0);	(572000.0, 4194000.0,	340.0,	.0);
(572000.0, 4195000.0,	340.0,	.0);	(572000.0, 4196000.0,	340.0,	.0);
(572000.0, 4197000.0,	340.0,	.0);	(572000.0, 4198000.0,	340.0,	.0);
(572000.0, 4199000.0,	340.0,	.0);	(572000.0, 4200000.0,	340.0,	.0);
(572000.0, 4201000.0,	340.0,	.0);	(572000.0, 4202000.0,	340.0,	.0);
(572000.0, 4203000.0,	340.0,	.0);	(572000.0, 4204000.0,	340.0,	.0);

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(572000.0,	4205000.0,	340.0,	.0);	(572000.0,	4206000.0,	340.0,	.0);
(572000.0,	4207000.0,	340.0,	.0);	(572000.0,	4208000.0,	340.0,	.0);
(572000.0,	4209000.0,	340.0,	.0);	(572000.0,	4210000.0,	340.0,	.0);
(572000.0,	4211000.0,	340.0,	.0);	(572000.0,	4212000.0,	340.0,	.0);
(572000.0,	4178400.0,	330.0,	.0);	(572000.0,	4178900.0,	330.0,	.0);
(572000.0,	4179600.0,	330.0,	.0);	(572000.0,	4180000.0,	330.0,	.0);
(572000.0,	4180600.0,	330.0,	.0);	(572000.0,	4180800.0,	330.0,	.0);
(572000.0,	4181400.0,	330.0,	.0);	(572000.0,	4180800.0,	330.0,	.0);
(572000.0,	4181700.0,	330.0,	.0);	(572000.0,	4182100.0,	330.0,	.0);
(572000.0,	4182100.0,	330.0,	.0);	(572000.0,	4182600.0,	330.0,	.0);
(572000.0,	4183000.0,	330.0,	.0);				

** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

```
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1
```

METEOROLOGICAL DATA PROCESSED BETWEEN START DATE: 99 1 1 1
AND END DATE: 99 12 31 24

NOTE: METEOROLOGICAL DATA ACTUALLY PROCESSED WILL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE.

*** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***
(METERS/SEC)

1.54, 3.09, 5.14, 8.23, 10.80,

*** WIND PROFILE EXPONENTS ***

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
B	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
C	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00
D	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00
E	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00
F	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00

*** VERTICAL POTENTIAL TEMPERATURE GRADIENTS ***
(DEGREES KELVIN PER METER)

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
B	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: FT1.MET FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1,f9.4,f10.1,f8.4,i4,f7.2)
SURFACE STATION NO.: 0 UPPER AIR STATION NO.: 0
NAME: SURFNAME NAME: UAIRNAME
YEAR: 1999 YEAR: 1999

YEAR	MONTH	DAY	HOUR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	MIXING HEIGHT (M) URBAN	USTAR (M/S)	M-O LENGTH (M)	Z-O (M)	IPCODE	PRATE (mm/HR)
99	1	1	1	.0	1.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	2	.0	2.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	3	.0	3.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	4	.0	4.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	5	.0	5.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	6	.0	6.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	7	.0	7.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	8	.0	8.00	293.1	4	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	9	.0	1.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	10	.0	2.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	11	.0	3.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	12	.0	4.00	293.1	5	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	13	.0	5.00	293.1	5	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	14	.0	6.00	293.1	5	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	15	.0	7.00	293.1	5	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	16	.0	8.00	293.1	5	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	17	.0	1.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	18	.0	2.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	19	.0	3.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	20	.0	4.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	21	.0	5.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	22	.0	6.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	23	.0	7.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00
99	1	1	24	.0	8.00	293.1	1	320.0	100.0	.0000	.0	.0000	0	.00

** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): SRC1 , SRC2 , SRC3 , SRC4 , SRC5 , SRC6 , SRC7 ,
SRC8 , SRC9 , SRC10 , SRC11 , SRC12 ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
572000.00	4180600.00	1701.47700	(99010101)	572000.00	4180000.00	1850.48400	(99010101)
572000.00	4179400.00	2027.67300	(99010101)	572000.00	4178900.00	2198.27700	(99010101)
572000.00	4178500.00	2352.30000	(99010101)	572000.00	4178200.00	2480.91700	(99010101)
572000.00	4178100.00	2526.23800	(99010101)	572000.00	4178000.00	2572.95500	(99010101)
572000.00	4178100.00	2526.23800	(99010101)	572000.00	4177100.00	3067.46300	(99010101)
572000.00	4177300.00	2944.60600	(99010101)	572000.00	4176700.00	3266.19500	(99010101)
572000.00	4176400.00	3572.64100	(99010101)	572000.00	4175700.00	4232.61200	(99010101)
572000.00	4176400.00	3546.68000	(99010101)	572000.00	4177200.00	3004.99100	(99010101)
572000.00	4178100.00	2526.23800	(99010101)	572000.00	4177600.00	2774.82300	(99010101)
572000.00	4177300.00	2944.60600	(99010101)	572000.00	4177100.00	3047.79400	(99010101)
572000.00	4177000.00	3131.33500	(99010101)	572000.00	4177100.00	3067.46300	(99010101)
572000.00	4177300.00	2944.60600	(99010101)	572000.00	4177600.00	2774.41100	(99010101)
572000.00	4178500.00	2352.76800	(99010101)	572000.00	4179500.00	1996.19400	(99010101)
572000.00	4180800.00	1656.25800	(99010101)	572000.00	4181700.00	1475.82300	(99010101)
572000.00	4183000.00	1268.05800	(99010101)	572000.00	4184300.00	1105.76800	(99010101)
572000.00	4184800.00	1052.62800	(99010101)	572000.00	4185300.00	995.45980	(99010101)
572000.00	4185000.00	1031.35300	(99010101)	572000.00	4184900.00	975.50450	(99010101)
572000.00	4184100.00	1072.92900	(99010101)	572000.00	4183400.00	1210.30800	(99010101)
572000.00	4183600.00	1184.87000	(99010101)	572000.00	4184400.00	1084.96900	(99010101)
572000.00	4185300.00	986.48480	(99010101)	572000.00	4184800.00	1043.52300	(99010101)
572000.00	4184300.00	1104.66500	(99010101)	572000.00	4183900.00	1140.94300	(99010101)
572000.00	4183600.00	1148.07400	(99010101)	572000.00	4183300.00	1227.11700	(99010101)
572000.00	4183200.00	1236.69800	(99010101)	572000.00	4183000.00	1222.65900	(99010101)
572000.00	4183000.00	1268.05800	(99010101)	572000.00	4183		

.00 1240.36300 (99010101)

572000.00	4182200.00	1374.28200	(99010101)
572000.00	4180200.00	1713.55500	(99010101)
572000.00	4178100.00	2481.54900	(99010101)
572000.00	4176700.00	3082.58300	(99010101)
572000.00	4175700.00	4232.61200	(99010101)
572000.00	4174500.00	5899.17000	(99010101)
572000.00	4174000.00	7060.87200	(99010101)
572000.00	4174500.00	5238.46200	(99010101)
572000.00	4176300.00	3656.08800	(99010101)
572000.00	4177200.00	3004.99100	(99010101)
572000.00	4178500.00	2352.76800	(99010101)
572000.00	4179000.00	2162.28200	(99010101)
572000.00	4187000.00	864.01960	(99010101)
572000.00	4189000.00	739.17000	(99010101)
572000.00	4191000.00	644.12870	(99010101)
572000.00	4193000.00	570.18100	(99010101)
572000.00	4181200.00	1565.83500	(99010101)
572000.00	4179100.00	2127.26000	(99010101)
572000.00	4177300.00	2926.34600	(99010101)
572000.00	4175800.00	3354.99700	(99010101)
572000.00	4175000.00	4960.88700	(99010101)
572000.00	4174100.00	6547.51400	(99010101)
572000.00	4174100.00	6547.51400	(99010101)
572000.00	4175400.00	4579.88700	(99010101)
572000.00	4176700.00	3340.35900	(99010101)
572000.00	4177800.00	2670.82100	(99010101)
572000.00	4179200.00	2093.17400	(99010101)
572000.00	4186000.00	941.64580	(99010101)
572000.00	4188000.00	797.16060	(99010101)
572000.00	4190000.00	688.55550	(99010101)
572000.00	4192000.00	604.93080	(99010101)
572000.00	4194000.00	539.23590	(99010101)

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): SRC1 , SRC2 , SRC3 , SRC4 , SRC5 , SRC6 , SRC7 ,
SRC8 , SRC9 , SRC10 , SRC11 , SRC12 ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
572000.00	4195000.00	511.56320	(99010101)	572000.00	4196000.00	486.71710	(99010101)
572000.00	4197000.00	464.32360	(99010101)	572000.00	4198000.00	444.06630	(99010101)
572000.00	4199000.00	425.67630	(99010101)	572000.00	4200000.00	408.93450	(99010101)
572000.00	4201000.00	393.97050	(99010101)	572000.00	4202000.00	380.20120	(99010101)
572000.00	4203000.00	367.49390	(99010101)	572000.00	4204000.00	355.73380	(99010101)
572000.00	4205000.00	344.82070	(99010101)	572000.00	4206000.00	334.66740	(99010101)
572000.00	4207000.00	325.19760	(99010101)	572000.00	4208000.00	316.34410	(99010101)
572000.00	4209000.00	308.04800	(99010101)	572000.00	4210000.00	300.25700	(99010101)
572000.00	4211000.00	292.92540	(99010101)	572000.00	4212000.00	286.01210	(99010101)
572000.00	4178400.00	2381.70000	(99010101)	572000.00	4178900.00	2187.54400	(99010101)
572000.00	4179600.00	1956.76700	(99010101)	572000.00	4180000.00	1842.63700	(99010101)
572000.00	4180600.00	1694.72500	(99010101)	572000.00	4180800.00	1649.82400	(99010101)
572000.00	4181400.00	1526.51700	(99010101)	572000.00	4180800.00	1649.82400	(99010101)
572000.00	4181700.00	1470.59400	(99010101)	572000.00	4182100.00	1401.25900	(99010101)
572000.00	4182100.00	1401.25900	(99010101)	572000.00	4182600.00	1322.09200	(99010101)
572000.00	4183000.00	1264.08900	(99010101)				

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE 2ND HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): SRC1 , SRC2 , SRC3 , SRC4 , SRC5 , SRC6 , SRC7 , SRC8 , SRC9 , SRC10 , SRC11 , SRC12 ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
572000.00	4180600.00	969.04950	(99010112)	572000.00	4180000.00	1047.25200	(99010112)
572000.00	4179400.00	1139.67100	(99010112)	572000.00	4178900.00	1227.98800	(99010112)
572000.00	4178500.00	1306.69900	(99010112)	572000.00	4178200.00	1372.96700	(99010112)
572000.00	4178100.00	1396.06800	(99010112)	572000.00	4178000.00	1419.84000	(99010112)
572000.00	4178100.00	1396.06800	(99010112)	572000.00	4177100.00	1669.06600	(99010112)
572000.00	4177300.00	1607.54300	(99010112)	572000.00	4176700.00	1699.15800	(99010112)
572000.00	4176400.00	1919.50100	(99010112)	572000.00	4175700.00	2240.98300	(99010112)
572000.00	4176400.00	1882.57900	(99010112)	572000.00	4177200.00	1637.81400	(99010112)
572000.00	4178100.00	1396.06800	(99010112)	572000.00	4177600.00	1521.87600	(99010112)
572000.00	4177300.00	1607.54300	(99010112)	572000.00	4177100.00	1640.12900	(99010112)
572000.00	4177000.00	1700.18600	(99010112)	572000.00	4177100.00	1669.06600	(99010112)
572000.00	4177300.00	1607.54300	(99010112)	572000.00	4177600.00	1521.25300	(99010112)
572000.00	4178500.00	1307.43300	(99010112)	572000.00	4179500.00	1123.30500	(99010112)
572000.00	4180800.00	945.20010	(99010112)	572000.00	4181700.00	849.44260	(99010112)
572000.00	4183000.00	737.85830	(99010112)	572000.00	4184300.00	649.49110	(99010112)
572000.00	4184800.00	620.27430	(99010112)	572000.00	4185300.00	577.42920	(99010112)
572000.00	4185000.00	606.84950	(99010112)	572000.00	4184900.00	495.88000	(99010112)
572000.00	4184100.00	564.26240	(99010112)	572000.00	4183400.00	701.90020	(99010112)
572000.00	4183600.00	688.21000	(99010112)	572000.00	4184400.00	625.28940	(99010112)
572000.00	4185300.00	560.64500	(99010112)	572000.00	4184800.00	603.19630	(99010112)
572000.00	4184300.00	647.43600	(99010112)	572000.00	4183900.00	654.95720	(99010112)
572000.00	4183600.00	623.47440	(99010112)	572000.00	4183300.00	715.67710	(99010112)
572000.00	4183200.00	716.07090	(99010112)	572000.00	4183000.00	659.20010	(99010112)
572000.00	4183000.00	737.85830	(99010112)	572000.00	4183200.00	722.67510	(99010112)
572000.00	4182200.00	776.83800	(99010112)	572000.00	4181200.00	890.47340	(99010112)
572000.00	4180200.00	885.51430	(99010112)	572000.00	4179100.00	1191.30200	(99010112)
572000.00	4178100.00	1328.22700	(99010112)	572000.00	4177300.00	1580.43800	(99010112)
572000.00	4176700.00	1541.29100	(99010102)	572000.00	4175800.00	1677.49800	(99010102)
572000.00	4175700.00	2240.98300	(99010112)	572000.00	4175000.00	2480.44300	(99010102)
572000.00	4174500.00	2974.67700	(99010112)	572000.00	4174100.00	3273.75700	(99010102)
572000.00	4174000.00	3554.57500	(99010112)	572000.00	4174100.00	3273.75700	(99010102)
572000.00	4174500.00	2619.23100	(99010102)	572000.00	4175400.00	2407.75900	(99010112)
572000.00	4176300.00	1960.49300	(99010112)	572000.00	4176700.00	1804.84500	(99010112)
572000.00	4177200.00	1637.81400	(99010112)	572000.00	4177800.00	1469.50700	(99010112)
572000.00	4178500.00	1307.43300	(99010112)	572000.00	4179200.00	1173.65500	(99010112)
572000.00	4179000.00	1209.40700	(99010112)	572000.00	4186000.00	558.58040	(99010112)
572000.00	4187000.00	514.99380	(99010112)	572000.00	4188000.00	477.00990	(99010112)
572000.00	4189000.00	443.65700	(99010112)	572000.00	4190000.00	414.17910	(99010112)
572000.00	4191000.00	389.67670	(99010112)	572000.00	4192000.00	367.66610	(99010112)
572000.00	4193000.00	347.79810	(99010112)	572000.00	4194000.00	329.78450	(99010112)

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE 2ND HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): SRC1 , SRC2 , SRC3 , SRC4 , SRC5 , SRC6 , SRC7 , SRC8 , SRC9 , SRC10 , SRC11 , SRC12 ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
572000.00	4195000.00	313.38580	(99010112)	572000.00	4196000.00	298.40120	(99010112)
572000.00	4197000.00	284.66130	(99010112)	572000.00	4198000.00	272.02240	(99010112)
572000.00	4199000.00	260.36160	(99010112)	572000.00	4200000.00	249.57330	(99010112)
572000.00	4201000.00	239.56640	(99010112)	572000.00	4202000.00	230.26180	(99010112)
572000.00	4203000.00	221.59040	(99010112)	572000.00	4204000.00	213.49200	(99010112)
572000.00	4205000.00	205.91340	(99010112)	572000.00	4206000.00	198.80780	(99010112)
572000.00	4207000.00	192.13380	(99010112)	572000.00	4208000.00	185.85440	(99010112)
572000.00	4209000.00	179.93700	(99010112)	572000.00	4210000.00	174.35640	(99010112)
572000.00	4211000.00	169.41270	(99010112)	572000.00	4212000.00	164.72450	(99010112)
572000.00	4178400.00	1309.21100	(99010112)	572000.00	4178900.00	1211.01400	(99010112)
572000.00	4179600.00	1093.15000	(99010112)	572000.00	4180000.00	1034.37200	(99010112)
572000.00	4180600.00	957.75900	(99010112)	572000.00	4180800.00	934.37680	(99010112)
572000.00	4181400.00	869.84320	(99010112)	572000.00	4180800.00	934.37680	(99010112)
572000.00	4181700.00	840.41280	(99010112)	572000.00	4182100.00	803.77180	(99010112)
572000.00	4182100.00	803.77180	(99010112)	572000.00	4182600.00	761.71760	(99010112)
572000.00	4183000.00	730.74640	(99010112)				

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE 3RD HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): SRC1 , SRC2 , SRC3 , SRC4 , SRC5 , SRC6 , SRC7 ,
SRC8 , SRC9 , SRC10 , SRC11 , SRC12 ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
572000.00	4180600.00	850.73850	(99010102)	572000.00	4180000.00	925.24180	(99010102)
572000.00	4179400.00	1013.83700	(99010102)	572000.00	4178900.00	1099.13800	(99010102)
572000.00	4178500.00	1176.15000	(99010102)	572000.00	4178200.00	1240.45800	(99010102)
572000.00	4178100.00	1263.11900	(99010102)	572000.00	4178000.00	1286.47700	(99010102)
572000.00	4178100.00	1263.11900	(99010102)	572000.00	4177100.00	1533.73200	(99010102)
572000.00	4177300.00	1472.30300	(99010102)	572000.00	4176700.00	1633.09800	(99010102)
572000.00	4176400.00	1786.32100	(99010102)	572000.00	4175700.00	2116.30600	(99010102)
572000.00	4176400.00	1773.34000	(99010102)	572000.00	4177200.00	1502.49600	(99010102)
572000.00	4178100.00	1263.11900	(99010102)	572000.00	4177600.00	1387.41100	(99010102)
572000.00	4177300.00	1472.30300	(99010102)	572000.00	4177100.00	1523.89700	(99010102)
572000.00	4177000.00	1565.66800	(99010102)	572000.00	4177100.00	1533.73200	(99010102)
572000.00	4177300.00	1472.30300	(99010102)	572000.00	4177600.00	1387.20500	(99010102)
572000.00	4178500.00	1176.38400	(99010102)	572000.00	4179500.00	998.09710	(99010102)
572000.00	4180800.00	828.12920	(99010102)	572000.00	4181700.00	737.91130	(99010102)
572000.00	4183000.00	634.02910	(99010102)	572000.00	4184300.00	552.88390	(99010102)
572000.00	4184800.00	526.31400	(99010102)	572000.00	4185300.00	497.72990	(99010102)
572000.00	4185000.00	515.67650	(99010102)	572000.00	4184900.00	487.75220	(99010102)
572000.00	4184100.00	536.46470	(99010102)	572000.00	4183400.00	605.15390	(99010102)
572000.00	4183600.00	592.43480	(99010102)	572000.00	4184400.00	542.48430	(99010102)
572000.00	4185300.00	493.24240	(99010102)	572000.00	4184800.00	521.76150	(99010102)
572000.00	4184300.00	552.33250	(99010102)	572000.00	4183900.00	570.47160	(99010102)
572000.00	4183600.00	574.03700	(99010102)	572000.00	4183300.00	613.55870	(99010102)
572000.00	4183200.00	618.34880	(99010102)	572000.00	4183000.00	611.32930	(99010102)
572000.00	4183000.00	634.02910	(99010102)	572000.00	4183200.00	620.18150	(99010102)
572000.00	4182200.00	687.14100	(99010102)	572000.00	4181200.00	782.91770	(99010102)
572000.00	4180200.00	856.77730	(99010102)	572000.00	4179100.00	1063.63000	(99010102)
572000.00	4178100.00	1240.77400	(99010102)	572000.00	4177300.00	1463.17300	(99010102)
572000.00	4176700.00	1454.46500	(99010112)	572000.00	4175800.00	1275.40100	(99010112)
572000.00	4175700.00	2116.30600	(99010102)	572000.00	4175000.00	2457.48400	(99010112)
572000.00	4174500.00	2949.58500	(99010102)	572000.00	4174100.00	3122.95000	(99010112)
572000.00	4174000.00	3530.43600	(99010102)	572000.00	4174100.00	3122.95000	(99010112)
572000.00	4174500.00	2214.86800	(99010112)	572000.00	4175400.00	2289.94400	(99010102)
572000.00	4176300.00	1828.04400	(99010102)	572000.00	4176700.00	1670.17900	(99010102)
572000.00	4177200.00	1502.49600	(99010102)	572000.00	4177800.00	1335.41000	(99010102)
572000.00	4178500.00	1176.38400	(99010102)	572000.00	4179200.00	1046.58700	(99010102)
572000.00	4179000.00	1081.14100	(99010102)	572000.00	4186000.00	470.82290	(99010102)
572000.00	4187000.00	432.00980	(99010102)	572000.00	4188000.00	398.58030	(99010102)
572000.00	4189000.00	369.58500	(99010102)	572000.00	4190000.00	344.27770	(99010102)
572000.00	4191000.00	322.06440	(99010102)	572000.00	4192000.00	302.46540	(99010102)
572000.00	4193000.00	285.09050	(99010102)	572000.00	4194000.00	269.61800	(99010102)

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE 3RD HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): SRC1 , SRC2 , SRC3 , SRC4 , SRC5 , SRC6 , SRC7 ,
SRC8 , SRC9 , SRC10 , SRC11 , SRC12 ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
572000.00	4195000.00	255.78160	(99010102)	572000.00	4196000.00	243.35860	(99010102)
572000.00	4197000.00	232.16180	(99010102)	572000.00	4198000.00	222.03310	(99010102)
572000.00	4199000.00	212.83820	(99010102)	572000.00	4200000.00	204.46730	(99010102)
572000.00	4201000.00	196.98520	(99010102)	572000.00	4202000.00	190.10060	(99010102)
572000.00	4203000.00	183.74700	(99010102)	572000.00	4204000.00	177.86690	(99010102)
572000.00							

4205000.00	172.41030	(99010102)		572000.00	4206000.00	167.33370	(99010102)
572000.00	4207000.00	162.59880	(99010102)	572000.00	4208000.00	158.17200	(99010102)
572000.00	4209000.00	154.02400	(99010102)	572000.00	4210000.00	150.12850	(99010102)
572000.00	4211000.00	146.46270	(99010102)	572000.00	4212000.00	143.00600	(99010102)
572000.00	4178400.00	1190.85000	(99010102)	572000.00	4178900.00	1093.77200	(99010102)
572000.00	4179600.00	978.38330	(99010102)	572000.00	4180000.00	921.31840	(99010102)
572000.00	4180600.00	847.36250	(99010102)	572000.00	4180800.00	824.91220	(99010102)
572000.00	4181400.00	763.25840	(99010102)	572000.00	4180800.00	824.91220	(99010102)
572000.00	4181700.00	735.29720	(99010102)	572000.00	4182100.00	700.62950	(99010102)
572000.00	4182100.00	700.62950	(99010102)	572000.00	4182600.00	661.04620	(99010102)
572000.00	4183000.00	632.04440	(99010102)				

** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF PM IN MICROGRAMS/M**3 **

OUP ID		AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
L	HIGH 1ST HIGH VALUE IS	7060.87200	ON 99010101:	AT (572000.00, 4174000.00, 340.00, .00)	DC	
	HIGH 2ND HIGH VALUE IS	3554.57500	ON 99010112:	AT (572000.00, 4174000.00, 340.00, .00)	DC	
	HIGH 3RD HIGH VALUE IS	3530.43600	ON 99010102:	AT (572000.00, 4174000.00, 340.00, .00)	DC	

** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

*** MODELING OPTIONS USED: CONC RURAL ELEV DFAULT

*** Message Summary : ISCSTDFT Model Execution ***

--------- Summary of Total Messages --------

A Total of 0 Fatal Error Message(s)
A Total of 1 Warning Message(s)
A Total of 0 Informational Message(s)

******** FATAL ERROR MESSAGES ********
*** NONE ***

******** WARNING MESSAGES ********
CO W151 7 COCARD: CO ELEVUNIT card obsolescent: use RE ELEVUNIT card instead

****
*** ISCSTDFT Finishes Successfully ***
****

CHEMICAL DEFENSE TRAINING FACILITY AIR PERMIT

Green 2078

STATE OF MISSOURI

Mel Carnahan, Governor • David A. Shorr, Director

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL QUALITY

P.O. Box 176 Jefferson City, MO 65102-0176

April 11, 1995

HAND DELIVERED: SHARON TURPIN, Environmental Engineer

Mr. Scott Murrell
Chief, Environmental Division
U.S. Army Engineering Center and
Fort Leonard Wood
ATZT-DPW-EE
Fort Leonard Wood, MO 65473

RE: Air Permit Application - Project/Facility No. 3860-0004-026

Dear Mr. Murrell:

Enclosed with this letter is your permit to construct. Please note the special conditions, if any, on accompanying pages. Operation in accordance with these conditions and your permit application is necessary for continued compliance. The document entitled "Review of Application for Authority to Construct" is part of the permit as well and should be kept with the permit in your files.

The reverse side of your permit certificate has important information concerning standard permit conditions, and your rights and obligations under the laws and regulations of the State of Missouri.

If you have any questions or need additional information regarding this permit, you can contact me by phone at (314) 751-4817 or you may write to me at the Department of Natural Resources, Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102.

Sincerely,

AIR POLLUTION CONTROL PROGRAM

Michael J. Stansfield, P. E.
Environmental Engineer

MJS:tb

Enclosures

c: Jefferson City Regional Office
Source File

Permit No.: 0495-013

RECYCLED PAPER

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI AIR CONSERVATION COMMISSION

PERMIT TO CONSTRUCT

Under the authority of RSMo 643 and the Federal Clean Air Act the applicant is authorized to construct the facility described below, in accordance with the laws, rules, and conditions as set forth herein.

Permit Number: 0495-013 Facility I.D. Number: 3860-0004-026

Owner: U.S. Army Engineering Center and Fort Leonard Wood

Owner's Address: ATZT-DPW-EE, Fort Leonard Wood, MO 65473

Facility Name: U.S. Army Engineering Center and Fort Leonard Wood

Facility Address: ATZT-DPW-EE, Fort Leonard Wood, MO 65473

Legal Description: Pulaski County, S21, T35N, R8W

Application for Authority to Construct was made for:

**** a Chemical Decontamination Training Facility and Thermal Treatment Unit. This review was conducted in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, "Construction Permits Required." ****

☐ Special Conditions are not applicable to this permit.

☒ Special Conditions do apply to this permit and are listed as attachments starting on page 2.

April 10, 1995
EFFECTIVE DATE

John A. Young
DIRECTOR
DIVISION OF ENVIRONMENTAL QUALITY

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

Materials Which May Not Be Charged to the Incinerator

a. No hazardous wastes may be charged to this incinerator. A waste is considered to be hazardous if, in order that it be charged to an incinerator, a permit from the Missouri Hazardous Waste Program would first be required in order that such a waste be charged to an incinerator.

b. Certain gas mask filters may not be charged to the incinerator because these filters contain levels of chromium sufficient to characterize the filters as a hazardous waste. Specifically, C2 filter masks, stock number 4240-01-119-2315 may not be charged to the incinerator.

Emission Limits:

a. Particulate matter (as PM_{10}) - 30 milligrams per dry standard cubic meter (0.013 grains per dry standard cubic foot).

b. Carbon monoxide - 50 parts per million by volume.

c. Dioxins/furans - 1.9 nanograms per dry standard cubic meter, toxic equivalency (1989 toxic equivalency factors).

d. Hydrogen chloride - 42 parts per million by volume or 97% reduction (9-hour average), whichever is more stringent.

e. Mercury - 0.47 milligrams per dry standard cubic meter (0.22 grains per million dry standard cubic feet) or 85% reduction, whichever is more stringent.

f. Nerve Agents - no detectable quantity of either GB (sarin) or VX. For purposes of determining a detectable level of either nerve agent, it shall be sufficient to use equipment which is at least as sensitive to GB (sarin) and VX as the gas chromatographs used in the automatic continuous air monitoring system (ACAMS) units located adjacent to the "hot areas" in the training building.

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

Performance Testing Conditions

a. Within 90 days of reaching full operation, but in no case later than 180 days after initial startup, an emission test shall be conducted in order to quantify air pollutant emissions. The stack test shall determine the emission rates of particulate matter (as PM_{10}), carbon monoxide, dioxins/furans, hydrogen chloride, mercury, and the nerve agents GB (sarin) and VX. A completed Proposed Test Plan Form (copy enclosed) will serve the purpose of notification and must be approved by the Air Pollution Control Program staff director prior to conducting emission testing.

b. The date on which performance tests are conducted must be pre-arranged with the Air Pollution Control Program (APCP) a minimum of 30 days prior to the proposed test date so that this Program may arrange a pretest meeting, if necessary, and assure that the test date is acceptable for an observer to be present. A completed Proposed Test Plan form enclosed may serve the purpose of notification and must be approved by the APCP prior to conducting the required emission testing.

c. Two copies of a written report of the performance test results shall be submitted to the Director of the Air Pollution Control Program within 30 days of completion of any required testing. The report must include legible copies of the raw data sheets, analytical instrument laboratory data, and complete sample calculations from the required EPA Test Methods for at least one sample run.

d. The test report is to fully account for all operational and emission parameters addressed both in the permit conditions as well as in any other applicable state or federal rules or regulations.

e. Performance testing shall be conducted under the condition of maximum process/production rate, or within ten per cent (10%) of this rated capacity. The process/production rate at which performance testing is conducted shall become the maximum process/production rate at which the incinerator is permitted to operate, under the authority granted by this permit.

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

f. Actual conditions under which performance testing is conducted shall be recorded every fifteen (15) minutes throughout each of the test runs. These conditions are to include all relevant process/production parameters as well as all parameters relating to the status of emission controls: this data is to be included in the emissions test report. No maintenance or upgrade of emission control efficiency shall be undertaken during emission testing.

g. Testing shall be conducted during periods of representative conditions at the maximum process/production rates, not to include periods of startup, shutdown, or malfunction.

h. Emission testing results, in "mass of pollutant/volume of air," shall be reported for the pollution source airstream, free from any extraneous source of dilution air. Potential dilution airstreams shall either be sealed off prior to testing or else be measured by appropriate EPA test Methods and subtracted from the total airflow at the sampling location. Failure to account for dilution air can lead to cancellation of testing and/or a violation notice for "circumvention."

i. The owner or operator shall provide, or cause to be provided, performance testing facilities as follows:

i. Safe sampling platform(s).
ii. Safe access to sampling platform(s).
iii. Utilities for sampling and testing equipment.
iv. Sampling ports adequate for test methods applicable to this facility. This includes:
(1) Constructing the air pollution control system such that volumetric flow rates and pollutant emission rates can be accurately determined by applicable test methods and procedures;
(2) Providing a stack or duct free of cyclonic flow during performance tests, and;
(3) Removal of the port caps 24 hours prior to testing to verify both their removability as well as full-diameter clearance to the stack; caps may be retained hand tight.

PERMIT NUMBER
0495-013

FACILITY I.D NUMBER
3860-0004-026

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

j. Performance tests shall be conducted, and data reduced, in accordance with specified EPA Test Methods unless an equivalent or alternative test method is otherwise approved by the Director.

k. Unless otherwise specified, each performance test shall consist of three separate runs using the applicable test method. Each run shall be conducted for the time and under the conditions specified in the applicable standard.

l. For the purpose of determining compliance with applicable standards, the arithmetic mean of results of the three runs shall apply. Only, under rare circumstances and upon approval by the Director, may compliance be determined by the arithmetic mean of two runs.

PROPOSED TEST PLAN

Submitted to: MO Dept. of Natural Resources,
Air Pollution Control Program
P.O. Box 176, Jefferson City, MO 65102

Date Submitted: _____

Attention: _____

Proposed Test Date: _____

1.) FACILITY INFORMATION:		
Name:		
Address:		
City	State:	Zip:
Name & title of Contact Person:		
Phone No. of Contact Person:	Fax No.:	

2.) AIR POLLUTION SOURCE TO BE TESTED:				
Type of Source:				
Reason for Test:		Condition of Permit		Consent Agreement
		Administrative Order		
		Other (specify)		
Permit No. of Source to Be Tested:				
Address of Source:				
Directions to Source (or map attached):				
Initial Start-up Date:				

3.) TESTING FIRM INFORMATION:		
Name of Firm:		
Address:		
City	State:	Zip:
Name & title of Contact Person:		
Phone No. of Contact Person:	Fax No.:	
Number of employees of firm:		
No. of employees actually engaged in air pollution source testing:		
Organizational chart with names & title of personnel: (please attach)		

3.) TESTING FIRM INFORMATION: (cont.)	
Location & description of laboratory facilities:	
Subcontractor(s) utilized by firm for source testing activities:	
Number of air pollution sources previously tested by firm:	
Sources tested by firm in Missouri in past 3 years (source, test, date):	

4.) PERFORMANCE TEST INFORMATION:					
	Pollutant	No. of Sampling Points	Total Time per Test Run	No. of Test Runs	Test Method to be Used
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					

PRELIMINARY METHOD 1 DATA

Duct to be Sampled:	Sketch of Stack or Duct with Port Locations & Distances Shown:

Duct Dimensions:

From inside far wall to outside of port	
Nipple length	
Depth (or diameter) of duct	
Width (rectangular duct)	

Equivalent Diameter:

$$D_e = \frac{2 \times \text{Depth} \times \text{Width}}{\text{Depth} + \text{Width}} = \frac{2 (\quad)(\quad)}{(\quad + \quad)} = \_\_\_\_\_$$

Distance from Ports to Nearest Flow Disturbance

	Upstream	Downstream
Diameters		
Diameters		

Stack Area = IN^2

Calculated by:

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

	4	6	8	10	12	14	16	18	20	22	24
1	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3	75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.3	6.7	6.0	5.5
4	93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5		85.4	67.7	34.2	25.0	20.1	16.9	15	12.9	11.6	10.5
6		95	80.6	65.8	36	26.9	22.0	19.5	17	14.6	13.2
7			89.5	77.4	64.4	36.9	29.3	23.6	20.4	18.0	16.1
8			96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9				91.9	82.3	73.1	62.5	38	30.6	26.2	23.0
10				97.4	86.2	80	71.7	61.8	38	31.5	27.2
11					89.3	85.4	78.0	70.4	61.2	39.3	33.3
12					97.8	90.1	83.1	75.4	69	60.7	39.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.5	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.3	13.8	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.3	59.1	54.2
8							93.8	83	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.8

POINT	% of Stack I.D.	Stack I.D.	Distance from Outside Wall	Nipple Length	Distance from Outside of Port

NOTE: Cyclonic flow must be measured by instrument and shown to be absent prior to the initiation of sampling.

5.) GENERAL

A. Sampling Equipment Information:

The manufacturer and model of the sampling equipment to be used by the tester for the performance tests, along with a description of any equipment which may differ from that required by the specified method(s).

_____

_____

B. Test Procedures:

A description of any test procedures to be used in the conduct of the performance tests which may differ from the specified method(s).

_____

_____

NOTE: Deviations from EPA test methods observed during test procedures will not necessarily be corrected by agency observer and could result in agency rejection of test results.

C. Analytical Procedures:

A description of any analytical procedures which differ from the specified method(s).

_____

_____

D. Data Sheets:

A sample of all field data sheets which do not provide the data shown on the example sheets in 40 CFR 60 for the specified method(s).

E. Air Pollution Control Equipment:

Types and manufacturers of all control equipment:

_____

_____

Design or guarantee efficiency: _____

Design gas volume at full load (acfm): _____

Design pressure drop: _____

Maintenance schedule and method of recordkeeping: _____

6.) SPECIFIC: for Incinerators			
Provide a full description of the source operation, including as a minimum the following:			
A. Manufacturer and type of incinerator:			
B. Type of feed (batch, intermittent, continuous) and frequency:			
C. Design feed rate (lbs/hr, lbs/batch):			
D. Expected normal feed rate:			
E. Type of scales			
F. 24 hour operational flow scheme (ash removal, preheat, burn cycle, postheat, etc.):			
G. Type of fuel:			
H. Secondary chamber volume _____ (cubic feet) & sketch of chamber with inside dimensions:			
I. Type of secondary chamber temperature continuous chart recorder:			
J. Type(s) of waste and relative percentages:			
K. Hospital:	YES	NO	Licensed No. of Beds:
Average bed occupancy:			

7.) CONTINUOUS MONITORING SYSTEM
A description of continuous monitoring system(s) including the following:
A. Manufacturer of each monitor:
B. Model number and serial number of each monitor:
C. Description of interface system (for extractive monitors):
D. Description of data acquisition and handling system:
E. Number of copies of operator's manual supplied with each monitor:
F. Name of testing firm that will perform the reference method tests for sulfur dioxide and/or nitrogen oxides during the continuous monitoring system performance evaluations:
G. Name of organization that will perform the continuous monitoring system performance evaluations (Source operator, monitoring system manufacturer or representative, or testing firm):
H. Anticipated starting date of the conditioning period for the monitoring systems:
I. Drawing of the monitoring system location(s) showing stack or duct dimensions, air pollution control equipment, fans, and location(s) of disturbances which affect monitor location(s) determination (May be shown on drawing required on Preliminary Test Method Page or attach to this document).

SOURCE TESTING REPORT FORMAT

COVER
- Plant name and location
- Source sampled
- Testing company or agency, name, and address

CERTIFICATION
- Certification by team leader
- Certification by reviewer (e.g.: Professional Engineer)

INTRODUCTION
- Test purpose
- Test location, type of process
- Test dates
- Pollutants tested
- Observers' names (industry and agency)
- Any other important background information

SUMMARY OF RESULTS
- Emission results
- Process data, as related to determination of compliance
- Allowable emissions
- Description of collected samples
- Visible emissions summary
- Discussion of errors, both real and apparent

SOURCE OPERATION
- Description of process and control device
- Process and control equipment flow diagram
- Process data and results, with example calculations
- Representatives of raw materials and products
- Any specially required operation demonstrated

SAMPLING and ANALYSIS PROCEDURES
- Sampling port location and dimensioned cross section
- Sampling port description, including labeling system
- Sampling train description
- Brief description of sampling procedures, with discussion of deviations from standard methods
- Brief description of analytical procedures, with discussion of deviations from standard methods

APPENDIX
- Complete results with example calculations
- Raw field data (original, not computer printouts)
- Laboratory report, with chain of custody
- Test log
- Calibration procedures and results
- Project participants and titles
- Related correspondence

REVIEW OF APPLICATION FOR AUTHORITY TO CONSTRUCT AND OPERATE
SECTION (5) REVIEW
Project/Facility No: 3860-0004-026
Permit No: 0495-013

U.S. Army Training Center and Fort Leonard Wood
ATZT-DPW-EE
Fort Leonard Wood, MO 65473

Complete: March 1, 1995
Reviewed: March 28, 1995

Pulaski County, S21, T35N, R8W

REVIEW SUMMARY

- This is a de minimis addition to an existing major source, and is reviewed in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required.*
- No adverse ambient air quality impact is expected to occur as a result of the operation of the proposed training facility.
- Hazardous air pollutants will be emitted from the incinerator, though in minute amounts. No nerve agents will be emitted from this training facility, as the training exercises themselves, in association with the incinerator, insure that these agents are neutralized.
- There are no New Source Performance Standards (NSPS) or National Emissions Standards for Hazardous Air Pollutant (NESHAP) standards which will apply to this training facility.
- Approval of this permit application is recommended.

PROJECT DESCRIPTION

The U.S. Army Engineering Center and Fort Leonard Wood has applied for authority to install a Chemical Decontamination Training Facility (CDTF) at its facility in Pulaski County. The CDTF will include a hot training area, an incinerator for disposing of training wastes, a standby package boiler, and a 600 kW standby electrical generator. The facility will be used to train army personnel on the identification, handling and decontamination of vehicles and other equipment tainted with nerve agents. As part of the training, instructors will contaminate various pieces of equipment with drops of nerve agents, which will be applied with a syringe. The soldiers will then identify and decontaminate the equipment using decontamination agents and water. The debris from the training, which can include nerve agents, wastewater, uniforms and cleaning materials,

will be burned in the incinerator. The nerve agents involved are binary agents, requiring the mixing of two separate compounds to produce the nerve agents. The binary agents themselves are kept in separate, guarded, locked areas.

The nerve agents which will be used in the training are GB (sarin) and VX. Sarin is a colorless liquid with a vapor pressure of 2.9 mm Hg @ 25°C, a vapor density of 4.86, and a volatility of 22,000 mg/m3 @ 25°C. VX is an odorless amber colored liquid similar in appearance to motor oil. It has a vapor pressure of 0.000^{7} mm Hg @ 25°C, a vapor density of 9.2, and a volatility of 10.5 mg/m3 @ 25°C. Both of these agents volatilize readily, and being heavier than air, stay low to the ground. Both agents are highly toxic. Both agents degrad(readily and rapidly in the presence of caustic agents.

The building in which the training is conducted is constructed as a "building within a building." The training building is functionally divided into a hot area and a cold area. The hot area is where the nerve agents are used, while the cold area is kept uncontaminated. The hot training area is divided into eight functionally separate areas, with each area kept under negative pressure and vented through filter trains made up of prefilters, activated carbon absorption systems and high efficiency particulate air (HEPA) filters. All hot areas are assumed to have air contaminated with nerve agents and chemical decontaminants. The hot area ventilating system is designed to maintain a negative pressure in the hot areas with respect to the cold areas of the building. The pressure in the hot areas varies with expected contamination levels, being least negative in areas adjacent to the cold areas, and becoming increasingly negative from front to rear of the hot area to force any air infiltration to flow from cold areas to hot areas. The air in each zone is exhausted through two sets of HEPA and activated carbon filters for redundancy in each filter train. Each of the filter trains is independent, and has a cross-sectional area sized for its design air flow. Seven automatic continuous air monitoring system (ACAMS) units will be located adjacent to hot areas in the training building. Each ACAMS unit consists of an air pump (1 liter/minute) and two gas chromatographs, one monitoring for sarin and the other monitoring for VX. Nerve agent concentrations are continuously recorded on a strip chart. If either nerve agent is detected at levels equal to or greater then occupationally safe levels established by the Surgeon General, then alarms are triggered on the monitor itself, and in the building control room. The alarm levels are 0.01 ng/l (nanogram/liter) for VX and 0.1 ng/l for sarin. All ACAMS units are backed up by the M43/M43A2 Chemical Agent Detector connected to a M8 Chemical Agent Alarm. This system has a sensitivity of 400 ng/l for VX and 200 ng/l for sarin. The detectors are based on electrochemical (M43 detectors) or ion mobility (M43A2 detectors) technology. In addition to the ACAMS, a Depot Air Monitoring System (DAMS) will be used to monitor for nerve agent air concentrations. The DAMS consist of an air pump (1 liter/minute) and a porous polymer filled tube. Air monitoring will be conducted by pumping air (40 liters total) through the DAMS tube followed by CDTF laboratory analysis of the sorbent. The DAMS monitors are twice as sensitive as the ACAMS units. This system insures that there is no chance that nerve agents will escape the building.

The incinerator is a Midland Ross Pyrobatch model forced draft, batch type, dual chamber unit. It has a rated design capacity of 125 pounds per hour of solid waste; the maximum design heat

release rate is 4,610 BTU/lb. The emissions from the incinerator are ducted through a rich fume reactor, a venturi scrubber, and a packed tower scrubber. A package boiler with a rated heat input capacity of 31.25 MMBTU/hr, fired with No. 2 fuel oil, is associated with the incinerator. The steam from this package boiler is used for space heat and process heat. The standby package boiler is fired with No. 2 distillate fuel, and has a rated heat input capacity of 6.25 MMBTU/hr. The 600kW standby generator uses a reciprocating engine, and is also fired with No. 2 fuel oil.

Fort Leonard Wood has stated in the application that the incinerator will (1) have an operable door lockout mechanism, (2) will be equipped with a continuous chart recorder which will monitor and record the temperature in the secondary chamber (to an accuracy of ±2%), (3) will keep complete paper records of operators on duty, emission tests performed, incinerator maintenance, combustion chamber temperatures and the quantity, type, and suppliers of any off-site waste which is incinerated, (4) will provide training to all incinerator operators, said training to include basic combustion theory, operating procedures, monitoring of combustion control parameters of the incinerator, and all emergency procedures to be followed if the incinerator should malfunction or exceed operating parameters, and (5) will stack test the incinerator within 90 days of reaching full operation in order to determine combustion efficiency and particulate emission rate. In view of the nature of materials incinerated at this facility, additional testing will be required to demonstrate that the incinerator will operate safely.

EMISSIONS/CONTROLS EVALUATION

Emissions are calculated using emissions factors from the U.S. Environmental Protection Agency document AP-42, *Compilation of Air Pollutant Emission Factors*, and from information supplied by the applicant. Emissions calculations are detailed in an appendix to this report. Potential emissions from the operation of this facility are listed in the following table. Potential emissions are calculated based on the operation of the facility for 8,760 hours per year, with all controls in place and operational. Potential emissions from this facility are below the deminimis emissions levels for all pollutants.

CDTF Decontamination Facility		
Pollutant	Hourly Emissions (lbs/hr)	Annual Emission (tons/yr)
PM_{10}	0.28	1.12
Sulfur Dioxide	1.59	7.00
Nitrogen Oxides	7.72	33.71
Carbon Monoxide	3.24	14.36
Volatile Organic Compounds	0.34	1.48
Lead	0.004600	0.020000
Hydrochloric Acid	0.032000	0.142000
Total PCB	0.000001	0.000002

CDTF Decontamination Facility		
Pollutant	Hourly Emissions (lbs/hr)	Annual Emission (tons/yr)
Antimony	0.000800	0.003500
Arsenic	0.000015	0.000070
Beryllium	0.000001	0.000002
Cadmium	0.000300	0.001500
Chromium	0.000048	0.000212
Manganese	0.000035	0.000160
Mercury	0.006690	0.029290
Nickel	0.000037	0.000162
Hydrogen Fluoride	0.001443	0.006322
Chlorine	0.001017	0.004500
TCDD	0.00000006	0.00000027
HxCDD	0.0000000001	0.0000000005
HpCDD	0.0000000003	0.0000000014
OCDD	0.0000000014	0.0000000100
Total CDD	0.00000133	0.00000583
TCDF	0.00000045	0.00000197
PcCDF	0.0000000002	0.0000000010
HxCDF	0.0000000011	0.0000000050
HpCDF	0.0000000013	0.0000000100
OCDF	0.0000000046	0.0000000200
Total CDF	0.00000447	0.00001957

PERMIT RULE APPLICABILITY

This permit review was conducted in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required.*

APPLICABLE REQUIREMENTS

I. Installation Level: U.S. Army Engineering Center, Fort Leonard Wood

A. General

1. Applicable Requirements: Submission of Emission Data, Emission Fees and Process Information
   a. Regulatory Authority: 10 CSR 10-6.110
   b. Payment of Fees: $25.70 per ton of pollutant as of 1994
   c. Recordkeeping Requirement: Emissions Inventory Questionnaire (EIQ)
   d. Reporting Requirement: April 1 for previous year's emissions (EIQ)

2. Applicable Requirements: Operating Permits
   a. Regulatory Authority: 10 CSR 10-6.065
   b. Emission Limitation: none
   c. Recordkeeping Requirement: none
   d. Monitoring Requirement: none
   e. Reporting Requirement: none

B. Visible Emissions

1. Applicable Requirements: Restriction of Emission of Visible Air Contaminants
   a. Regulatory Authority: 10 CSR 10-3.080
   b. Emission Limitation: Emissions may not exceed an opacity of 20%
   c. Recordkeeping Requirement: none
   d. Monitoring Requirement: Visual Inspection, EPA Method 9
   e. Reporting Requirement: none

C. Odors

1. Applicable Requirements: Restriction of Emission of Odors
   a. Regulatory Authority: 10 CSR 10-3.090
   b. Emission Limitation: Odorous matter may not be emitted in concentrations and frequencies or for durations where odor can be perceived when one volume of odorous air is diluted with seven volumes of odor-free air
   c. Recordkeeping Requirement: none
   d. Monitoring Requirement: Measurements made with a scentometer as manufactured by the Barneby-Cheney Company, or similar technique that will give equivalent results
   e. Reporting Requirement: none

II. Emission Point Level: CDTF Decontamination Incinerator

A. Particulate Matter

1. Applicable Requirements: Restriction of Emissions of Particulate Matter from Industrial Processes
   a. Regulatory Authority: 10 CSR 10-3.050

b. Emission Limitation: 5.78 pounds per hour. The incinerator emissions are expected to be approximately 0.73 pounds per hour, which will be in compliance with this rule.
c. Recordkeeping Requirement: none
d. Monitoring Requirement: none
e. Reporting Requirement: none

B. Sulfur Dioxide
1. Applicable Requirements: Restriction of Emission of Sulfur Compounds
a. Regulatory Authority: 10 CSR 10-3.100
b. Emission Limitation: Gases emitted from the incinerator shall not contain sulfur compounds in concentrations in excess of 500 parts per million by volume (ppmv). The incinerator exhaust gas is expected to have a sulfur concentration of 14.8 ppmv, which will be in compliance with this rule.
c. Recordkeeping Requirement: none
d. Monitoring Requirement: none
e. Reporting Requirement: none

III. Emission Point Level: Standby Package Boiler
A. Particulate Matter
1. Applicable Requirements: Maximum Allowable Emissions of Particulate Matter From Fuel Burning Equipment Used for Indirect Heating
a. Regulatory Authority: 10 CSR 10-3.060
b. Emission Limitation: 3.75 pounds per hour. The boiler emissions are expected to be approximately 0.3 pounds per hour, which will be in compliance with this rule.
c. Recordkeeping Requirement: none
d. Monitoring Requirement: none
e. Reporting Requirement: none

B. Sulfur Dioxide
1. Applicable Requirements: Restriction of Emissions of Sulfur Compounds From Indirect Heating Sources
a. Regulatory Authority: 10 CSR 10-3.150
b. Emission Limitation: 8 lbs/MMBTU, equivalent to 250 pounds per hour of sulfur dioxide. The boiler emissions are expected to be 0.3 pounds per hour, which will be in compliance with this rule.
c. Recordkeeping Requirement: none
d. Monitoring Requirement: none
e. Reporting Requirement: none

IV. Emission Point Level: 600 kW Standby Generator
A. Sulfur Dioxide
1. Applicable Requirements: Restriction of Emission of Sulfur Compounds

a. Regulatory Authority: 10 CSR 10-3.100
b. Emission Limitation: Gases emitted from the generator shall not contain sulfur compounds in concentrations in excess of 500 parts per million by volume (ppmv). The generator exhaust gas is expected to have a sulfur concentration of 18 ppmv, which will be in compliance with this rule.
c. Recordkeeping Requirement: none
d. Monitoring Requirement: none
e. Reporting Requirement: none

AMBIENT AIR QUALITY IMPACT ANALYSIS

Because of the nature of the mission of this facility, ambient air quality modeling was performed. The model chosen is a highly conservative model, meaning that it tends to overestimate actual ambient impacts. Ambient impacts are given as 1-hour averages. Modeling results are detailed in the following table.

CDTF Decontamination Facility				
Pollutant	Ambient Impact ($\mu g/m^3$)		Ambient Standard ($\mu g/m^3$)	
PM_{10}	0.58	24-hr	150.00	24-hr
Sulfur Dioxide	8.82	1-hr	1300.00	3-hr
Nitrogen Oxides	17.36	24-hr	100.00	annual
Carbon Monoxide	18.13	1-hr	40000.00	1-hr
Volatile Organic Compounds	1.88	1-hr	235.00	1-hr
Lead	0.0100	1-hr	1.50	quarterly

CDTF Decontamination Facility				
Pollutant	Ambient Impact ($\mu g/m^3$)		Acceptable Ambient Level ($\mu g/m^3$)	
Antimony	0.0046	1-hr	6.67	8-hr
Arsenic	0.0001	1-hr	0.03	8-hr
Beryllium	0.000004	1-hr	30.00	8-hr
Cadmium	0.0020	1-hr	50.00	8-hr
Chromium	0.0003	1-hr	1.36	24-hr
Manganese	0.0002	1-hr	0.89	8-hr
Mercury	0.0027	8-hr	0.01	8-hr
Nickel	0.0002	8-hr	1.33	8-hr
Hydrogen Fluoride	0.0033	24-hr	0.68	24-hr

CDTF Decontamination Facility				
Pollutant	Ambient Impact ($\mu g/m^3$)		Acceptable Ambient Level ($\mu g/m^3$)	
Chlorine	0.0024	1-hr	3.95	24-hr
TCDD	0.00000040	1-hr	no standard	
HxCDD	0.00000001	1-hr	no standard	
HpCDD	0.00000001	1-hr	no standard	
OCDD	0.00000001	1-hr	no standard	
Total CDD	0.00003700	1-hr	no standard	
TCDF	0.00000260	1-hr	no standard	
PcCDF	0.00000001	1-hr	no standard	
HxCDF	0.00000001	1-hr	no standard	
HpCDF	0.00000001	1-hr	no standard	
OCDF	0.00000003	1-hr	no standard	
Total CDF	0.00002600	1-hr	no standard	

The modeled values in the table above are taken at the point of highest impact, just under 300 meters downwind of the facility. All ambient impacts are below the applicable impact standards; where the table states "no standard," this simply means that acceptable ambient levels have not been determined by this program - it does not mean that these compounds are non-hazardous.

STAFF RECOMMENDATION

On the basis of this review conducted in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*, approval of this permit, with conditions, is recommended.

Michael J. Stansfield, P.E.
Environmental Engineer

31 March 95
Date

Daniel D. Carney
Environmental Engineer

31 March 95
Date

ATTACHMENTS

EMISSIONS CALCULATIONS

600kW Standby Generator

This generator is designed to keep the hot area ventilation system and the incinerator system in operation in the event of a power failure. Emission factors for calculating the emissions from this standby generator are from Section 3.4 of AP-42, *Large Stationary Diesel and All Stationary Dual Fuel Engines.* This section covers those engines larger than 600hp. The Source Classification Code (SCC) used is 20200401 for large bore internal combustion diesel engines. Emissions are estimated to be:

600kW Standby Generator			
Pollutant	Emission Factor (lb/MMBTU)	Hourly Emissions (lbs/hr)	Annual Emission (tons/yr)
PM_{10}	0.0496	0.1	0.4
Sulfur Dioxide	0.51	1	4.3
Nitrogen Oxides	3.1	6	26.2
Carbon Monoxide	0.81	1.6	6.9
Volatile Organic Compounds	0.1	0.2	0.9

Standby Package Boiler

Emissions factors for calculating the emissions from this standby package boiler are from Section 1.3 of AP-42, *Fuel Oil Combustion.* The maximum design heat input rate for this boiler is 6.25 MMBTU/hr. Emissions are estimated to be:

Standby Package Boiler			
Pollutant	Emission Factor ($lb/10^3$ gallon)	Hourly Emissions (lbs/hr)	Annual Emission (tons/yr)
PM_{10}	2	0.1	0.4
Sulfur Dioxide	7.1	0.3	1.4
Nitrogen Oxides	20	0.9	3.9
Carbon Monoxide	5	0.2	1
Volatile Organic Compounds	0.34	0.02	0.1

Decontamination Incinerator

The incinerator is a Pyrobatch System two chamber design, and will burn Type 0 (solid) and Type 5 (liquid) wastes. It is a batch type incinerator, using a forced, induced draft. The primary chamber volume is 378 cubic feet, and is fitted with a 2.594 MMBTU/hr burner. The secondary chamber volume is 1010 cubic feet, and is fitted with a 25.778 MMBTU/hr burner. The army

estimates that approximately 250,000 pounds per year of Type 0 waste, and 6,225,000 pounds of Type 5 waste will be incinerated annually. A typical daily load to the incinerator, from army records at the Fort McClellan site, will include:

Typical Daily Incinerator Loading			
Description	# of bags	Weight (lbs)	Volume (ft^3)
Wet sludge in plastic lined fiber drums	1	180	3.5
Chemistry Lab Trash	1	25	5
Training Bay Trash	4	100	20
Medical Lab Trash	1	15	5
Laundry Trash	1	15	5
Office & Classroom Trash	4	60	20
Grounds Trash	1	25	5
Carbon Filters in PVC bags	2	448.4	18
Extra PVC bags	5	20	5
Hoods, Boots & Gloves	1	6	1
Overgarments (Hoods, Boots & Gloves)	1	8	1
Overgarments	6	80	30
Gas Mask Filters	1	18	1
Totals	29	1000.4	122.5

A further description of each of the above categories is given below:

Garbage Composition	Details
Wet Sludge	95% water, 2% solids, 3% drumpaper + PVC bag
Chemistry Lab Trash	20% glass, 10% metal, 20% rags, 50% paper + PVC bags
Training Bay Trash	10% glass, 10% metal, 40% rags, 40% paper + PVC bags
Medical Lab Trash	40% plastic, 30% paper, 30% rags + PVC bags
Laundry Trash	50% cloth, 50% paper + PVC bags
Office & Classroom Trash	100% paper + PVC bags
Grounds Trash	30% paper, 30% plastic, 20% glass, 20% metal + PVC bags
Carbon Filters in PVC bags	28% water, 35% metal, 39% carbon + PVC bags
PVC bags	100% PVC
Hoods, Boots & Gloves	100% rubberized material + PVC bags
Hoods, Boots & Gloves from Overgarments	100% rubberized material + PVC bags
Overgarments	100% rubberized material + PVC bags

Gas Mask Filters	inerts 30%, 30% carbon, 20% metal, 20% plastic + PVC bags

The gas mask filters canisters which may be charged to the incinerator do not include the old C2 filter canister, stock number 4240-01-119-2315, which is no longer in production; the Army estimates that its existing stocks of this item will be exhausted by October 1995. This gas mask filter canister has been replaced by the C2A1 filter canister, stock number 4240-01-361-1319. While the C2A1 filter canister is currently in the supply system, it will not be issued until the residual supply of C2 canisters is exhausted from the supply system.

Solid wastes are introduced into the primary chamber at a maximum rate of 125 pounds per hour. Liquid wastes are introduced into the secondary chamber, identified on process flow diagram as a rich fume reactor, at a maximum rate of 3,130 pounds per hour. The emissions from the incinerator are ducted through a venturi scrubber and packed tower scrubber connected in series. Control efficiencies claimed in the application are 94.95% for TSP and lead, 90.96% for PM_{10}, and 84.5% for sulfur dioxide, nitrogen oxides and carbon monoxide. The incinerator is expected to operate 8 hours per day, 250 days year. The incinerator has associated with it an external combustion boiler with a rated heat input of 34.6 MMBTU/hr, and fired with distillate oil at the rate of 247 gallons per hour. Acid gas concentrations of hydrogen chloride (HCl) and sulfur dioxide (SO_2) in the exhaust gas stream are directly related to the chlorine and sulfur content of the waste. Most of the chlorine will be converted to HCl. The packed tower is categorized as a medium-energy scrubber, and relies on impingement to facilitate removal of either particulate matter or acid gases. The venturi scrubber is categorized as a high-energy system, and is used primarily for control of particulate matter. The design outlet concentration for particulate matter is 0.09 grains/ascf. Parameters monitors by instrumentation affixed to the incinerator will include carbon monoxide, primary and secondary chamber temperatures, pH and flow of scrubbing brine, liquid waste feed rate, combustion gas velocity, and exhaust gas CO concentration in ppm.

The emissions factors chosen are from Sections 1.3 and 2.6 of AP-42, *Fuel Oil Combustion* and *Medical Waste Incineration.* Section 2.6 was chosen as being most representative of the types of wastes to be disposed of in the incinerator. While it is recognized that there will be little or no pathological wastes disposed of through the incinerator, the wastes which will be processed will be high in chlorine content, and will contain quantities of wastewater and cleaning materials including masks, gloves, suits, and boots, which are also present in medical wastes. For purposes of estimating emissions from the incinerator, only the weight of solid wastes are considered, since the wastewater is almost exclusively water contaminated with bleach and the nerve agents. While the nerve agents are toxic, they also decompose very rapidly at the temperatures encountered in the incinerator.

CDTF Thermal Treatment Waste Heat Boiler			
Pollutant	Emission Factor ($lb/10^3$ gallon)	Hourly Emissions (lbs/hr)	Annual Emission (tons/yr)
PM_{10}	2	0.05	0.2
Sulfur Dioxide	7.1	0.27	1.2
Nitrogen Oxides	20	0.77	3.4
Carbon Monoxide	5	1.2	5.4
Volatile Organic Compounds	0.34	0.1	0.4

CDTF Incinerator			
Pollutant	Emission Factor (lb/ton)	Hourly Emissions (lbs/hr)	Annual Emission (tons/yr)
PM_{10}	4.67	0.03	0.12
Sulfur Dioxide	2.17	0.02	0.09
Nitrogen Oxides	4.95	0.05	0.21
Carbon Monoxide	3.86	0.24	1.06
Volatile Organic Compounds	0.299	0.02	0.08
Lead	0.073	0.004563	0.019984
Hydrochloric Acid	3.35	0.032453	0.142145
Total PCB	0.0000465	0.000000	0.000002
Antimony	0.0128	0.000800	0.003504
Arsenic	0.000242	0.000015	0.000066
Beryllium	0.00000625	0.000000	0.000002
Cadmium	0.00548	0.000343	0.001500
Chromium	0.000775	0.000048	0.000212
Manganese	0.000567	0.000035	0.000155
Mercury	0.107	0.006688	0.029291
Nickel	0.00059	0.000037	0.000162
Hydrogen Fluoride	0.149	0.001443	0.006322
Chlorine	0.105	0.001017	0.004455
TCDD	0.000001	0.00000006	0.00000027

CDTF Incinerator			
Pollutant	Emission Factor (lb/ton)	Hourly Emissions (lbs/hr)	Annual Emission (tons/yr)
HxCDD	0.000000002	0.0000000001	0.0000000005
HpCDD	0.000000005	0.0000000003	0.0000000014
OCDD	0.000000022	0.0000000014	0.0000000060
Total CDD	0.0000213	0.00000133	0.00000583
TCDF	0.00000721	0.00000045	0.00000197
PcCDF	0.000000003	0.0000000002	0.0000000008
HxCDF	0.000000017	0.0000000011	0.0000000047
HpCDF	0.00000002	0.0000000013	0.0000000055
OCDF	0.000000074	0.0000000046	0.0000000203
Total CDF	0.0000715	0.00000447	0.00001957

EMISSION CALCULATIONS

Summary of Emission Points

As Discussed in Subsection 4.3.1.2

Summary of Emission Points

Point No.	Source Description	Throughput (units)		Pollutant (tons/yr) TSP	PM10	SOx	NOx	VOC	CO	Lead	HAPs	Category	Permit No.	
001A	Bldg 4056 - Gasoline Tank	205,401	gallons	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	Fuel Storage	0179-010 (Construction Permit)	
001B	Bldg 4056 - Gasoline Tank	205,401	gallons	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	Fuel Storage	0179-010 (Construction Permit)	
001C	Bldg 4055 - Naptha Ag Tank	0	gallons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Fuel Storage	0179-010 (Construction Permit)	
001D	Bldg 4053 - Distillate	407,813	gallons	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	Fuel Storage	0179-006,007,009 (Construction Permit)	
001D	Bldg 4053 - Distillate #2	407,813	gallons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Fuel Storage	0179-006,007,009 (Construction Permit)	
001F	Bldg 4054 - Distillate #2	1,352,330	gallons	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00	Fuel Storage	0179-008 (Construction Permit)	
001F	Bldg 4054 - Distillate	1,352,330	gallons	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	Fuel Storage	0179-008 (Construction Permit)	
001H	Bldg 2210 - Gasoline UST	50,088	gallons	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001I	Bldg 2210 - Diesel UST	20,067	gallons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001J	Boiler Plant - Distillate	747,646	gallons	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	Fuel Storage		
001J	Boiler Plant - Distillate	747,646	gallons	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	Fuel Storage		
001L	Motor Pool - Diesel Storage	120,994	gallons	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001L	Motor Pool - Diesel Storage	120,994	gallons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001N	Motor Pool - Gasoline Storage	187,170	gallons	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001O	Bldg 170 - Gasoline Storage	1,552,560	gallons	0.00	0.00	0.00	0.00	4.42	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001P	Bldg 170 - Gas Storage	599,894	gallons	0.00	0.00	0.00	0.00	2.46	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001Q	Bldg 170 - Gas Storage	549,091	gallons	0.00	0.00	0.00	0.00	2.75	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
001R	Bldg 5015 - Jet Naptha (JP-4)	65,945	gallons	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	Fuel Storage	0294-007 (Fuel Throughput)	
002A	Bldg 311A - #2 Fuel Oil Boiler	11,526	gallons	0.01	0.01	0.83	0.12	0.00	0.03	0.00	0.00	Boiler	0794-011	550,000 Gallons
002A	Bldg 311A - Natural Gas Boiler	19,225,210	cubic feet	0.06	0.00	0.00	1.35	0.03	0.34	0.00	0.00	Boiler	0794-011	
002B	Bldg 311A - #2 Fuel Oil Boiler	11,526	gallons	0.01	0.01	0.41	0.12	0.00	0.03	0.00	0.00	Boiler	0794-011	550,000 Gallons
002B	Bldg 311A - Natural Gas Boiler	19,225,210	cubic feet	0.06	0.00	0.01	1.35	0.03	0.34	0.00	0.00	Boiler	0794-011	
002C	Bldg 311A - Fulton Natural Gas	3,204,202	cubic feet	0.02	0.00	0.00	0.16	0.01	0.03	0.00	0.00	Boiler	0794-011	
002E	Bldg 311A - Natural Gas Boiler	3,204,202	cubic feet	0.02	0.00	0.00	0.16	0.01	0.03	0.00	0.00	Boiler	0794-011	
002F	Bldg 311A - Natural Gas Boiler	3,204,202	cubic feet	0.02	0.00	0.00	0.16	0.01	0.03	0.00	0.00	Boiler	0794-011	
002G	Bldg 311A - Natural Gas Boiler	3,204,202	cubic feet	0.02	0.00	0.00	0.16	0.01	0.03	0.00	0.00	Boiler	0794-011	
002H	Bldg 311A - Natural Gas Boiler	3,204,202	cubic feet	0.02	0.00	0.00	0.16	0.01	0.03	0.00	0.00	Boiler	0794-011	
002I	Bldg 311A - Natural Gas Boiler	3,204,202	cubic feet	0.02	0.00	0.00	0.16	0.01	0.03	0.00	0.00	Boiler	0794-011	
002J	Bldg 645B - #6 Residual Oil Bo	3,212	gallons	0.03	0.06	0.76	0.09	0.00	0.01	0.00	0.00	Boiler		
002K	Bldg 645C - #6 Residual Oil Bo	3,212	gallons	0.03	0.06	0.76	0.09	0.00	0.01	0.00	0.00	Boiler		
002L	Bldg 645D - #6 Residual Oil Bo	3,212	gallons	0.03	0.06	0.76	0.09	0.00	0.01	0.00	0.00	Boiler		
002M	Bldg 645E - #6 Residual Oil Bo	3,212	gallons	0.03	0.06	0.76	0.09	0.00	0.01	0.00	0.00	Boiler		
002N	Bldg 745F - #2 Fuel Oil Boiler	4,471	gallons	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.00	Boiler		
002N	Bldg 745F - Natural Gas Boiler	29,698,450	cubic feet	0.09	0.00	0.01	2.08	0.04	0.52	0.00	0.00	Boiler		
002O	Bldg 745G - #2 Fuel Oil Boiler	4,471	gallons	0.00	0.00	0.48	0.04	0.00	0.01	0.00	0.00	Boiler		
002O	Bldg 745G - Natural Gas Boiler	29,698,450	cubic feet	0.09	0.00	0.00	2.08	0.04	0.52	0.00	0.00	Boiler		
002P	Bldg 745H - Natural Gas Boiler	14,849,230	cubic feet	0.05	0.00	0.00	1.04	0.02	0.26	0.00	0.00	Boiler		

Summary of Emission Points

Point No.	Source Description	Throughput (units)		Pollutant (tons/yr) TSP	PM10	SOx	NOx	VOC	CO	Lead	HAPs	Category	Permit No.
002Q	Bldg 745I - Natural Gas Boiler	14,849,230	cubic feet	0.05	0.00	0.00	1.04	0.02	0.26	0.00	0.00	Boiler	
002R	Bldg 745J - Natural Gas Boiler	0	cubic feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Boiler	
002S	Bldg 1021L - #2 Fuel Oil Boiler	98,231	gallons	0.10	0.05	3.54	0.98	0.01	0.25	0.00	0.00	Boiler	
002S	Bldg 1021L - Natrual Gas Boiler	22,689,440	cubic feet	0.07	0.00	0.00	1.59	0.03	0.40	0.00	0.00	Boiler	
002T	Bldg 2351N - Propane Boiler	110,894	gallons	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	Boiler	
002U	Bldg 2351M - Propane Boiler	110,894	gallons	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	Boiler	
002V	Bldg 2351O - #2 Fuel Oil Boiler	15,961	gallons	0.02	0.01	0.06	0.16	0.00	0.04	0.00	0.00	Boiler	
002W	Bldg 2351P - #2 Fuel Oil Boiler	15,961	gallons	0.02	0.01	0.01	0.16	0.00	0.04	0.00	0.00	Boiler	
002X	Bldg 2369R - #2 Fuel Oil Boiler	286,327	gallons	0.29	0.14	10.31	2.86	0.03	0.72	0.00	0.00	Boiler	
002Y	Bldg 2369G - #2 Fuel Oil Boiler	286,327	gallons	0.29	0.14	10.31	2.86	0.03	0.72	0.00	0.00	Boiler	
003A	577th Rock Crusher 1C Engine	327	gallons	0.01	0.01	0.01	0.10	0.72	0.02	0.00	0.00	Generator	
003B	285th Rock Crusher 1C Engine	600	gallons	0.01	0.01	0.01	0.18	1.32	0.04	0.00	0.00	Generator	
003C	Bldg 485 - Diesel Generator	90	gallons	0.00	0.00	0.00	0.03	0.20	0.01	0.00	0.00	Generator	
003D	Bldg 1021 - Diesel Generator	350	gallons	0.01	0.01	0.01	0.11	0.77	0.02	0.00	0.00	Generator	
003E	Bldg 2056 - Diesel Generator	410	gallons	0.01	0.01	0.01	0.12	0.90	0.03	0.00	0.00	Generator	
003F	Bldg 2056 - Diesel Generator	40	gallons	0.00	0.00	0.00	0.01	0.09	0.00	0.00	0.00	Generator	
003G	Bldg 2369 - Diesel Generator	460	gallons	0.01	0.01	0.01	0.14	1.01	0.03	0.00	0.00	Generator	
003H	Bldg 3200 - Diesel Generator	90	gallons	0.00	0.00	0.00	0.03	0.20	0.01	0.00	0.00	Generator	
003I	Bldg 402 - Diesel Generator	70	gallons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Generator	
003J	Bldg 404 - Diesel Generator	260	gallons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Generator	
003K	Bldg 5006 - Diesel Generator	240	gallons	0.01	0.01	0.00	0.07	0.53	0.02	0.00	0.00	Generator	
003L	Bldg 5008 - Diesel Generator	20	gallons	0.00	0.00	0.00	0.01	0.04	0.00	0.00	0.00	Generator	
003M	Bldg 5009 - Diesel Generator	10	gallons	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	Generator	
003N	Bldg 5018 - Diesel Generator	30	gallons	0.00	0.00	0.00	0.01	0.07	0.00	0.00	0.00	Generator	
003O	Bldg 5027 - Diesel Generator	10	gallons	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	Generator	
003P	Bldg 645 - Diesel Generator	170	gallons	0.00	0.00	0.00	0.05	0.37	0.01	0.00	0.00	Generator	
003Q	Bldg 745 - Diesel Generator	170	gallons	0.00	0.00	0.00	0.05	0.37	0.01	0.00	0.00	Generator	
003R	Bldg 745 - Diesel Generator	120	gallons	0.00	0.00	0.00	0.04	0.26	0.01	0.00	0.00	Generator	
003S	Bldg 755 - Diesel Generator	50	gallons	0.00	0.00	0.00	0.02	0.11	0.00	0.00	0.00	Generator	
003T	Bldg 311 - Diesel Generator	290	gallons	0.01	0.01	0.01	0.09	0.64	0.02	0.00	0.00	Generator	
003U	Bldg 311 - Diesel Generator	290	gallons	0.01	0.01	0.01	0.09	0.64	0.02	0.00	0.00	Generator	
003V	Bldg 311 - Diesel Generator	290	gallons	0.01	0.01	0.01	0.09	0.64	0.02	0.00	0.00	Generator	
003W	Sewage Treatment Plant - Diesel Ge	460	gallons	0.01	0.01	0.01	0.14	1.01	0.03	0.00	0.00	Generator	
004	Hospital EO Sterilizer (EO Use)	0.25	tons	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	Sterilizer	
005	Composite Cold Degreasing	6,151	gallons	0.00	0.00	0.00	0.00	2.37	0.00	0.00	0.00	Degreasing	0294-007
006	Post Wide Pesticide/Herbicide	317.30	gallons	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	Pesticide/Herbicide	
007	Golf Course Pesticide/Herbicide	42.00	gallons	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	Pesticide/Herbicide	

Summary of Emission Points

Point No.	Source Description	Throughput (units)		Pollutant (tons/yr) TSP	PM10	SOx	NOx	VOC	CO	Lead	HAPs	Category	Permit No.
008	Bldg 5265 - Paint Booth (Furniture)	61	gallons	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	Paint Booth	0294-007
009	Bldg 5266 - Paint Booth (Vehicle)	1,860	gallons	0.00	0.00	0.00	0.00	4.48	0.00	0.00	0.00	Paint Booth	0294-007
010	ECS Bldg 1390 - Paint Booth	953	gallons	0.00	0.00	0.00	0.00	3.03	0.00	0.00	0.00	Paint Booth	
011	TASC Bldg 1448 - Paint Booth	263	gallons	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00	Paint Booth	0294-007
012	Bldg 2351 - Dry Cleaning	2.13	tons	0.00	0.00	0.00	0.00	2.13	0.00	0.00	0.00	Miscellaneous	
013	Print Plant 2350	0.00	tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Miscellaneous	
014	Bldg 310 - Hospital Incinerator (Propa	13,288	gallons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Incinerator	0590-004
014	Bldg 310 - Hospital Incinerator	18.39	tons	0.04	0.05	0.00	0.03	0.09	0.00	0.00	0.00	Incinerator	0590-004
015	Bldg 2399 - Vet Clinic Incinerator (Closed)											Incinerator	
016	Bldg 1448 - Wood Working	0.75	tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Woodworking	
017	Bldg 2215 - Woodworking	1.00	tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Woodworking	
018	Bldg 5265 - Woodworking	1.00	tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Woodworking	
019	Bldg 486 - Woodworking	7.79	tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Woodworking	
020	Space Heating - Propane: Post-	1,091,654	gallons	0.33	1.01	0.00	10.92	0.00	1.86	0.00	0.00	Space Heating	
021	Space Heating - #2 Fuel Oil	661,497	gallons	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	Space Heating	
022	Space Heating - Natural Gas	459,227,900	cubic feet	0.69	0.69	0.00	22.96	1.22	4.59	0.00	0.00	Space Heating	
023	Quarry Operations Haul Road	1,986	VMT	9.40	4.70	0.00	0.00	0.00	0.00	0.00	0.00	Quarry	0392-001, 0995-017
024	Storage Pile	19,863	tons	5.84	2.92	0.00	0.00	0.00	0.00	0.00	0.00	Quarry	0392-001, 0995-017
025	Crushing/Screening Plants	19,863	tons	4.97	1.36	0.00	0.00	0.00	0.00	0.00	0.00	Quarry	0392-001, 0995-017
025A	Asphalt Plant Heater (Dist Oil)	2,500	gallons	0.00	0.00	0.18	0.03	0.00	0.00	0.00	0.00	Asphalt	
025B	Asphalt Plant (Rotary Dryer)	209	tons	0.18	0.04	0.01	0.00	0.00	0.00	0.00	0.00	Asphalt	
026	Wastewater Treatment - Industrial	620,500,000	gallons	0.00	0.00	0.00	0.00	2.76	0.00	0.00	0.00	Wastewater Treatment	
027	Welding Operations	0.38	tons	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	Miscellaneous	
028	Misc Post-Wide VOC Emissions	24,568.9	gallons	0.00	0.00	0.00	0.00	53.30	0.00	0.00	0.00	Miscellaneous	
029	Misc Heating Fuel Storage - #2	661,497.0	gallons	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	Fuel Storage	

Summary of Emission Points

Point No.	Source Description	Throughput (units)	Pollutant (tons/yr) TSP	PM10	SOx	NOx	VOC	CO	Lead	HAPs	Category	Permit No.
30	Paint Booth Building 5138	478.0 gallons	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.00	Paint Booth	0294-007
31	POL Fuel Loading Racks Distillate	929,180.0 gallons	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	Fuel Storage	
32	POL Fuel Loading Racks Gasoline	9,779 gallons	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	Fuel Storage	
	Sum		**23.00**	**12.47**	**29.29**	**54.51**	**94.84**	**11.46**	**0.00**	**0.00**		

	TSP	PM10	SOx	NOx	VOC	CO	Lead	HAPs
Asphalt	0.18	0.04	0.19	0.03	0.00	0.00	0.00	0.00
Boiler	1.45	0.63	29.01	19.19	0.36	4.71	0.00	0.00
Degreasing	0.00	0.00	0.00	0.00	2.37	0.00	0.00	0.00
Fuel Storage	0.00	0.00	0.00	0.00	11.56	0.00	0.00	0.00
Generator	0.10	0.10	0.09	1.38	9.93	0.30	0.00	0.00
Incinerator	0.04	0.05	0.00	0.03	0.09	0.00	0.00	0.00
Miscellaneous	0.00	0.16	0.00	0.00	55.43	0.00	0.00	0.00
Paint Booth	0.00	0.00	0.00	0.00	10.13	0.00	0.00	0.00
Pesticide/Herbicide	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00
Quarry	20.21	8.98	0.00	0.00	0.00	0.00	0.00	0.00
Space Heating	1.02	2.51	0.00	33.88	1.22	6.45	0.00	0.00
Sterilizer	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00
Wastewater Treatment	0.00	0.00	0.00	0.00	2.76	0.00	0.00	0.00
Woodworking	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**23.00**	**12.47**	**29.29**	**54.51**	**94.84**	**11.46**	**0.00**	**0.00**

Air Emission Calculations for Flame Field Expedient Deterrents Training

As Discussed in Subsection 5.2.2.3.1

ENVIRONMENTAL ENGINEERING AND SCIENCES

USAF EHL-M

AIR POLLUTANT EMISSIONS FROM JP-4 FIRES USED IN FIRE FIGHTING TRAINING

by

Harry J. Suggs, Major, USAF

November 1971

U S A F ENVIRONMENTAL HEALTH LABORATORY
McCLELLAN AFB, CA. 95652

AFLC SMAMA APR 69, 3M

conditions are shown in Table IV.

TABLE IV

EMISSION FACTORS

		lb/1000 lb fuel
Particulates:	Solid	131
	"Condensible"	64
	Total	195
Carbon monoxide		204
Methane		24
Ethylene		29
Acetylene		9
Formaldehyde		11
Oxides of Nitrogen		3

Discussion of Results

The most difficult part of determining air pollution emission factors applicable to fire training exercises is simulating the burning conditions and still being able to collect representative samples that can be related to combustion of a given amount of fuel. The material balance method used in this study offers a realistic method of relating concentrations measured to a quantity of fuel and the fire training facility offered a realistic method of collecting samples. The question still remained whether the burning inside this structure did, in fact, simulate open burning as might be experienced in a fire training exercise.

At the start of the sampling run, burning appeared disturbingly quiescent, even though burning in the 7 containers did give a reasonable burning surface area and the induced draft should have afforded sufficient air and turbulence. Midway through the run the burning rate quite obviously increased suddenly and significantly. Smoke began billowing out at all cracks and openings in the building, temperatures and all the monitored concentrations suddenly shot up (see Figure 3). It is theorized that the material in the burn pots suddenly "boiled over" presenting a much greater burning area and attendant rapid combustion. In a matter of a few minutes though, with the overflow liquid consumed, the burning rate decreased to that originally present and temperatures and monitored concentrations fell toward their initial values. It is very likely that this unplanned and unpredicted event is, in fact, the factor that makes this test truly representative of actual fire training exercises.

Explosives Requirements Used In Conjunction With Flame Field Expedient Deterrents Training

Type of Ammunition or Explosive	Particulate Emissions (lbs/yr)	
	RCP	OPTM/EPTM
Thickening Compound	160	99
Fuel Usage	20,300	12,400
Detonation Cord	NC	NC
C4, 1 1/4 lbs	NC	NC
Trip Flares	NC	NC
M6 Caps	NC	NC
Totals	20,460	12,499
Number of Annual Training Cycle	41	41
Totals Emissions Per Training Cycle	**499**	**305**

NC Not Calculated. Current methodology for calculating emissions does not exist for these items.

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Date: 3/5/97, Time: 8:50 AM

EMISSION OF CRITERIA AIR POLLUTANTS
FROM FLAME FIELD EXPEDIENT DETERRENTS TRAINING (RCP)
AT FORT LEONARD WOOD, MISSOURI

(a) Fuel Usage Per Training Session * (gal): ---------->	830
(b) Training Sessions Per Year * (#):---------->	41
(c) Fuel Density [3] (lbs/gal):---------->	6.09
(d) Conversion Factor (lbs/ton): ---------->	2,000

Air Pollutants Emitted	Emission Factor (lbs emitted/ 1000 lb fuel burned)	Emission Factor Sources	Annual Emissions (tons/yr) [4]
Criteria Pollutants (CP)			
Nitrogen Oxides (NOx)	3	2	0.31
Sulfur Oxides (SOx)	-	-	0.00
Particulate Matter (PM10)	98	2	10.15
Total Hydrocarbons[1]	38	2	3.94
Total Hydrocarbons[5] (evaporative)	-	-	8.74
Carbon Monoxide (CO)	204	2	21.14

REFERENCES:

Since gasoline emission factors for this type of training are not readily available, JP-4 emission factors are used

Reference gives emission factor for total particulate, but it is assumed by Parsons ES that PM10 is 50% of total particulate

* Data provided by Fort Leonard Wood

1 Sum Of Ethylene and Acetylene

2 Air Pollutant Emissions From JP-4 Fires Used In Fire Fighting Training, USAF Environmental Health Laboratory, Major H.J. Suggs, Nov 1971

3 Calculation And Compilation Methods For Criteria Air Pollutant Emission Inventories, Armstrong Laboratory, March 1994 (AL/OE-TR-1994)

4 EF x a x b x c / d

5 70 (gal) x b x c / d

NOTES:

gal = Gallon; lb = Pound, yr = year

Disk File: FFE-RCP.XLS

Date: 3/5/97 Time: 8:50 AM

EMISSION OF CRITERIA AIR POLLUTANTS
FROM FLAME FIELD EXPEDIENT DETERRENTS TRAINING (RCP)
AT FORT LEONARD WOOD, MISSOURI

(a) Thickening Compound Usage Per Year * (cans): ---------->	580
(b) Volume per can * (oz/can):---------->	40
(c) Density [3] (lbs/gal):---------->	9.15
(d) Conversion Factor (lbs/ton): ---------->	2,000

Air Pollutants Emitted	Emission Factor (lbs emitted/ 1000 lb fuel burned)	Emission Factor Sources	Annual Emissions (tons/yr) [4]
Criteria Pollutants (CP)			
Nitrogen Oxides (NOx)	3	2	0.00
Sulfur Oxides (SOx)	-	-	0.00
Particulate Matter (PM10)	98	2	0.08
Total Hydrocarbons[1]	38	2	0.03
Carbon Monoxide (CO)	204	2	0.17

REFERENCES:

Since gasoline emission factors for this type of training are not readily available, JP-4 emission factors are used

Reference gives emission factor for total particulate, but it is assumed by Parsons ES that PM10 is 50% of total particulate

* Data provided by Fort Leonard Wood

1 Sum Of Ethylene and Acetylene

2 Air Pollutant Emissions From JP-4 Fires Used In Fire Fighting Training, USAF Environmental Health Laboratory, Major H.J. Suggs, Nov 1971

3 Material Safety Data Sheet

4 EF x a x b/128 x c / d

NOTES:

gal = Gallon; lb = Pound, yr = year

Disk File: FFE-RCP.XLS

Date: 3/5/97 Time: 8:51 AM

EMISSION OF CRITERIA AIR POLLUTANTS
FROM FLAME FIELD EXPEDIENT DETERRENTS TRAINING (OPTM/EPTM)
AT FORT LEONARD WOOD, MISSOURI

(a) Fuel Usage Per Training Session * (gal): ---------->	507
(b) Training Sessions Per Year * (#):---------->	41
(c) Fuel Density [3] (lbs/gal):---------->	6.09
(d) Conversion Factor (lbs/ton): ---------->	2,000

Air Pollutants Emitted	Emission Factor (lbs emitted/ 1000 lb fuel burned)	Emission Factor Sources	Annual Emissions (tons/yr) [4]
Criteria Pollutants (CP)			
Nitrogen Oxides (NOx)	3	2	0.19
Sulfur Oxides (SOx)	-	-	0.00
Particulate Matter (PM10)	98	2	6.20
Total Hydrocarbons[1]	38	2	2.41
Total Hydrocarbons[5] (evaporative)	-	-	5.62
Carbon Monoxide (CO)	204	2	12.91

REFERENCES:

Since gasoline emission factors for this type of training are not readily available, JP-4 emission factors are used

Reference gives emission factor for total particulate, but it is assumed by Parsons ES that PM10 is 50% of total particulate

* Data provided by Fort Leonard Wood

1 Sum Of Ethylene and Acetylene

2 Air Pollutant Emissions From JP-4 Fires Used In Fire Fighting Training, USAF Environmental Health Laboratory, Major H.J. Suggs, Nov 1971

3 Calculation And Compilation Methods For Criteria Air Pollutant Emission Inventories, Armstrong Laboratory, March 1994 (AL/OE-TR-1994)

4 EF x a x b x c / d

5 45 (gal) x b x c / d

NOTES:

gal = Gallon; lb = Pound, yr = year

EMISSION OF CRITERIA AIR POLLUTANTS FROM FLAME FIELD EXPEDIENT DETERRENTS TRAINING (OPTM/EPTM) AT FORT LEONARD WOOD, MISSOURI

(a) Thickening Compound Usage Per Year * (cans): ---------->	354
(b) Volume per can * (oz/can):---------->	40
(c) Density [3] (lbs/gal):---------->	9.15
(d) Conversion Factor (lbs/ton): ---------->	2,000

Air Pollutants Emitted	Emission Factor (lbs emitted/ 1000 lb fuel burned)	Emission Factor Sources	Annual Emissions (tons/yr) [4]
Criteria Pollutants (CP)			
Nitrogen Oxides (NOx)	3	2	0.00
Sulfur Oxides (SOx)	-	-	0.00
Particulate Matter (PM10)	98	2	0.05
Total Hydrocarbons[1]	38	2	0.02
Carbon Monoxide (CO)	204	2	0.10

REFERENCES:

Since gasoline emission factors for this type of training are not readily available, JP-4 emission factors are used

Reference gives emission factor for total particulate, but it is assumed by Parsons ES that PM10 is 50% of total particulate

* Data provided by Fort Leonard Wood

1 Sum Of Ethylene and Acetylene

2 Air Pollutant Emissions From JP-4 Fires Used In Fire Fighting Training, USAF Environmental Health Laboratory, Major H.J. Suggs, Nov 1971

3 Material Safety Data Sheet

4 EF x a x b/128 x c / d

NOTES:

gal = Gallon; lb = Pound, yr = year

Air Emission Calculations for Explosives Used in Training

As Discussed in Subsection 5.2.2.3.2

Emissions From Explosives Used In Training
Fort Leonard Wood, Missouri

No.	Type of Ammunition or Explosive[1]	Additional BRAC requirements (a)	Quantity of Active Explosive[2] (for CO) (b)	Quantity of Active Explosive[3] (for CO) (tons/yr)	Quantity of Active Ingredient[2] (for PM) (c)	Quantity of Active Ingredient[4] (for PM) (lbs/yr)	Release Efficiency (%)	CO Emission Factor (lbs/ton)	CO Emissions (lbs/yr)	Particulate Emissions (lbs/yr)
									NC	NC
1	12 gauge shotgun	42,881 rounds							NC	NC
2	5.56 mm ball	1,584,005 rounds							NC	NC
3	5.56 mm tracer	52,200 rounds							NC	NC
4	5.56 mm ball	29,600 rounds							NC	NC
5	5.56 mm blank	1,434,018 rounds							NC	NC
6	7.62 mm blank linked	538,200 rounds							NC	NC
7	7.62 mm ball linked (4 ball plus 1 tracer round)	652,600 rounds							NC	NC
8	7.62 mm ball	4,754 rounds							NC	NC
9	7.62 mm ball linked for machine gun	18,800 rounds							NC	NC
10	7.62 mm 4 ball	76,800 rounds							NC	NC
11	9 mm practice AT-4	17,946 rounds							NC	NC
12	9 mm ball pistol	1,021,737 rounds							NC	NC
13	0.38 caliber blank (sentry dog)	16,800 rounds							NC	NC
14	0.50 caliber (4 ball with 1 tracer round)	88,299 rounds							NC	NC
15	40 mm practice M781	9,638 rounds							NC	NC
16	40 mm high explosive duel purpose low pressure	279 rounds							NC	NC
17	40 mm high explosive	4,404 rounds							NC	NC
18	40 mm training practice M918	118,216 rounds							NC	NC
19	Cartage 84 mm M136 AT-4 and launcher	43							NC	NC
20	Grenade smoke screening	48 grenades							NC	NC
21	Grenade & launcher smoke	36 grenades							NC	NC
22	Fuze hand grenade, practice	66,571 grenades							NC	NC
23	Grenade hand fragmentation M67	7,743 grenades							NC	NC
24	Grenade hand incendiary	28 grenades							NC	NC
25	Grenade hand smoke, TPA, M83 [3]	1,524 grenades	0.340 lbs	0.26	0.450 lbs	685.8	80	77	19.9	548.6
26	Grenade hand smoke, Green (MIL	3,297 grenades	6.750 oz	0.70	4.750 oz	978.8	95	77	53.6	929.9
27	Grenade hand smoke, Yellow (M1	1,404 grenades	6.750 oz	0.30	4.750 oz	416.8	95	77	22.8	396.0
28	Grenade hand smoke, Red (M18)	487 grenades	6.750 oz	0.10	4.750 oz	144.6	95	77	7.9	137.3
29	Grenade hand smoke, Violet (M18	240 grenades	6.750 oz	0.05	4.750 oz	71.3	95	77	3.9	67.7
30	Grenade hand riot, CS (Tear)	1,396 grenades	6.750 oz	0.29	4.750 oz	414.4	95	77	22.7	393.7
31	Grenade hand smoke, M82 (TI02)	48 grenades	0.340 lbs	0.01	800 grams	84.7	100	77	0.6	84.7
32	Burster incendiary field M4	64 charges							NC	NC
33	Mine anti-personnel directional M1 (claymore)	18 mines							NC	NC
34	Riot control Agent, CS (Tear) capsule	883 capsules							NC	NC
35	Smoke pot M8, TPA [3]	840	10.500 lbs	4.41	13.500 lbs	11,340.0	80	77	339.6	9072.0
36	Thickening Compound - (quantity of 40 ounce cans used)	354							NC	NC
37	Signal illumination red star cluster	60 signals							NC	NC
38	Signal illumination white star cluster	357 signals							NC	NC
39	Signal illumination red star parachute	260 signals							NC	NC
40	Signal illumination white star parachute	1,204 signals							NC	NC
41	Signal illumination green star	207 signals							NC	NC
42	Flare surface trip	436 flares							NC	NC
43	Illumination projectile ground burst	2,844 projectiles							NC	NC
44	Simulated projectile air burst	26 projectiles							NC	NC
45	Simulated booby trap	124 signals							NC	NC

No.	Type of Ammunition or Explosive[1]	Additional BRAC requirements (a)	Quantity of Active Explosive[2] (for CO) (b)	Quantity of Active Explosive[3] (for CO) (tons/yr)	Quantity of Active Ingredient[2] (for PM) (c)	Quantity of Active Ingredient[4] (for PM) (lbs/yr)	Release Efficiency (%)	CO Emission Factor (lbs/ton)	CO Emissions (lbs/yr)	Particulate Emissions (lbs/yr)
46	Simulated booby trap, illuminated	146 signals							NC	NC
47	Simulated booby trap, whistle	1,190 signals							NC	NC
48	Simulated hand grenade	1,079 signals							NC	NC
49	Charge demolition C4, 1¼ pound	353 charges							NC	NC
50	Charge demolition TNT ¼ pound	1,805 charges							NC	NC
51	Charge demolition TNT 1 pound	72 charges							NC	NC
52	Cap blasting electric M6	1,445 charges							NC	NC
53	Cap blasting non-electric M7	657 charges							NC	NC
54	Cord detonation reinforced (quantity of linear feet used)	63,800 linear feet							NC	NC
55	Fuze time blasting (quantity of 25-foot long sections used)	6,812 charges							NC	NC
56	Igniter fuze blast time	657 charges							NC	NC
57	Light Sticks, number of boxes with 25 per box	12							NC	NC
									471	11,630
								tons/year	0.24	5.81

1 Data provided by Fort Leonard Wood

2 See Assumptions, Page 3

3 For Obscurants, Total Quantity of Explosive = a x b / (2000 lbs/ton)

4 For Obscurants, Total Quantity of Active Ingredient = a x c

5 Overall assumption that particulate emissions are equivalent to active ingredient quantity.

6 CO Emissions (lbs/yr) = EF x Quantity of Active Explosive (tons/yr)
PM Emissions (lbs/yr) = Quantity of Active Ingredient (lbs/yr) x Release Efficiency.

NC Not Calculated. Current methodology for calculating emissions does not exist for these items.

Emissions From Explosives Used In Training
Fort Leonard Wood, Missouri
Assumptions Used

No.	Type of Ammunition or Explosive	Unit Charge Assumption or Data Source	Emission Factor Assumption or Data Source
1	12 gauge shotgun		Methodology not established, data provided by AEC.
2	5.56 mm ball		Methodology not established, data provided by AEC.
3	5.56 mm tracer		Methodology not established, data provided by AEC.
4	5.56 mm ball		Methodology not established, data provided by AEC.
5	5.56 mm blank		Methodology not established, data provided by AEC.
6	7.62 mm blank linked		Methodology not established, data provided by AEC.
7	7.62 mm ball linked (4 ball plus 1 tracer round)		Methodology not established, data provided by AEC.
8	7.62 mm ball		Methodology not established, data provided by AEC.
9	7.62 mm ball linked for machine gun		Methodology not established, data provided by AEC.
10	7.62 mm 4 ball		Methodology not established, data provided by AEC.
11	9 mm practice AT-4		Methodology not established, data provided by AEC.
12	9 mm ball pistol		Methodology not established, data provided by AEC.
13	0.38 caliber blank (sentry dog)		
14	0.50 caliber (4 ball with 1 tracer round)		Methodology not established, data provided by AEC.
15	40 mm practice M781		Methodology not established, data provided by AEC.
16	40 mm high explosive duel purpose low pressure		Methodology not established, data provided by AEC.
17	40 mm high explosive		Methodology not established, data provided by AEC.
18	40 mm training practice M918		Methodology not established, data provided by AEC.
19	Cartage 84 mm M136 AT-4 and launcher		Methodology not established, data provided by AEC.
20	Grenade smoke screening		Methodology not established, data provided by AEC.
21	Grenade & launcher smoke		Methodology not established, data provided by AEC.
22	Fuze hand grenade, practice		Methodology not established, data provided by AEC.
23	Grenade hand fragmentation M67		Methodology not established, data provided by AEC.
24	Grenade hand incendiary		Methodology not established, data provided by AEC.
25	Grenade hand smoke, TPA, M83 [3]	Data provided by Army Environmental Center	
26	Grenade hand smoke, Green (MILES) (M18)	Data provided by Army Environmental Center	Assumed to be 77 lbs/ton
27	Grenade hand smoke, Yellow (M18)	Data provided by Army Environmental Center	Assumed to be 77 lbs/ton
28	Grenade hand smoke, Red (M18)	Data provided by Army Environmental Center	Assumed to be 77 lbs/ton
29	Grenade hand smoke, Violet (M18)	Data provided by Army Environmental Center	Assumed to be 77 lbs/ton
30	Grenade hand riot, CS (Tear)		
31	Grenade hand smoke, M82 (TI02)	Same as Item 25	
32	Burster incendiary field M4		Methodology not established, data provided by AEC.
33	Mine anti-personnel directional M1 (claymore)		Methodology not established, data provided by AEC.
34	Riot control Agent, CS (Tear) capsule		Methodology not established, data provided by AEC.
35	Smoke pot M8, TPA [3]	Data provided by Army Environmental Center	Assumed to be 77 lbs/ton
36	Thickening Compound - (quantity of 40 ounce cans used)		Methodology not established, data provided by AEC.
37	Signal illumination red star cluster		Methodology not established, data provided by AEC.
38	Signal illumination white star cluster		Methodology not established, data provided by AEC.
39	Signal illumination red star parachute		Methodology not established, data provided by AEC.
40	Signal illumination white star parachute		Methodology not established, data provided by AEC.
41	Signal illumination green star		Methodology not established, data provided by AEC.
42	Flare surface trip		Methodology not established, data provided by AEC.
43	Illumination projectile ground burst		Methodology not established, data provided by AEC.
44	Simulated projectile air burst		Methodology not established, data provided by AEC.
45	Simulated booby trap		Methodology not established, data provided by AEC.
46	Simulated booby trap, illuminated		Methodology not established, data provided by AEC.
47	Simulated booby trap, whistle		Methodology not established, data provided by AEC.
48	Simulated hand grenade		Methodology not established, data provided by AEC.
49	Charge demolition C4, 1¼ pound		Methodology not established, data provided by AEC.
50	Charge demolition TNT ¼ pound		Methodology not established, data provided by AEC.
51	Charge demolition TNT 1 pound		Methodology not established, data provided by AEC.
52	Cap blasting electric M6		Methodology not established, data provided by AEC.
53	Cap blasting non-electric M7		Methodology not established, data provided by AEC.
54	Cord detonation reinforced (quantity of linear feet used)		Methodology not established, data provided by AEC.
55	Fuze time blasting (quantity of 25- foot long sections used)		Methodology not established, data provided by AEC.
56	Igniter fuze blast time		Methodology not established, data provided by AEC.
57	Light Sticks, number of boxes with 25 per box	Closed system therefore no emissions	Methodology not established, data provided by AEC.

Air Emission Calculations for Miscellaneous Materials Used in Training

As Discussed in Subsections 5.2.2.3.3, 5.2.2.3.4 and 5.2.2.3.5

Miscellaneous Materials Used In Training

Training	Material	Container (ml)	Container (oz)	Quantity Used	Total Use (gal)	Density (lbs/gal)	Total Uncontrolled VOC Emissions (lbs)	Control Eff.	Total Controlled VOC Emissions (lbs)	Total Particulate Emissions (lbs/yr)
Military Police Chemicals	Ethyl 2-Cyanoacrylate		16	12.5	1.6	8.6	13.4375	0	13.4	0.0
BIDS Simulants	BG	9	0.304	20	0.0	8.6	49.5	0	0.0	49.5
	BG	9	0.304	20	0.0	8.6	0.0	0	0.0	0.0
	MS2	9	0.304	20	0.05	8.6	0.0	0	0.0	0.0
	Erwinia Herbicola	9	0.304	20	0.05	8.6	0.0	0	0.0	0.0
	Ovalbumin	9	0.304	20	0.05	8.6	0.0	0	0.0	0.0
	Kaolin Dust		1.000	387.2			0.0	0	0.0	24.2
FOX Simulants	Anisole	72	2.435	1	0.02	8.6	0.2	0	0.2	0.0
	Benzaldehyde	30	1.015	1	0.01	8.6	0.1	0	0.1	0.0
	Cyclohexanone	30	1.015	1	0.01	8.6	0.1	0	0.1	0.0
	Diethyl Malonate	19030	643.558	1	5.03	8.6	43.2	0	43.2	0.0
	Diethyl Phthalate	1200	40.582	1	0.32	8.6	2.7	0	2.7	0.0
	Dimethyl Phthalate	60	2.029	1	0.02	8.6	0.1	0	0.1	0.0
	Ethyl Phthalate	30	1.015	1	0.01	8.6	0.1	0	0.1	0.0
	Eucalyptol	6000	202.908	1	1.59	8.6	13.6	0	13.6	0.0
	Isopropyl Alcohol		36	1	0.28	8.6	2.4	0	2.4	0.0
	Methyl Salicylate	15030	508.285	1	3.97	8.6	34.2	0	34.2	0.0
Future Chemical Simulant	GD	1,800,000	60872.5	1	475.57	2.236	1063.4	0	1063.4	0.0
Implement In FY 98	HL	1,800,000	60872.5	1	475.57	2.15	1022.5	0	1022.5	0.0
	CADS		16	1800	225.00	6.106	1373.9	0	1373.9	0.0
Class Support Materials	Acetone	7,600	257.0	1	2.01	8.6	17.3	0	17.3	0.0
	FC-43, Fluorinert		3	6	0.14	8.6	1.2	0	1.2	0.0
	PEG-200	540000	18261.8	1	142.67	9.69	1382.8	0	1382.8	
	Microcare Solvent		32	18	4.50	8.6	38.7	0	38.7	0.0
							Total Emissions (lbs/yr) =		**5,010**	**73.7**
							Total Emissions (tons/yr) =		**2.50**	**0.04**

Assumptions:

1) All materials are assumed conservatively 100% VOC, except for Kaolin Dust which is assumed 100% particulate.
2) All materials are evaporated.
3) All materials have a density of 8.6 lbs/gal if data not available.
4) Materials quantities taken from EIS, Appendix B.

Ambient Air Quality Impact from the Chemical Defense Training Facility (RCP Alternative)

As Discussed in Subsection 5.2.2.3.6

Ambient Air Quality Impact from the Chemical Defense Training Facility (RCP Alternative Only)

Pollutant	Ambient Impact ($\mu g/m^3$)[1]		Multiplication Factor	Ambient Impact ($\mu g/m^3$)[2]		Ambient Impact ($\mu g/m^3$)[1]	
PM-10	0.58	24-hour	1	0.58	24-hour	150.00	24-hour
Sulfur Dioxide	8.82	1-hr	0.9	7.938	3-hr	1,300.00	3-hr
Nitrogen Oxides	17.36	24-hr	0.25	4.34	annual	100.00	annual
Carbon Monoxide	18.13	1-hr	1	18.13	1-hr	40,000.00	1-hr
VOCS	1.88	1-hr	1	1.88	1-hr	235.00	1-hr
Lead	0.01	1-hr	0.4	0.004	quarterly	1.50	quarterly
Pollutant	**Ambient Impact ($\mu g/m^3$)[1]**		**Multiplication Factor**	**Ambient Impact ($\mu g/m^3$)[2]**		**MDNR Acceptable Ambient Level (mg/m^3)[1, 3]**	
Antimony	0.0046	1-hr	0.7	0.00322	8-hr	6.67	8-hr
Arsenic	0.0001	1-hr	0.7	0.00007	8-hr	0.03	8-hr
Beryllium	0.000004	1-hr	0.7	0.0000028	8-hr	30.00	8-hr
Cadmium	0.002	1-hr	0.7	0.0014	8-hr	50.00	8-hr
Chromium	0.0003	1-hr	0.4	0.00012	24-hr	1.36	24-hr
Manganese	0.0002	1-hr	0.7	0.00014	8-hr	0.89	8-hr
Mercury	0.0027	8-hr	1	0.0027	8-hr	0.01	8-hr
Nickel	0.0002	8-hr	1	0.0002	8-hr	1.33	8-hr
Hydrogen Fluoride	0.0033	24-hr	1	0.0033	24-hr	0.68	24-hr
Chlorine	0.0024	1-hr	0.4	0.00096	24-hr	3.95	24-hr
TCDD	0.0000004	1-hr	1	0.0000004	1-hr	no standard	
HxCDD	0.00000001	1-hr	1	0.00000001	1-hr	no standard	
HpCDD	0.00000001	1-hr	1	0.00000001	1-hr	no standard	
OCDD	0.00000001	1-hr	1	0.00000001	1-hr	no standard	
Total CDD	0.000037	1-hr	1	0.000037	1-hr	no standard	
TCDF	0.0000026	1-hr	1	0.0000026	1-hr	no standard	
PcCDF	0.00000001	1-hr	1	0.00000001	1-hr	no standard	
HxCDF	0.00000001	1-hr	1	0.00000001	1-hr	no standard	
HpCDF	0.00000001	1-hr	1	0.00000001	1-hr	no standard	
OCDF	0.00000003	1-hr	1	0.00000003	1-hr	no standard	
Total CDF	0.000026	1-hr	1	0.000026	1-hr	no standard	

Note:
1 Data taken from Air Permit # 0495-013
2 Calculated by Harland Bartholomew and Associates, Inc. based on established multiplying factors and data taken from Air Permit # 0495-013
3 Developed by MDNR based on health based standards.

Averaging Time	Multiplying Factor
3 hours	0.9 (+/- 0.1)
8 hours	0.7 (+/- 0.2)
24 hours	0.4 (+/- 0.2)
1 year	0.1 (Engineering Judgement)

Reference: Guidelines for Air Quality Maintenance Planning and Analysis Volume 10 (Revised): Procedures for Evaluating Air Quality Impact of New Stationary Sources

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Air Emission Calculations for Criteria Pollutants from Fog Oil Training

As Discussed in Subsection 5.2.2.3.7

EMISSIONS OF CRITERIA POLLUTANTS FROM OBSCURANT TRAINING (RCP) AT FORT LEONARD WOOD, MISSOURI

(a) Fog Oil Usage Per Year * (gal/yr): ---------->	125,500
(b) Density (lbs/gal):---------->	7.68

Air Pollutants Emitted	Percent Emissions by Weight (c) (%)	Annual Emissions (tons/yr) [1]
Particulate Matter (PM10)	70	337
Volatile Organic Matter (VOCs)	30	145

REFERENCES:

It is assumed that PM10 is 70% of emissions by weight and that VOCs are 30% of emissions by weight.

* Data provided by Fort Leonard Wood

1 (a x b x c/100) / 2000

NOTES:

gal = Gallon; lb = Pound, yr = year

EMISSIONS OF CRITERIA POLLUTANTS FROM OBSCURANT TRAINING (OPTM) AT FORT LEONARD WOOD, MISSOURI

(a) Fog Oil Usage Per Year * (gal/yr): ---------->	84,500
(b) Density (lbs/gal):---------->	7.68

Air Pollutants Emitted	Percent Emissions by Weight (c) (%)	Annual Emissions (tons/yr) [1]
Particulate Matter (PM10)	70	227
Volatile Organic Matter (VOCs)	30	97

REFERENCES:

It is assumed that PM10 is 70% of emissions by weight and that VOCs are 30% of emissions by weight.

* Data provided by Fort Leonard Wood

1 (a x b x c/100) / 2000

NOTES:

gal = Gallon; lb = Pound, yr = year

EMISSIONS OF CRITERIA POLLUTANTS FROM OBSCURANT TRAINING (EPTM) AT FORT LEONARD WOOD, MISSOURI

(a) Fog Oil Usage Per Year * (gal/yr): ---------->	49,500
(b) Density (lbs/gal):---------->	7.68

Air Pollutants Emitted	Percent Emissions by Weight (c) (%)	Annual Emissions (tons/yr) [1]
Particulate Matter (PM10)	70	133
Volatile Organic Matter (VOCs)	30	57

REFERENCES:

It is assumed that PM10 is 70% of emissions by weight and that VOCs are 30% of emissions by weight.

* Data provided by Fort Leonard Wood

1 (a x b x c/100) / 2000

NOTES:

gal = Gallon; lb = Pound, yr = year

Fort Leonard Wood, Missouri

EMISSION CALCULATIONS FOR CRITERIA POLLUTANTS FROM
Fog Oil Diesel Generators (RCP)

Turbine Generators Using Diesel Fuel #2

Source Location: Fog Oil Training Locations

(a) Fuel Sulfur Content Percent (S): ---------->	0.4
(b) Actual Annual Operational Time For All Generators Combined [AAOT]* (hrs/yr): -------->	3,169
(c) Hourly Generator Fuel Rate (gal/hr): ---------->	15.0
(d) Maximum number of generators operating concurrently (#):---------->	20
(e) Annual quantity of fuel used (gal/yr):---------->	47,535
(f) Maximum hourly diesel fuel rate (gal per hour):---------->	300

Air Pollutants Emitted	Emission Factor (lb/1000 gal)	Emission Factor Sources	Actual Emissions	
			Hourly (lbs/hr)	Annually (pounds/yr.)
Nitrogen Oxides (NOx)	67.8	1	20.3	3,223
Sulfur Oxides (SOx)	140 (S)	1	16.8	2,662
Particulate Matter (PM-10)	4.8	1	1.4	228
Volatile Organic Compounds (VOCs)	4.77	1	1.4	227
Carbon Monoxide (CO)	15.4	1	4.6	732

REFERENCES:

1 Emission Factors taken from "Calculation and Compilation Methods for Criteria Air Pollutant Emission Inventories" Jagielski, K.D., Armstrong Laboratory, March, 1994.

* (125,500 gal per year fog oil) / (0.66 gal/min fog oil generator capacity)

Sulfur content taken from AP-42, Fifth Edition, Appendix A (page A-5)

Maximum hourly diesel fuel rate is 20 generators X 15 gallons per hour = 300 gph

NOTES:

Btu = British Thermal Unit; gal = Gallon; lb = Pound; hr = Hour; yr = Year; g = Gram

Fort Leonard Wood, Missouri

EMISSION CALCULATIONS FOR CRITERIA POLLUTANTS FROM Fog Oil Diesel Generators (OPTM)

Turbine Generators Using Diesel Fuel #2

Source Location: Fog Oil Training Locations

(a) Fuel Sulfur Content Percent (S): ---------->	0.4
(b) Actual Annual Operational Time For All Generators Combined [AAOT]* (hrs/yr): -------->	2,134
(c) Hourly Generator Fuel Rate (gal/hr): ---------->	15.0
(d) Maximum number of generators operating concurrently (#):---------->	20
(e) Annual quantity of fuel used (gal/yr):---------->	32,010
(f) Maximum hourly diesel fuel rate (gal per hour):---------->	300

Air Pollutants Emitted	Emission Factor (lb/1000 gal)	Emission Factor Sources	Actual Emissions	
			Hourly (lbs/hr)	Annually (pounds/yr.)
Nitrogen Oxides (NOx)	67.8	1	20.3	2,170
Sulfur Oxides (SOx)	140 (S)	1	16.8	1,793
Particulate Matter (PM-10)	4.8	1	1.4	154
Volatile Organic Compounds (VOCs)	4.77	1	1.4	153
Carbon Monoxide (CO)	15.4	1	4.6	493

REFERENCES:

1 Emission Factors taken from "Calculation and Compilation Methods for Criteria Air Pollutant Emission Inventories" Jagielski, K.D., Armstrong Laboratory, March, 1994.

* (84,500 gal per year fog oil) / (0.66 gal/min fog oil generator capacity)

Sulfur content taken from AP-42, Fifth Edition, Appendix A (page A-5)

Maximum hourly diesel fuel rate is 20 generators X 15 gallons per hour = 300 gph

NOTES:

Btu = British Thermal Unit; gal = Gallon; lb = Pound; hr = Hour; yr = Year; g = Gram

Fort Leonard Wood, Missouri

EMISSION CALCULATIONS FOR CRITERIA POLLUTANTS FROM Fog Oil Diesel Generators (EPTM)

Turbine Generators Using Diesel Fuel #2

Source Location: Fog Oil Training Locations

(a) Fuel Sulfur Content Percent (S): ---------->	0.4
(b) Actual Annual Operational Time For All Generators Combined [AAOT]* (hrs/yr): -------->	1,250
(c) Hourly Generator Fuel Rate (gal/hr): ---------->	15.0
(d) Maximum number of generators operating concurrently (#):---------->	20
(e) Annual quantity of fuel used (gal/yr):---------->	18,750
(f) Maximum hourly diesel fuel rate (gal per hour):---------->	300

Air Pollutants Emitted	Emission Factor (lb/1000 gal)	Emission Factor Sources	Actual Emissions	
			Hourly (lbs/hr)	Annually (pounds/yr.)
Nitrogen Oxides (NOx)	67.8	1	20.3	1,271
Sulfur Oxides (SOx)	140 (S)	1	16.8	1,050
Particulate Matter (PM-10)	4.8	1	1.4	90
Volatile Organic Compounds (VOCs)	4.77	1	1.4	89
Carbon Monoxide (CO)	15.4	1	4.6	289

REFERENCES:

1 Emission Factors taken from "Calculation and Compilation Methods for Criteria Air Pollutant Emission Inventories" Jagielski, K.D., Armstrong Laboratory, March, 1994.

* (49,500 gal per year fog oil) / (0.66 gal/min fog oil generator capacity)

Sulfur content taken from AP-42, Fifth Edition, Appendix A (page A-5)

Maximum hourly diesel fuel rate is 20 generators X 15 gallons per hour = 300 gph

NOTES:

Btu = British Thermal Unit; gal = Gallon; lb = Pound; hr = Hour; yr = Year; g = Gram

Explosives Requirements Used In Conjunction With Fog Oil Training

Type of Ammunition or Explosive	BRAC requirements	Active Ingredient	Quantity of Active Ingredient	Release Efficiency (%)	Time	Particulate Emissions (lbs/yr)	Maximum Emission Rate (lbs/hr)	Source Type (area,point etc.)	Location	Remarks
Smoke Grenades	0					0	0			Smoke grenades will NOT be used in conjunction with fog oil training
Smoke pot M8, TPA	840	terephthalic acid	13.5 lbs	80	3 min	9,072	13.5 lbs/hr X 0.8 X 24 pots = 260 lbs/hr	point	fog oil training sites	
Notes: Assume particulate emissions = quantity of active ingredient X release efficieny										

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Air Emission Calculations for Criteria Pollutants Unpaved Road Emissions During Training

As Discussed in Subsections 5.2.2.3.7 and 5.2.2.3.8

Fort Leonard Wood EIS
EMISSION CALCULATIONS FOR CRITERIA POLLUTANTS
Unpaved Road Emissions During Training

School	Vehicle Type	k	s (%)	S (mph)	W (tons)	w	p	Emission Factor (lb/VMT)	Maximum Miles Driven Per Hour	Maximum Hourly Emissions (lbs/hr)	Annual Vehicle Miles Traveled (VMT)	PM10 Emissions (lbs/yr)
MP School (Field Training Exercise)												
	HMMWV	0.36	5.1	15.0	4.1	4	110	0.392	800	313.917	153,600	60,272
MP School (Tactical Vehicle Training)												
	HMMWV	0.36	5.1	15.0	4.1	4	110	0.392	22	8.633	4,224	1,657
Chem School (Driver Training)												
	FOX	0.36	5.1	14.0	19.6	6	110	1.341	84	112.646	1,200	1,609
Chem School (FTX)												
	FOX	0.36	5.1	14.0	19.6	6	110	1.341	84	112.646	1,200	1,609
Chem School (Fog Oil Training)												
	OBC											
	Smk Block (tracked)	0.36	8.9	7.0	13.0	8	110	1.014	15	15.204	629	638
	FTX (wheel)	0.36	8.9	7.0	4.4	4	110	0.337	30	10.121	1,258	424
	OSUT											
	Smk Block (tracked)	0.36	8.9	7.0	13.0	8	110	1.014	10	10.136	1,127	1,142
	FTX (wheel)	0.36	8.9	7.0	4.4	4	110	0.337	20	6.747	2,253	760
	ANCOC											
	Smk Block (wheeled)	0.36	8.9	7.0	4.4	4	110	0.337	1	0.337	24	8
	FTX (wheel)	0.36	8.9	7.0	4.4	4	110	0.337	20	6.747	472	159
	BNCOC/BNCOC-R											
	Smk Block (tracked)	0.36	8.9	7.0	13.0	8	110	1.014	15	15.204	1,395	1,414
	FTX (wheel)	0.36	8.9	7.0	4.4	4	110	0.337	20	6.747	1,860	627
	Driver Training (OSUT)											
	Smk Block (tracked)	0.36	8.9	7.0	13.0	8	110	1.014	10	10.136	4,128	4,184
	FTX (wheel)	0.36	8.9	7.0	4.4	4	110	0.337	10	3.374	4,128	1,393
	Driver Training (OBC)											
	Smk Block (tracked)	0.36	8.9	7.0	13.0	8	110	1.014			210	213
	FTX (wheel)	0.36	8.9	7.0	4.4	4	110	0.337			210	71
	Driver Training (OSUT-Reserves)											
	Smk Block (tracked)	0.36	8.9	7.0	13.0	8	110	1.014			230	233
	FTX (wheel)	0.36	8.9	7.0	4.4	4	110	0.337			230	78
11th Chemical Company												
	Truck CGO: 1/2 ton, 6X6	0.36	8.9	7.0	2.9	6	110	0.308			320	98
	Truck CGO: 2 1/2 ton, 6X6	0.36	8.9	7.0	6.8	6	110	0.557			160	89
	Truck CGO: 5 ton, 6X6	0.36	8.9	7.0	11.0	6	110	0.781			2,240	1,750
	Truck CGO: 5 ton, 6X6	0.36	8.9	7.0	11.0	6	110	0.781			1,920	1,500
	Truck Cargo: 4X4, LMTV	0.36	8.9	7.0	2.6	4	110	0.235			5,440	1,277
	Truck Cargo: 4X4, LMTV	0.36	8.9	7.0	2.6	4	110	0.235			320	75
	Truck Cargo: MTV	0.36	8.9	7.0	2.6	4	110	0.235			5,120	1,202
	Truck Utility Cargo	0.36	8.9	7.0	2.6	6	110	0.288			4,800	1,380
	HMMWV, 1 1/4 Ton, 4X4	0.36	8.9	7.0	2.6	4	110	0.235			2,240	526
	HMMWV, 5 Ton GVW, 4X4	0.36	8.9	7.0	2.6	4	110	0.235			9,600	2,254
	Truck Wrecker: MTV	0.36	8.9	7.0	10.5	6	110	0.755			160	121
	Truck Wrecker: 5 ton, 6X6	0.36	8.9	7.0	10.5	6	110	0.755			160	121

Total (lbs/yr) =	86,887.9
Total (tons/yr) =	43.4

Formula:
$E = k(5.9)*(s/12)*(S/30)*((W/3)^{0.7})*((w/4)^{0.5})*((365-p)/365)$

E = emission factor (pounds particulate emissions/VMT)
k = particle size multiplier (dimensionless)
s = silt content of road surface material (%)
S = mean vehicle speed (mph)
W = mean vehicle weight (tons)
w = mean number of wheels on vehicle
p = number of days with at least 0.01 in of precipitation per year

References:
All Vehicle Information, Miles Traveled Etc. Obtained From Fort Leonard Wood
Assume tracked vehicles are similar to eight wheeled vehicles
Emission Factor Is Calculated From AP-42, Fifth Edition, Section 13.2.2
Silt Content (%) Is Taken From AP-42, Fifth Edition, Table 13.2.2-1
Number of days of precipitation is taken from AP-42, Fifth Edition, Figure 13.2.2-1
Aerodynamic Particle Size Multiplier (k) Taken From AP-42, Fifth Edition, Section 13.2.2

Air Emission Calculations for Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

As Discussed in Subsection 5.3.2.3.2

ENERGY REQUIREMENTS

Miscellaneous Buildings

Fort Leonard Wood, MO

REQUIRED INPUTS AND ASSUMPTIONS

112.00	HR	WEEK (7 DAYS AT 16 HOURS/DAY)
0.00	GAL/DAY/PN	WATER USAGE
0.00	PN	ASSIGNED TO THE BUILDING
365.00	DAYS/YEAR	BUILDING USAGE
7.6500		ELECTRICAL USAGE FACTOR

BUILDING DATA

BUILDING AREA	850,542	SF
Building Volume (9 FT ceilings)	7,654,878	CF
Parking/Walks Surface	0.00	SY
Roads Surface	0.00	SY
Roads/Parking Gravel	0.00	SY
Improved Grounds	0.00	SF
Unimproved Grounds	0.00	SF

ENERGY CONSUMPTION INFORMATION

Heating Day Units		127,581	HDU
HEATING MBTU/YR		40,745	MBTU/YR
Heating Plant Size		25.52	MBTU/HR
Gas Distribution		40	KSF
AIR CONDITIONING	Tons =	1,308.53	TONS
	KW =	4,602.09	KW
	KWH/YEAR =	11,339,541.09	KWH/YR
WATER SERVICE		0.00	KGAL/YR
Sewage Service		0.00	KGAL/YR
ELECTRIC SERVICE			
Interior Electical		6,506,646.30	KWH/YR
Parking/Road Lighting		0.00	WATTS
(.6 fc or 0.016 watts/SF)			
or		0.00	KWH/YR
TOTAL ELECTRICAL DEMAND		**17,846,187.39**	**KWH/YR**
Air Conditioning		11,339,541.09	KWH/YR
Interior Electrical		6,506,646.30	KWH/YR
Exterior Electrical		0.00	KWH/YR

Increased Utility Requirements For Combined Headquarters and Instruction

Title	Fuel Oil (DF2) Requirement (Million Btu/year)
Underutilized On-Post Facilities	40,745
General Officer Quarters	0
MOUT Facility	0
Chemical Defense Training Facility	0
General Instruction Facility	0
Applied Instruction Facility	0
Unaccompanied Personnel Housing	0
Range Modifications	0
Convert Housing	0
Total Installation =	40,745
Total Fuel Input (gal/yr) =	297,409

1) Calculated by Harland Bartholomew and Associates, Inc.
2) Assumed 137,000 Btu/gal, AP-42, Fifth Edition, Appendix A

Increased Utility Requirements For Combined Headquarters and Instruction

Title	Natural Gas Requirement	
	(Million Btu/year)	(mmcf/yr)
Underutilized On-Post Facilities	0	0.000
General Officer Quarters	240	0.229
MOUT Facility	280	0.267
Chemical Defense Training Facility	13,138	12.512
General Instruction Facility	18,534	17.652
Applied Instruction Facility	15,851	15.096
Unaccompanied Personnel Housing	17,032	16.221
Range Modifications	1,949	1.856
Convert Housing	12,481	11.887
Total Installation =	79,505	
Total Fuel Input (mmcf/yr) =		75.719

1) Data taken from DD Form 1391 (HBA, 1995)
2) Assumed 1,050 Btu/cf, AP-42, Fifth Edition, Appendix A

Emission Factors

for Industrial, Institutional, and Commercial Boilers and Steam Generators

Fuel Type		NG	NG	NG
Boiler Design Capacity[1]		*Large*	*Medium*	*Small*
Pollutant	EF Ref.	EF (lbs / mm Btu)		
Nitrogen Dioxide (NO_2)	2,3,4	0.13333	0.09524	0.08952
Sulfur Dioxide (SO_2)	2,3,4	0.00057	0.00057	0.00057
Particulate Matter (PM10)	2,3,4	0.01305	0.01143	0.01065
VOC	2,3,4	0.00267	0.00503	0.00691
Carbon Monoxide (CO)	2,3,4	0.03333	0.02000	0.03810

	NG-Large	NG-Medium	NG-Small
	lb/mmcf	lb/mmcf	lb/mmcf
NO_2	140	100	94
SO_2	0.6	0.6	0.6
PM10	13.7	12	11.18
VOC	2.80	5.28	7.26
CO	35	21	40

1 Small: design heat input capacity less than 0.3 mmBtu/hr.
Medium: design heat input capacity between 0.3 and 10 mmBtu/hr
Large: design heat input capacity between 10 and 100 mmBtu/hr

2 AP-42, Fifth Edition, Table 1.4-1

3 AP-42, Fifth Edition, Table 1.4-2

4 AP-42, Fifth Edition, Table 1.4-3

Heating Values:			
	Natural Gas	1,050	Btu/cf, AP-42, Fifth Edition, Appendix A
	Diesel Fuel	137,000	Btu/gal, AP-42, Fifth Edition, Appendix A

SUM TOTAL OF EMISSION FROM IDENTICAL

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Diesel Fuel With .3 - 10 mmBtu/hr Heat Input Design Capacity

Prepared By: **Checked By:**

Source ID:
No. of Identical Units (IU): 1
Source Location: This is the existing power plant, thus the potential to emit does not increase due to BRAC

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 0.000
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Diesel Fuel
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 0.000
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (Gal/yr):----------> 297,409

Air Pollutants Emitted	Emission Factors (EF) ($lb/10^6Btu$)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.1460	1.77E+00	2.97E+00	0.00E+00	0.00E+00
Sulfur Dioxide (SO_2)	0.5182	6.28E+00	1.06E+01	0.00E+00	0.00E+00
Particulate Matter (PM10)	0.0079	9.56E-02	1.61E-01	0.00E+00	0.00E+00
VOC	0.0025	3.01E-02	5.06E-02	0.00E+00	0.00E+00
Carbon Monoxide (CO)	0.0365	4.43E-01	7.44E-01	0.00E+00	0.00E+00

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : (EF x (e) x D.F. Btu rating per gallon) / (2,000 x 1,000,000)
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSION FROM IDENTICAL

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters
Natural Gas With less than 0.3 mmBtu/hr Heat Input Design Capacity

Prepared By: **Checked By:**

Source ID: General Officer Quarters
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 0.040
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 0.040
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 0.229

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.08952	6.40E-03	1.07E-02	3.58E-03	1.57E-02
Sulfur Dioxide (SO_2)	0.00057	4.08E-05	6.86E-05	2.29E-05	1.00E-04
Particulate Matter (PM10)	0.01065	7.61E-04	1.28E-03	4.26E-04	1.87E-03
VOC	0.00691	4.94E-04	8.30E-04	2.77E-04	1.21E-03
Carbon Monoxide (CO)	0.03810	2.72E-03	4.57E-03	1.52E-03	6.67E-03

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: MOUT Facility
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ----------	0.040
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ---------->	Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ---------->	0.040
(d) Boiler/Generator/Heater/Furnace Type: ---------->	Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):---------->	0.267

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.08952	7.46E-03	1.25E-02	3.58E-03	1.57E-02
Sulfur Dioxide (SO_2)	0.00057	4.76E-05	8.00E-05	2.29E-05	1.00E-04
Particulate Matter (PM10)	0.01065	8.87E-04	1.49E-03	4.26E-04	1.87E-03
VOC	0.00691	5.76E-04	9.68E-04	2.77E-04	1.21E-03
Carbon Monoxide (CO)	0.03810	3.17E-03	5.33E-03	1.52E-03	6.67E-03

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: Chemical Defense Training Facility
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 5.250
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 5.250
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 12.512

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.09524	3.72E-01	6.26E-01	5.00E-01	2.19E+00
Sulfur Dioxide (SO_2)	0.00057	2.23E-03	3.75E-03	3.00E-03	1.31E-02
Particulate Matter (PM10)	0.01143	4.47E-02	7.51E-02	6.00E-02	2.63E-01
VOC	0.00503	1.97E-02	3.30E-02	2.64E-02	1.16E-01
Carbon Monoxide (CO)	0.02000	7.82E-02	1.31E-01	1.05E-01	4.60E-01

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: General Instruction Facility
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 6.600
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 6.600
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 17.652

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.09524	5.25E-01	8.83E-01	6.29E-01	2.75E+00
Sulfur Dioxide (SO_2)	0.00057	3.15E-03	5.30E-03	3.77E-03	1.65E-02
Particulate Matter (PM10)	0.01143	6.30E-02	1.06E-01	7.54E-02	3.30E-01
VOC	0.00503	2.77E-02	4.66E-02	3.32E-02	1.45E-01
Carbon Monoxide (CO)	0.02000	1.10E-01	1.85E-01	1.32E-01	5.78E-01

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: Applied Instruction Facility
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 5.000
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 5.000
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 15.096

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.09524	4.49E-01	7.55E-01	4.76E-01	2.09E+00
Sulfur Dioxide (SO_2)	0.00057	2.70E-03	4.53E-03	2.86E-03	1.25E-02
Particulate Matter (PM10)	0.01143	5.39E-02	9.06E-02	5.71E-02	2.50E-01
VOC	0.00503	2.37E-02	3.99E-02	2.51E-02	1.10E-01
Carbon Monoxide (CO)	0.02000	9.43E-02	1.59E-01	1.00E-01	4.38E-01

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: Range Modifications
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 0.200
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 0.200
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 1.856

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.08952	5.19E-02	8.72E-02	1.79E-02	7.84E-02
Sulfur Dioxide (SO_2)	0.00057	3.31E-04	5.57E-04	1.14E-04	5.01E-04
Particulate Matter (PM10)	0.01065	6.18E-03	1.04E-02	2.13E-03	9.33E-03
VOC	0.00691	4.01E-03	6.74E-03	1.38E-03	6.06E-03
Carbon Monoxide (CO)	0.03810	2.21E-02	3.71E-02	7.62E-03	3.34E-02

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: Convert Housing
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 4.000
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 4.000
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 11.887

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.09524	3.54E-01	5.94E-01	3.81E-01	1.67E+00
Sulfur Dioxide (SO_2)	0.00057	2.12E-03	3.57E-03	2.29E-03	1.00E-02
Particulate Matter (PM10)	0.01143	4.25E-02	7.13E-02	4.57E-02	2.00E-01
VOC	0.00503	1.87E-02	3.14E-02	2.01E-02	8.81E-02
Carbon Monoxide (CO)	0.02000	7.43E-02	1.25E-01	8.00E-02	3.50E-01

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: Unaccompanied Personnel Housing (a)
No. of Identical Units (IU): 30
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 0.300
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 9.000
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 12.891

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.09524	3.84E-01	6.45E-01	8.57E-01	3.75E+00
Sulfur Dioxide (SO_2)	0.00057	2.30E-03	3.87E-03	5.14E-03	2.25E-02
Particulate Matter (PM10)	0.01143	4.60E-02	7.73E-02	1.03E-01	4.51E-01
VOC	0.00503	2.03E-02	3.40E-02	4.53E-02	1.98E-01
Carbon Monoxide (CO)	0.02000	8.06E-02	1.35E-01	1.80E-01	7.88E-01

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: Unaccompanied Personnel Housing (b)
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ----------	1.800
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ---------->	Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ---------->	1.800
(d) Boiler/Generator/Heater/Furnace Type: ---------->	Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):---------->	2.578

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.09524	7.67E-02	1.29E-01	1.71E-01	7.51E-01
Sulfur Dioxide (SO_2)	0.00057	4.60E-04	7.73E-04	1.03E-03	4.51E-03
Particulate Matter (PM10)	0.01143	9.21E-03	1.55E-02	2.06E-02	9.01E-02
VOC	0.00503	4.05E-03	6.81E-03	9.05E-03	3.96E-02
Carbon Monoxide (CO)	0.02000	1.61E-02	2.71E-02	3.60E-02	1.58E-01

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS FROM NATURAL GAS INPUTS

Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

Prepared By: **Checked By:**

Source ID: Unaccompanied Personnel Housing (c)
No. of Identical Units (IU): 1
Source Location: FLW

(a) HI = Design Heat Input Rate per Unit (mmBtu/hr): ---------- 0.525
(b) Type of Fuel Burned (Natural Gas, Propane, Diesel Fuel, or NG/DF-Dual Fuel): ----------> Natural Gas
(c) TH = Total Design Heat Input Rate of All Units, IU x HI, (mmBtu/hr): ----------> 0.525
(d) Boiler/Generator/Heater/Furnace Type: ----------> Boiler
(e) Actual Annual Fuel Consumption (AAFC) (mmcf/yr):----------> 0.752

Air Pollutants Emitted	Emission Factors (EF) (lb/mmBtu)	Actual Emission		Potential To Emit	
		Hourly[1] (lb/hr)	Annually[2] (ton/yr)	Hourly[3] (lb/hr)	Annually[4] (ton/yr)
Nitrogen Dioxide (NO_2)	0.09524	2.24E-02	3.76E-02	5.00E-02	2.19E-01
Sulfur Dioxide (SO_2)	0.00057	1.34E-04	2.26E-04	3.00E-04	1.31E-03
Particulate Matter (PM10)	0.01143	2.69E-03	4.51E-03	6.00E-03	2.63E-02
VOC	0.00503	1.18E-03	1.99E-03	2.64E-03	1.16E-02
Carbon Monoxide (CO)	0.02000	4.70E-03	7.90E-03	1.05E-02	4.60E-02

REFERENCES:

1 : 1994 Annual Emission x 2000 / 3360 (Assumes 24 hours per day for 5 months operation per year)
2 : EF x (e) x N.G. Btu rating per cubic foot / 2000
3 : EF x (c)
4 : Potential hourly emissions x 8760 / 2000

SUM TOTAL OF EMISSIONS
FROM DIESEL FUEL INPUTS
FOR ALL BOILERS

Air Pollutants Emitted	Actual Emissions (ton/yr)	Potential Emissions (ton/yr)
Nitrogen Dioxide (NO_2)	2.97E+00	0.00E+00
Sulfur Dioxide (SO_2)	1.06E+01	0.00E+00
Particulate Matter (PM10)	1.61E-01	0.00E+00
VOC	5.06E-02	0.00E+00
Carbon Monoxide (CO)	7.44E-01	0.00E+00

SUM TOTAL OF EMISSIONS
FROM NATURAL GAS INPUTS
FOR ALL BOILERS

Air Pollutants Emitted	Actual Emissions (ton/yr)	Potential Emissions (ton/yr)
Nitrogen Dioxide (NO_2)	3.78E+00	1.35E+01
Sulfur Dioxide (SO_2)	2.27E-02	8.12E-02
Particulate Matter (PM10)	4.53E-01	1.62E+00
VOC	2.02E-01	7.17E-01
Carbon Monoxide (CO)	8.17E-01	2.87E+00

Air Emissions Calculations for Fuel Dispensing Operations

As Discussed in Subsection 5.4.2.3.2

VOC Emissions
From Tank And Refueling Sources At Gas Station

Assume an aboveground storage tank (AST) storing gasoline
All ASTs on FLW have Stage I and Stage II vapor recovery system

Annual VOC emissions calculated using the following equations:
(Reference: California Air Resources Board Memo Dated 30 January 1996)

Systems are inspected daily, so use 92% overall efficiency

Total Annual VOC Emissions From Tanks And Refueling

Emission Point	Emission Factor With Controls (lbs vapor/1000 gal dispensed)	Throughput (gal/yr)	VOC Emissions (lbs/yr)	VOC Emissions (tons/yr)
Loading	0.42	212,766	89.36	0.04
Breathing	0.63	212,766	134.04	0.07
Refueling	0.67	212,766	142.55	0.07
Spillage	0.42	212,766	89.36	0.04
Total	2.14	212,766	455.32	0.23

VOC Emissions
From Refueling Operations At Gas Station

Assume an aboveground storage tanks (AST) storing diesel fuel

Assume no vapor recovery system

Annual VOC emissions calculated using the following equations:

(Reference: USEPA, AP-42, 5th ed., p. 5.2-4, see p. 5.2-16 for Stage II efficiency)

Saturation Factor (S) =	1.45	(splash)
True Vapor Pressure, psia (P) =	0.0071	(diesel)
Mol. Wt. of Vapor, lb/lb-mol (M) =	130.0	
Bulk Liquid Temperature, °R (T) =	520.62	
Stage II Efficiency (eff) =	0%	

$ER_{VOC} = L_L \times V$ in lbs VOC/yr

$L_L = (12.46\ SPM / T) = (12.46)(1.45)(0.0071)(130.0)/(520.62) =$ 0.032 lbs/1000 gal

Controlled VOC Emissions = $ER_C = (ER_{UN}) \times (1\text{-eff}) = (ER_{UN}) \times (1 - 0.00) =$ 0.0320 lbs/1000 gal

Total Annual VOC Emissions From Dispensing

	Annual Throughput, V (gal/yr)	VOC Emissions (lbs/yr)	VOC Emissions (tpy)
	814,733	26.10	1.30E-02
TOTALS:	**814,733**	**26.10**	**1.30E-02**

Summary Of Criteria And Hazardous Air Pollutant Emissions From Fuel Dispensing Operations

Air Pollutant	CAS #	Gasoline Fuel, Tank & Refueling (tpy)	Diesel Fuel, Refueling (tpy)	Actual Emissions (tons/yr)
Nitrogen Oxides	0102440			
Sulfur Oxides	7446095			
Particulate Matter				
Total VOCs		2.28E-01	1.30E-02	0.24
Carbon Monoxide	630080			

CUMULATIVE ANALYSIS SUMMARY

WORLDWIDE SERVICES
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February 6, 1997

Mr. Alan Gehrt
U.S. Army Corp of Engineers
Kansas City District
601 East 12th Street
Kansas City, MO 64106-2896

USFLWPR
Summary of Modeling Results for EIS
94-800-4-032

Dear Mr. Gehrt,

This letter addresses air quality comments on the October, 1996 Draft Environmental Impact Statement (DEIS) for the U.S. Army's Base Realignment and Closure (BRAC) action to relocate the U.S. Army's Military Police School and Chemical School from Fort McClellan, Alabama, to Fort Leonard Wood, Missouri. Public comments on the draft EIS identified two air quality questions that should be addressed in the final EIS. One of the comments concerned the cumulative impacts of all new and existing particulate matter sources. The other comment was to document the fog oil impacts for the three EIS alternatives (RCP, OPTM, and EPTM).

The purpose of this letter and attachments is to provide the Kansas City Corps of Engineers, Fort Leonard Wood and Harland, Bartholomew & Associates (HBA) with the quantified particulate matter 10 microns or less diameter (PM-10) impacts from new BRAC sources (RCP, OPTM, EPTM and mitigation option (existing fog oil permit)) and, cumulative PM-10 24 hour and annual impacts (existing sources, BRAC sources including fog oil, FFE, driver training, etc.).

SUMMARY

Burns & McDonnell used HBA's Final EIS PM-10 emission sources and emissions rates to conduct air dispersion modeling to predict impacts from the proposed BRAC action. Training durations and descriptions were also obtained from HBA (through the Army's Chemical and Military Police Schools). Potential particulate matter source impacts were predicted by using a conservative, EPA-approved air dispersion model. Burns & McDonnell used the Industrial Source Complex Short Term air dispersion model

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(ISCST3) version 96113. The ISCST3 model was used in the original June 1995 air permit for smoke training. Five years of actual meteorological data (1987 to 1991) were used for the cumulative impacts analysis as directed by MDNR. The surface data was from Springfield, MO; the upper air data was from Monet, MO. The details of the modeling inputs and methodologies are included in the next sections.

Three sets of additional modeling runs were performed in response to the draft EIS comments. The first set of modeling runs determined PM-10 impacts from OPTM BRAC cumulative sources (all proposed activities except fog oil). The second set of modeling runs determined PM-10 impacts from the fog oil RCP, OPTM and EPTM options. The third modeling effort determined the PM-10 cumulative impacts (existing sources, OPTM BRAC cumulative sources and currently permitted fog oil training).

Using the modeling inputs described in Tables 1, 2 and 3 and the assumptions described under section **II. DERIVATION OF EMISSION PARAMETERS** of this letter, the maximum BRAC cumulative impacts were determined for a five year period. The highest 24 hour PM-10 concentration, 32 micrograms/cubic meter occurred, in 1990 and 1991. The highest annual impact, 8 micrograms/cubic meter, was predicted to occur in 1990. In 1990, all the contributions at the highest receptor point were from unpaved road dust from MP School training (HMMWV tactical and field training) and FOX driver training. In 1991, most of the contributions at the highest receptor point were from the FFE training. A small portion of the maximum impacts were from unpaved road emissions. Table 4 shows the breakout of BRAC cumulative impacts.

The second set of modeling runs performed determined the PM-10 impacts from the fog oil training RCP, OPTM and EPTM alternatives. The modeling runs used PM-10 emissions from fog oil, smoke pots, unpaved road emissions from smoke training vehicles and the exhaust emissions from operation of the smoke generators (diesel). The impacts were modeled assuming the fog oil training had the same meteorological restrictions as in the current air permit. Impacts at each training site by stability class are shown in Table 5. The worst case fog oil RCP, OPTM and EPTM impacts are shown in Table 6. The maximum 24 hour second highest high occurs at Ballard Hollow. Under the RCP, the 24 hour impact was 196 micrograms/cubic meter, and 129 micrograms/cubic meter for the OPTM and EPTM. The maximum annual impacts were also predicted to occur at Ballard Hollow. The predicted annual impacts were 35 micrograms/cubic meter for the RCP, 25 micrograms/cubic meter for the OPTM and 15 micrograms/cubic meter for the EPTM.

The third set of modeling runs determined whether or not the combined BRAC actions including fog oil training (fog oil, unpaved roads , smoke pots and generator exhaust emissions), FFE training, unpaved road dust from training, etc. combined with existing on and off post source emissions meet the 24 hour and annual PM-10 NAAQS. The results of the first set of BRAC cumulative modeling runs (Table 4) were added to the existing source impacts, 24 hour PM-10 background concentration (39 micrograms/cubic meter), and PSD increment (fog oil training) at each receptor point and date for a five year meteorological period. The cumulative impacts were compared to the 24 hour and annual NAAQS. For the 24 hour PM-10 standard, the 2nd highest high concentration was predicted to be 147 micrograms/cubic meter (Table 9). The 24 hour NAAQS is 150 micrograms/cubic meter. The highest annual PM-10 impact was predicted to be 31 micrograms/cubic meter (Table 10). The PM-10 annual standard is 50 micrograms/cubic meter. The results of the modeling indicate that the total proposed BRAC actions (fog oil training, FFE, MP School, FOX, etc.) will not cause or contribute to a NAAQS exceedence.

I. WHY THE ISCST3 AIR DISPERSION MODEL WAS USED

The ISCST3 model was used to predict the potential particulate matter emissions impacts for three reasons:

1) The ISCST3 model was used to obtain the air permit for the fog oil training (Missouri Department of Natural Resources permit number 0695-010). The model input parameters, locations of receptors, and terrain elevations are identical to the permit modeling.

2) The ISCST3 is EPA approved. The model is a Gaussian based, steady-state model and is the "workhorse" model for most industrial sources. It can account for point, area, and volume sources of pollutants, plume rise, and elevated terrain. The ISCST3 can calculate concentrations averaged over 1, 3, 8, and 24 hour periods, or annually.

3) The ISCST3 is a conservative model. It calculates concentrations of pollutants that are "worst case" given the emissions parameters and meteorological conditions. The ISCST3 assumes that the wind direction and wind speed does not vary for one hour, no pollutant settles out of the plume, all sources operate simultaneously, the plume is not

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affected by terrain or vegetation, the plume is non-reactive and that mixing heights[1] are lower for rural environments, than for urban.

II. DERIVATION OF BRAC EMISSION PARAMETERS

The unorthodox nature of the emission sources from the MP School and Chemical School required a number of assumptions in determining the emission parameters used in the modeling.

The ISCST3 is used primarily for industrial sources like power plants, or boilers, or any industry with point source emissions. The ISCST3's area and volume source capability is designed more toward sources with little or no vertical projection of its emissions, such as lagoons, or slag piles. Some of the sources of particulate matter at Fort Leonard Wood are area and volume sources in nature, but also have a prominent vertical dimension to their emissions. For example, the FFE training involves the explosion of petroleum products which distribute particulate matter into the air. The FFE emissions occur over a large area and the plume is buoyant. The ISCST3 has no direct algorithms to account for buoyancy in a volume source. Therefore, in order to approximate the emissions from the area and volume sources at Fort Leonard Wood, a few assumptions had to be made. These assumptions are listed below in the derivation of emission parameters.

Area sources were given an initial vertical dimension. Burns & McDonnell assumed that the unpaved road dust from vehicles were area sources, since the driving took place over a large area. The unpaved road emissions are entrained in the wake of the vehicle and mixed upward above the vehicle height. In order to approximate this effect, the area source was given an initial release height equivalent to the height of the vehicle.

In addition, the area sources were assumed to emit pollutants evenly over their entire surface area. Even though the vehicle dust modeled are confined to unpaved roads, the dust created by vehicles flows and disperses over the entire area creating the effect of dust coming from a large area source.

Volume sources were given an initial vertical and horizontal dimension. Burns & McDonnell assumed that the FFE, smoke grenades, smoke pots, and the fog oil

---

[1]The mixing height is the height above ground through which vigorous mixing of the atmosphere occurs. It is often called the inversion height.

generators were all volume sources, since each of the sources had both an initial horizontal and vertical dimension to their particulate matter emissions. The ISCST3 assumes that emissions of particulate matter from a volume source begin as a "cube." In order to better approximate the vertical motion of the pollutant, a larger "cube" needed to be used. The EPA allows a series of adjacent volume sources to approximate a larger volume source. To determine an equivalent initial horizontal dimension, the EPA recommends dividing the lateral dimension by 2.15. So, for each volume source modeled, the lateral dimension was divided by 2.15.

The CDTF which contains, a conventional boiler, was modeled as a point source. Also, the emissions from the diesel fuel used to power the smoke generator was modeled as a point source.

HBA calculated PM-10 emissions estimate which are included in the Air Quality Technical Reference Document. The following source-specific assumptions were used in the model:

1. FFE (labeled as FFEV1 in modeling runs)
   a) PM-10 emissions are 305 lbs/training exercise x 453.6 g/lb = 38.43 g/s,
   b) Assume area for FFE training is 750' x 500' (228.7m x 152.4 m). If training area diagonal is used instead of the "cube" side, the FFE has an initial lateral dimension (diagonal divided by 2.15 per EPA guidance - σ_y) of 127.8 m,
   c) FFE is a buoyant source, with a release height of 18 meters,
   d) Training exercise lasts no more than one hour and only one training event per day maximum, 41 training events in a year.

2. HMMWV-Field Training Exercise (ROADS1A, 1B and 1C in modeling runs)
   a) 313.6 lbs/hr total PM-10 emissions rate for ROADS1A, 1B and 1C,
   b) MP training occurs over the entire installation whose training area is approximately 9.7×10^7 m^2,
   c) MP training was divided into three area sources (ROADS1A,1B and 1C) over installation,
   d) Emissions conversion from lb/hr to g/s/m^2 is:
      313.6 lb/hr x 453.6 g/lb x 1/3600 hr/s = 39.5 g/s (total)
      39.5 g/s / 9.7×10^7 m^2 = 4.07×10^{-7} g/s/m^2 (total)
   e) ROADS1A area is 4 x 4 km, PM-10 emissions are 4.07×10^{-7} g/s/m^2
   f) ROADS1B area is 10 x 6 km, PM-10 emissions are 4.07×10^{-7} g/s/m^2

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g) ROADS1C area is 3 x 7 km, PM-10 emissions are 4.07×10^{-7} g/s/m^2
h) Assume training event lasts one hour or less, one training event per day, 192 training events in a year,
I) Assume a 2 meter release height.

3. HMMWV-Tactical Vehicle Training (ROADS2A, 2B AND 2C)
   a) Same assumptions as HMMWV-Field Exercise except total PM-10 emissions rate is 1.08 g/s,
   b) The area's PM-10 emissions rate is 1.08 g/s / 9.7×10^7 m^2 = 1.1×10^{-8} g/s/ m^2,
   c) Assume training event lasts one hour or less, one training event per day, 192 training events in a year,
   d) Assume a 2 meter release height.

4. FOX - Driver Training (ROADS3)
   a) PM-10 emissions rate is 112.646 lbs/hr,
   b) Assume training area of 1.6×10^7 m^2,
   c) Assume release height of about 2 meters,
   d) Assume PM-10 emission rate as:
      112.646 lbs/hr x 453.6 g/lb x 1/3600 hr/s = 14.19 g/s
      14.19 g/s / 1.6×10^7 m^2 = 8.9×10^{-7} g/s/m^2,
   e) Assume training for one hour, once per day,14 training events in a year.

5. FOX - FTX (ROADS4)
   a) Same assumptions as FOX Driver Training except in a different location.

6. CDTF (CDTF)
   a) PM-10 emissions from the boilers and standby generator are included (1 ton/year) and hourly emissions were determined by dividing 1 ton by 8760 hours/year,
   b) Emissions all exit through one 32 foot stack,
   c) No downwash was used.

7. DRIVING EXERCISES FOR SMOKE TRAINING (DTBAIL, DTBAL, DTMUG, DTMUS)
   a) Assume driver training for fog oil generator HMMWV vehicles occurs once/day at each smoke training site, 100 days/year,
   b) Assume OSUT and OBC occur together on one day,

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c) Unpaved road emissions were assumed to occur over a 1000 meter by 1000 meter area,
d) Total PM-10 emissions per training event are 10 lbs.

8. SMOKE TRAINING VEHICLE DUST (VD)
a) Used the same assumptions as the smoke driver training except training occurs over a 360 meter by 50 meter area and the total PM-10 emissions per training event is 30.4 lbs.

9. SMOKE POTS (POTS)
a) Assume 24 pots per smoke training event,
b) Assume smoke pots are volume sources,
c) Assume 1 meter release height, 4.8 meter initial lateral dimension for all 24 smoke pots.
d) Assuming 24 smoke pots are used a day, the total annual days used are 35.

10. SMOKE GRENADES (GRENAD)
a) Assume equal usage of grenades (24 grenades/day) at each of the 22 grenade sites,
b) Model only the nearest upwind site from the highest concentration to determine relative impacts to highest concentration,
c) Model smoke grenades as volume sources with 2 meter release height, 2 meter initial lateral dimension, 4 meter vertical dimension for all the grenades at one site collectively.
d) Assuming the maximum daily usage, grenades are used about 30 days/year.

11. SMOKE GENERATOR (GENERA)
a) PM-10 emissions from smoke generator (diesel) are 1.4 lb/hr for each generator,
b) Assume 12 generators for OPTM/EPTM, 19 generators for RCP,
c) Model smoke generator emissions as a point source with stack height 2.4 meters, 45 meters/second, 650 degrees Kelvin, and .17 meter diameter stack.

12. FOG OIL TRAINING SITES (BAIL, BAL, MUS, MUG)
a) Use same coordinates as fog oil air permit, except use 19 generators for the RCP with each generator 20 meters apart,

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b) Model each site using meteorological restrictions in the fog oil air permit.

III. MODELING INPUTS FOR BRAC CUMULATIVE ANALYSIS

The location of the potential BRAC sources emitting particulate matter emissions are depicted in Figure 1 along with the location of the four fog oil smoke training sites.

Tables 1, 2 and 3 show the PM-10 emission sources used in the BRAC cumulative modeling demonstration and the BRAC cumulative modeling input parameters. Table 1 shows point source inputs, Table 2 shows area source inputs and Table 3 shows volume source inputs.

Table 1
Point Source Inputs

Source	UTME (km)	UTMN (km)	Stack Ht. (M)	Stack Vel (m/s)	Stack Temp. (K)	Stack Dia. (M)	PM-10 Emissions Rate (g/s)
CDTF	575.0	4177.0	9.76	18.29	355	0.36	0.029
GENERA	572.0	4170.0	2.44	45	650	0.17(optm) 0.22(rcp)	2.16(optm) 3.42 (rcp)

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Table 2 Area Source Inputs						
Source	**UTME (km)**	**UTMN (km)**	**Length (M)**	**Width (M)**	**Release Ht. (M)**	**PM-10 Emissions Rate ($g/s/m^2$)**
ROADS1A	568.0	4164.0	4000	4000	2	4.07×10^{-7}
ROADS1B	568.0	4168.0	10000	6000	2	4.07×10^{-7}
ROADS1C	572.0	4174.0	3000	7000	2	4.07×10^{-7}
ROADS2A	568.0	4164.0	4000	4000	2	1.10×10^{-8}
ROADS2B	568.0	4168.0	10000	6000	2	1.10×10^{-8}
ROADS2C	572.0	4174.0	3000	7000	2	1.10×10^{-8}
ROADS3	574.0	4169.0	4000	4000	2	8.90×10^{-7}
ROADS4	574.0	4169.0	4000	4000	2	8.90×10^{-7}
DTMUG	573.0	4165.0	1000	1000	2	1.20×10^{-6}
DTMUS	568.0	4165.5	1000	1000	2	1.20×10^{-6}
DTBAIL	572.0	4170.0	1000	1000	2	1.20×10^{-6}
DTBAL	573.0	4181.0	1000	1000	2	1.20×10^{-6}
VD	572.0	4170.0	360	50	0	2.50×10^{-3}

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Table 3 Volume Source Inputs						
Source	**UTME (km)**	**UTMN (km)**	**Length (M)**	**Vertical (M)**	**Release Ht. (M)**	**PM-10 Emissions Rate (g/s)**
FFEV1	573.0	4169.0	127.8	35	18	$3.84x10^{1}$
POTS	572.0	4169.9	4.28	0	1	$3.28x10^{1}$
GRENAD	Fig. 1	Fig. 1	2	4	2	$9.2x10^{-1}$
BAIL(1)	572.0	4170.0	1	1	2.44	$6.77x10^{1}$
BAL(2)	573.0	4181.0	1	1	2.44	$6.77x10^{1}$
MUS(3)	568.0	4165.5	1	1	2.44	$6.77x10^{1}$
MUG(4)	573.0	4165.0	1	1	2.44	$6.77x10^{1}$

(1) Bailey Hollow OPTM/EPTM has 12 generators placed 20 meters apart. Emissions rates in Table 3 reflect one generator for OPTM/EPTM training assuming 70 % particulate, 30 % VOC. RCP uses 19 generators placed 20 meters apart.

(2) Ballard Hollow OPTM/EPTM has 12 generators placed 20 meters apart. Emissions rates in Table 3 reflect one generator for OPTM/EPTM training assuming 70 % particulate, 30 % VOC. RCP uses 19 generators placed 20 meters apart.

(3) Mush Paddle OPTM/EPTM has 12 generators placed 20 meters apart. Emissions rates in Table 3 reflect one generator for OPTM/EPTM training assuming 70 % particulate, 30 % VOC. RCP uses 19 generators placed 20 meters apart.

(4) Musgrave Hollow OPTM/EPTM has 12 generators placed 20 meters apart. Emissions rates in Table 3 reflect one generator for OPTM/EPTM training assuming 70 % particulate, 30 % VOC. RCP uses 19 generators placed 20 meters apart.

The BRAC cumulative impacts from all the new sources (CDTF, unpaved road emissions from MP School Field and Tactical Vehicle Training, unpaved road emissions from the

Chemical School FOX driving and FTX, unpaved road emissions from the driver training classes on fog oil, Flame Field Expedient (FFE) training and smoke grenades) except fog oil emission impacts were determined using the data in Tables 1, 2 and 3. The BRAC cumulative impacts from the sources were determined at the installation boundary, cantonment area and an area extending 14 kilometers away from the centroid of the post.

The purpose of the modeling was to determine the highest concentration points. Since impacts decrease with distance from the post, the highest impacts will be near or on the installation boundary or cantonment area. Therefore, the air dispersion modeling grid extended out 14 kilometers. Each source's highest and second highest high impacts were determined at each receptor point. The "highest second high" is the second highest impact predicted at any particular point. EPA allows one exceedance per point in a given year for all averaging periods of 24 hours or less (see Attachment A).

PM-10 has a 24 hour and one year standard. The PM-10 National Ambient Air Quality Standard (NAAQS) is 150 ug/m^3 for a 24 hour period and 50 ug/m^3 for an annual standard.

IV. BRAC CUMULATIVE MODELING METHODOLOGY

The first BRAC cumulative modeling runs performed used five years of meteorological data. The modeling runs are on computer files with the names: cum87t.lst to cum91t.lst. The sources used in the model included emissions from:

1) FFE (FFEV1)
2) MP School HMMWV Field Training (ROADS1A, 1B, 1C)
3) MP School HMMWV Tactical Vehicle Training (ROADS2A, 2B, 2C)
4) Chemical School FOX Driver Training (ROADS3)
5) Chemical School FOX FTX (ROADS4)
6) CDTF (CDTF)
7) Chemical School fog oil driving (DTMUS, DTMUG, DTBAIL, DTBAL)

The BRAC cumulative modeling determined the highest and second highest concentrations from these sources at each receptor point out to 14 kilometers from the post's centroid (UTME 564,000 meters, UTMN 4,173,000 meters). The meteorological data for each of these concentrations were reviewed. It was found in a few cases that the mixing height dramatically changed between one hour before sunrise to one hour after sunrise. For example, in June 23, 1987, the mixing height at 0400 hours was around 1800 meters, at 0500 hours the mixing height was 2.4 meters and then 150 meters at 0600

hours. Meteorological mixing height data is collected twice daily. The mixing heights for most hours of the day and night are not collected but instead calculated. According to Mr. Russ Lee, EPA Research Triangle Park (One of the developers of the mixing height calculation program), the large change in mixing height is "unrealistic". This large change in mixing height occurs if sunrise is near the top of the hour since the mixing height program assumes a zero mixing height at sunrise. For those concentrations near sunrise where the mixing heights change over 500 meters in an hour, the meteorology was considered unrealistic and these cases were not used.

Since all of the BRAC training activities emit pollutants for only one hour or less, the maximum one hour impact was determined then divided by 24 hours to obtain the 24 hour concentration. The modeling conservatively assumed that all training activities were occurring within the same hour of the day. If all training events are considered mutually exclusive and exhaustive, the chance of all events occurring simultaneously in the same hour is 6.58×10^{-12} percent. The chance all events occur on the same day is 0.0012 percent. For the BRAC cumulative analysis, only the OPTM (Operationally Preferred Training Method) was modeled.

Table 4 shows the predicted second highest high impacts for the BRAC cumulative analysis.

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Table 4 BRAC Cumulative Impacts (ug/m^3)*										
Source	1987		1988		1989		1990		1991	
	24hr	1yr	24hr	1yr	24hr	1yr	24hr	1yr	24hr	1yr
CDTF	0	0	0	0	0	0	0	0	0	0
ROADS1	3	2	2	1	5	3	11	6	4	2
ROADS2	0	0	0	0	0	0	1	0	0	0
ROADS3	3	0	0	0	1	0	10	1	2	0
ROADS4	3	0	0	0	1	0	10	1	2	0
DTMUG	0	0	0	0	0	0	0	0	0	0
DTMUS	0	0	0	0	0	0	0	0	0	0
DTBAIL	0	0	1	0	0	0	0	0	0	0
DTBAL	0	0	0	0	0	0	0	0	0	0
FFEV1	15	2	19	2	20	2	0	0	24	3
TOTAL	**24**	**4**	**22**	**3**	**27**	**5**	**32**	**8**	**32**	**5**

* Annual impacts were obtained by determining the maximum daily vehicle miles traveled (VMT). The max. daily VMT were multiplied by 365. The actual annual VMT were divided by the potential VMT to obtain an annual usage factor. This annual usage factor was multiplied by the daily impacts. For ROADS1 and 2 the annual usage factor is 0.53. for ROADS3 and 4 the factor is 0.04, for DT*** the factor is 0.27, for FFE the factor is 0.11.

V. FOG OIL RCP, OPTM AND EPTM ALTERNATIVES

The fog oil impacts were determined for the RCP, OPTM and EPTM. For the RCP, the alternative was modeled at each training site (Bailey, Ballard, Mush Paddle and Musgrave) using 19 generators each producing 100 gallons/hour of fog oil (see Table 3 for modeling inputs). Each generator was modeled as a 1 meter by 1 meter volume source located 2 meters above the ground (same assumptions as used in the fog oil air

permitting modeling exercise). The generators were separated by 20 meters and located in a line perpendicular to the wind direction. Also, the unpaved road emissions, 24 smoke pots, and smoke generator fuel (diesel) emissions were modeled (VD, POTS, and GENERA). Input parameters are shown in Tables 2 and 3. The OPTM and EPTM were also modeled using a 1200 gallon/day limit. In these modeling runs, 12 generators were modeled which were separated by 20 meters.

For the fog oil RCP, OPTM and EPTM training, Burns & McDonnell modeled only the meteorological conditions used in the fog oil air permit. For each training area, valid receptors (based on wind direction) were included in the modeling runs. Each stability class has different valid receptors. Five runs were performed for each training site (A through E stability) for the RCP. Five additional runs per site were run for the OPTM and EPTM. The OPTM and EPTM were lumped together in the same modeling runs since they both use the same daily quantity of fog oil (1200 gallons/day). The computer file names for Ballard Hollow RCP are : balrcpa.lst to balrcpe.lst. The computer file names for Ballard Hollow OPTM/EPTM are: balopta.lst to balopte.lst. Bailey Hollow runs are named bail*.*, Musgrave runs are named mug*.* and Mush Paddle runs are named mus*.*. Table 5 below lists the highest predicted PM-10 impacts for each stability class and each training area. In the air dispersion modeling, only valid receptors were used. Valid receptors are those that are allowed based on the permitted wind direction and atmospheric stability.

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Table 5 RCP/OPTM/EPTM 24 hour impacts (ug/m³)*										
Area	**A Stability**		**B Stability**		**C Stability**		**D Stability**		**E Stability**	
	rcp+	optm	rcp+	optm	rcp+	optm	rcp+	optm	rcp+	optm
Bailey	81	52	49	32	112	74	-	-	68	45
Ballard	49	32	40	26	92	60	196	129	166	112
Musgrave	49	32	40	26	85	54	169	110	166	112
Mush Paddle	41	26	33	21	59	38	78	50	86	56

* Impacts were modeled using existing fog oil permit meteorological restrictions

+ RCP modeling results at Fort Leonard Wood should not be compared to Fort McClellan because of differences in meteorological conditions, ambient air receptor locations and elevations, other surrounding particulate sources on and off post and background impacts.

Table 6 shows the highest predicted concentration for each training area and the breakout of individual activities' contribution to the maximum impact.

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Table 6 For Oil Training Impacts (ug/m³)						
Source	RCP+		OPTM		EPTM	
	24 hr	1 yr	24 hr	1 yr	24 hr	1 yr
FOG OIL	104	19	67	13	67	8
POTS	3	0	3	0	3	0
GENERA	0	0	0	0	0	0
VD	6	1	4	1	4	0
BAIL	**112**	**20**	**74**	**14**	**74**	**8**
FOG OIL	182	33	118	23	118	13
POTS	5	0	5	1	5	1
GENERA	0	0	0	0	0	0
VD	9	2	6	1	6	1
BAL	**196**	**35**	**129**	**25**	**129**	**15**
FOG OIL	80	14	52	10	52	6
POTS	2	0	2	0	2	0
GENERA	0	0	0	0	0	0
VD	4	1	2	0	2	0
MUS	**86**	**16**	**56**	**11**	**56**	**8**
FOG OIL	156	28	103	20	103	12
POTS	4	1	4	1	4	0
GENERA	0	0	0	0	0	0
VD	8	0	5	1	5	1
MUG	**169**	**30**	**112**	**22**	**112**	**13**

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* OPTM and EPTM have the same daily usage (1200 gallons/day)
* RCP modeling results at Fort Leonard Wood should not be compared to Fort McClellan because of differences in meteorological conditions, ambient air receptor locations and elevations, other surrounding particulate sources on and off post and background impacts.

The annual impacts were obtained by dividing the annual usage by the potential usage assuming the maximum daily consumption for each of the three options (RCP,OPTM and EPTM). This factor was multiplied by the daily maximum impacts to obtain the annual impacts. For example, the OPTM requires 1200 gallons per day, 84,000 gallons per year. The potential usage is: 1200 gallons/day * 365 days/year = 384,000 gallons/year. The OPTM annual usage (84,500 gallons) is divided by the potential usage (438,000 gallons) to obtain a factor of 0.192. The 0.192 factor is multiplied by the maximum daily impacts (i.e. 112 micrograms/cubic meter at Bailey (see Table 6)) to obtain an annual PM-10 impact of 14 micrograms/cubic. The annual impacts were calculated using the above method for all the training sites. The results are shown in Table 7.

Table 7
RCP/OPTM/EPTM Annual Impacts (ug/m^3)

Area	RCP*	OPTM	EPTM
Bailey	20	14	8
Ballard	35	25	15
Musgrave	30	22	13
Mush Paddle	16	11	8

* RCP modeling results at Fort Leonard Wood should not be compared to Fort McClellan because of differences in meteorological conditions, ambient air receptor locations and elevations, other surrounding particulate sources on and off post and background impacts.

VI. INSIGNIFICANT BRAC SOURCES

After the invalid hours were discarded due to "unrealistic" meteorological data, the closest downwind grenade site was determined. The grenade emission impacts from the

closest upwind site with the second highest concentrations was then determined. The computer file names are: cum87g.lst to cum91g.lst. It was determined that maximum grenades 24 hour, PM-10 emission impacts from the closest upwind grenade sites are very small (1 microgram/cubic meter or less) compared to the total BRAC 24 hour PM-10 impacts; thus sites further away would contribute even less. Therefore, none of the 22 grenade areas were modeled.

The BRAC action includes additional emissions from utility boilers. These boilers are primarily used for facility heating. As can be seen by the CDTF boiler impacts (Table 4), these numbers are very low (almost zero). The emissions for utility boilers are less than the CDTF boilers, therefore, these boilers were considered insignificant sources compared to the total BRAC impacts.

VII. BRAC CUMULATIVE IMPACTS

The BRAC modeling results and RCP, OPTM and EPTM fog oil impacts are shown in Table 8.

Table 8
BRAC Modeling Summary

Modeling Run	24 hr. 2nd High (ug/m^3)	Annual impact (ug/m^3)
BRAC Cumulative	32	8
Fog oil RCP*	196	35
Fog oil OPTM	129	25
Fog oil EPTM	129	15
Mitigated Fog oil (Air Permit)	30	11

* RCP modeling results at Fort Leonard Wood should not be compared to Fort McClellan because of differences in meteorological conditions, ambient air receptor locations and elevations, other surrounding particulate sources on and off post and background impacts.

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VIII. CUMULATIVE IMPACTS FOR EXISTING AND BRAC SOURCES

The BRAC actions (fog oil, FFE, unpaved road impacts, etc.) along with all existing sources in and around Ft. Leonard Wood must be in compliance with the PM-10 NAAQS at each ambient air receptor point. In order to demonstrate compliance with the NAAQS, the air dispersion modeling runs from the existing sources (performed with the fog oil air permit) and the BRAC cumulative analysis modeling runs (attached with this letter) were compared at every receptor point in ambient air and within 14 kilometers of the Ft. Leonard Wood installation centroid (Universal Transverse Mercator (UTM) coordinates 564,000 meters East, and 4,173,000 meters North). *The results of the modeling demonstrate that the proposed BRAC action will not cause or contribute to a NAAQS violation.*

The paragraphs below contain a description of the methodology used to demonstrate compliance with the PM-10 24 hour and annual NAAQS. This analysis was necessary to determine if a NAAQS exceedence is predicted for a given receptor point on a given day. For the 24 hour PM-10 NAAQS determination, the BRAC cumulative analysis assumed all activities were performed in a one hour period per day and meteorological conditions were unrestricted. The BRAC cumulative one hour impact had to be converted to a 24 hour impact. This was done by dividing the one hour impact by 24. The fog oil training activities were restricted based on meteorological conditions and assumed training for a one hour period. The fog oil training impacts had to be converted to a 24 hour period. Existing source impacts assumed continuous emissions over a 24 hour period.

1. PM-10 24 hour NAAQS

The 24 hour PM-10 NAAQS is 150 micrograms/cubic meter. For this analysis, the PM-10 background concentration plus impacts from existing and BRAC action sources must total less than 150 micrograms/cubic meter or the BRAC actions must have an insignificant contribution (5 ug/m^3 or less for a 24 hour period) to a potential NAAQS exceedence.

The background impacts used in the fog oil air permit were also used for this analysis. The 24 hour PM-10 background concentration used was 39 micrograms/cubic meter. The background was determined by the MDNR. *It should be noted that in the three months of ambient air monitoring at Fort Leonard Wood (October through December, 1996), the highest PM-10 24 hour impact has been 20 micrograms/cubic meter.*

The highest predicted fog oil impact level (from the PSD permit- 481 gallons/day, 65,000 gallons/year) was 30 micrograms/cubic meter (see fog oil air permitting modeling results).

The highest predicted BRAC cumulative impact level was 32 micrograms/cubic meter (Table 4).

Unpaved road emissions from fog oil training and smoke pots from fog oil training highest impacts were predicted to be as high as 11 micrograms/cubic meter (Table 6) at Ballard or as low as 4 micrograms/cubic meter at Musgrave. Unpaved road dust from fog oil training and smoke pots are used in conjunction with the fog oil training. The unpaved road dust and smoke pots usage were restricted to the meteorological conditions set forth in the air permit application due to:

1) the relatively small PM-10 impacts (compared to the NAAQS) from unpaved road dust and smoke pots, and
2) the discrepancy between the background PM-10 value used (39) and the current measured PM-10 values (20).

Smoke pots and unpaved road dust emissions impacts were modeled only if the analysis showed that the cumulative impacts at a receptor point were within 11 micrograms/cubic meter of the NAAQS and if the smoke training area had a contribution on the given receptor.

Methodology

Since there are several modeling runs and each modeling run shows a highest impact at a different point and time, the modeling methodology involved several steps. The steps are listed below:

1. The maximum predicted impacts from the BRAC cumulative (32 micrograms/cubic meter) action plus the background concentration (39 micrograms/cubic meter) plus the 24 hour PSD increment for fog oil training (30 micrograms/cubic meter) were summed. These impacts (101 micrograms/cubic meter) were subtracted from the NAAQS (150 micrograms/cubic meter) to obtain the existing source impacts threshold (49 micrograms/cubic meter). All existing source receptors whose impacts were predicted at 49 micrograms/cubic meter or greater (runs Q187.lst, Q287.lst to Q191.lst, Q291.lst) for each year of the five

year period were identified. For each of these receptors and days, an analysis was performed to identify the contributions from the BRAC cumulative, and the fog oil training (fog oil, unpaved road dust and smoke pots).

2. The next step was to determine the BRAC cumulative impacts (extcm87a.lst to extcm91a.lst) on those existing source receptor points (greater than 49 micrograms/cubic meter) identified in step 1. If the existing source impact receptor, say UTME 579,785, UTMN 4,179,895 had a concentration of 60 micrograms/cubic meter on June 2, 1987, the cumulative impacts on this day and point have to be analyzed. So, in step 2, the BRAC cumulative impacts were determined for each point and day where the impacts exceeded 49 micrograms/cubic meter(extcum87.lst to extcum91.lst). Step 2 was performed a second time to further reduce the number of receptor concentrations which may exceed the NAAQS. If the sum (existing source impacts plus background plus the PSD increment) was less than the NAAQS at a given receptor point, then no further analysis was performed. If the receptor point still exceeded the NAAQS. then the analysis continued to step 3.

3. The assumption in step 1 was that the fog oil PSD increment was 30 micrograms/cubic meter at all receptor points. This assumption is very conservative. The PSD increment consumed by fog oil impacts will vary by point. Therefore, the analysis went back to the PSD permit restrictions for each site to determine whether or not wind direction or atmospheric stability allowed training to occur on that day where the existing sources showed impacts above 49 micrograms/cubic meter. If no training was allowed at the site on that day, then. the fog oil impact was considered to be zero. If training was allowed, then the day's acceptable meteorological conditions (by the air permit) were modeled (see footnote for files) to determine the impacts. If the sum was less than the NAAQS at a given receptor point, then no further analysis was performed. If the receptor point still exceeded the NAAQS, then the analysis would assume a possible exceedence of the NAAQS. It would then have to be determined whether the entire BRAC cumulative and fog oil training had a significant impact on the receptor point on a given day.

24 Hour NAAQS Example

An example of the 24 hour cumulative analysis methodology is shown below for the year 1989.

Step 1:
In step 1, identify existing source impacts greater than 49 micrograms/cubic meter. In ambient air, the Q187.lst modeling run has no receptors in ambient air [2]greater than 49 micrograms/cubic meter. The modeling run Q287.lst has five receptors (2nd highest high) that need analysis. These UTM points and maximum impacts are:

1. 563607 meters East, 4179000 meters North (85 micrograms/cubic meter),
2. 562741 meters East, 4179500 meters North (98 micrograms/cubic meter),
3. 561875 meters East, 4180000 meters North (53 micrograms/cubic meter),
4. 564041 meters East, 4181356 meters North (58 micrograms/cubic meter),
5. 563275 meters East, 4181999 meters North (63 micrograms/cubic meter).

Step 2:
In step 2, the highest 50 24-hour concentrations were reviewed to determine which days receptor points were above 49 micrograms/cubic meter. In several instances, a single receptor point had several days above 49 micrograms/cubic meter. Each of these days were reviewed to see what the cumulative impacts were on those days. These days for 1989 were:

- January 17,
- February 9,
- March 7, 13, 18,
- April 3, 9, 13, 18, 19, 22, 25, 30,
- May (none)
- June 5, 7, 9, 29,
- July 6, 13, 29,
- August 3, 8, 16, 17, 23, 26,
- September 2, 11, 12, 13, 14, 26
- October 2, 3, 7, 8, 9,
- November 6, 12,
- December 6, 9, and 14.

A modeling run (extcm89a.lst) was run for the BRAC cumulative sources on the days listed above. The highest one hour concentration was 189 micrograms/cubic meter. As

---

[2]Fog oil training impacts for 1987 are under file bailext7.lst, for 1991 are under file bailext1.lst. All other years showed no impacts from fog oil training on the receptors being evaluated.

stated above, we conservatively assumed all BRAC operations occurred within a one hour period. Since the other 23 hours have no impact, then the 189 micrograms/cubic meter were divided by 24 to obtain a 24 hour average. This number is 7.8 micrograms/cubic meter. In our iterative process, we then looked at existing source receptor points whose predicted impacts were greater than:

150 (NAAQS)-39 (background)-30 (PSD increment)- 7.8(BRAC cum.) = 73.2 (existing rec.)

All existing source impacts at receptors above 73.2 micrograms/cubic meter were reviewed (2nd highest high). Only 3 receptor points met this criteria (see max. 50 tables). These predicted PM-10 concentration points and dates were:

1. 98 micrograms/cubic meter at point (562741 E, 4179500 N) on day September 26,
2. 92 micrograms/cubic meter at point (562741 E, 4179500 N) on day April 9, and
3. 85 micrograms/cubic meter at point (563607 E, 4179000 N) on day February 9.

Another modeling run was performed at the points and times listed above. The modeling run (extcum89.lst) showed the highest one hour BRAC sources impact to be 48.7 micrograms/cubic meter (2 micrograms/cubic meter for a 24 hour period. Even with this small a BRAC cumulative number, the impacts of all three points are still potentially above the NAAQS.

85 (existing) + 39 (background) + 30 (PSD increment) + 2 (BRAC cum.) = 156 micrograms/cubic meter.

However, we have conservatively assumed the fog oil impacts (PSD increment) to be 30 micrograms/cubic meter at each of the three points and times. So, we proceeded to step 3.

Step 3:

Step 3 involved determining which training areas had allowable meteorological conditions to operate on Sept. 26, April 9 or Feb. 9, 1989. The only two training areas which had an allowable wind direction (135 degrees) toward these points were Bailey and Musgrave Hollows. However, this wind direction is allowed only under A stability. There were no A stabilities for Sept. 26, April 9 or Feb. 9, 1989. Therefore, the fog oil contribution to each of these points is zero. Now, the maximum predicted impact is:

98 (existing) + 39 (background) + 0 (fog oil PSD increment) + 2 (BRAC cum.) = 139 micrograms/cubic meter.

Since no fog oil training area had an impact on these points and days, emission impacts from unpaved road dust and smoke pots would not have an impact on these days and points.
The year 1989 shows compliance with the NAAQS. In this particular year, an existing source nearby Ft. Leonard Wood was the primary contributor to all the receptors and days with the highest predicted concentrations. This year was one of the worst case years for this analysis. The other four years (1987, 1988, 1990, and 1991) were evaluated using the methodology described above and for each year, the NAAQS was not exceeded at any point.

The cumulative 24 hour PM-10 impacts are compared to the NAAQS in Table 9 below.

Table 9
24 Hour Cumulative PM-10 Highest Impacts (ug/m^3)*

Year	Total Combined Impacts	NAAQS
1987	144	150
1988	141	150
1989	139	150
1990	147	150
1991	141	150

* Includes impacts from smoke pots, fog oil, and unpaved roads, generator exhaust, other BRAC actions, existing sources, and background.

The 24 hour PM-10 cumulative impacts meets the NAAQS for the five year period. The following is a description of the analysis of the potential annual impacts.

2. PM-10 1 year NAAQS

The PM-10 NAAQS annual standard is 50 micrograms/cubic meter. The existing source impacts, BRAC cumulative, and fog oil impacts need to be added together and compared

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to the NAAQS. The annual PM-10 standard does not have a background concentration, like the 24 hour standard. So, the maximum predicted existing impacts (modeling runs Q187.lst, Q287.lst to Q191.lst, Q291.lst) were added to the maximum predicted impacts from the fog oil permit (11 micrograms/cubic meter) and the BRAC cumulative analysis (Table 8). Each of the individual maximum concentrations from existing sources , BRAC cumulative impacts, fog oil and fog oil unpaved road driving/smoke pots occur at different locations. However, for this analysis, it can be shown that summing the maximum impacts from each action, regardless of receptor location, is still below the annual PM-10 NAAQS. Based on this analysis, the cumulative impacts are compared to the NAAQS in Table 10 below.

Table 10
Annual Cumulative PM-10 Impacts (ug/m^3)

Year	Existing Source Impacts	BRAC Cumulative Impacts	Fog Oil Impacts	Smoke Pots/fog oil/ unpaved roads	Total Cumulative Impacts	NAAQS
1987	9	8	11	2	30	50
1988	8	8	11	2	29	50
1989	10	8	11	2	31	50
1990	9	8	11	2	30	50
1991	8	8	11	2	29	50

The highest predicted impact is 31 micrograms/cubic meter. The BRAC actions will not cause or contribute to an annual PM-10 exceedence.

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If you have any questions, please feel free to call either myself at (816)822-3455 or Mark Saito at (816)333-9400 ext. 5640.

Sincerely,

Block Andrews

Block Andrews, P.E.
Permitting Coordinator

Attachments

cc: Rory McCarthy, FLW
Emily Brown, FLW
Mike Grimm, HBA/Parsons

ATTACHMENT A

EPA-450/2-78-027R

GUIDELINE ON AIR QUALITY MODELS (REVISED)

(Appendix W of 40 CFR Part 51)

July 1986

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

11.2.3 Emission Limits

11.2.3.1 Design Concentrations

Emission limits should be based on concentration estimates for the averaging time that results in the most stringent control requirements. The concentration used in specifying emission limits is called the design value or design concentration and is a sum of the concentration contributed by the source and the background concentration.

To determine the averaging time for the design value, the most restrictive National Ambient Air Quality Standard (NAAQS) should be identified by calculating, for each averaging time, the ratio of the applicable NAAQS (S) minus background (B) to the predicted concentration (P) (i.e., (S-B)/P). The averaging time with the lowest ratio identifies the most restrictive standard. If the annual average is the most restrictive, the highest estimated annual average concentration from one or a number of years of data is the design value. When short term standards are most restrictive, it may be necessary to consider a broader range of concentrations than the highest value. For example, for pollutants such as SO_2, the highest, second-highest concentration is the design value. For pollutants with statistically based NAAQS, the design value is found by determining the more restrictive of: (1) the short-term concentration that is not expected to be exceeded more than once per year over the period specified in the standard, or (2) the long-term concentration that is not expected to exceed the long-term NAAQS. Determination of design values for PM-10 is presented in more detail in the "PM-10 SIP Development Guideline".[108]

When the highest, second-highest concentration is used in assessing potential violations of a short term NAAQS, criteria that are identified in "Guideline for Interpretation of Air Quality Standards"[88] should be followed. This guideline specifies that a violation of a short term standard occurs at a site when the standard is exceeded a second time. Thus, emission limits that protect standards for averaging times of 24 hours or less are appropriately based on the highest, second-highest estimated concentration plus a background concentration which can reasonably be assumed to occur with the concentration.

11.2.3.2 NAAQS Analyses for New or Modified Sources

For new or modified sources predicted to have a significant ambient impact[63] and to be located in areas designated attainment or unclassifiable for the SO_2, Pb, NO_2, or CO NAAQS, the demonstration as to whether the source will cause or contribute to an air quality violation should be based on: (1) the highest estimated annual average concentration determined from annual averages of individual years; or (2) the highest, second-highest estimated concentration for averaging times of 24-hours or less; and (3) the significance of the spatial and temporal contribution to any modeled violation. For Pb, the highest estimated concentration based on an individual calendar quarter averaging period should be used. Background concentrations should be added to the estimated impact of the source. The most restrictive standard should be used in all cases to assess the threat of an air quality violation. For new or modified sources predicted to have a significant

ambient impact[63] in areas designated attainment or unclassifiable for the PM-10 NAAQS, the demonstration of whether or not the source will cause or contribute to an air quality violation should be based on sufficient data to show whether: (1) the projected 24-hour average concentrations will exceed the 24-hour NAAQS more than once per year, on average; (2) the expected (i.e., average) annual mean concentration will exceed the annual NAAQS; and (3) the source contributes significantly, in a temporal and spatial sense, to any modeled violation.

11.2.3.3 PSD Air Quality Increments and Impacts

The allowable PSD increments for criteria pollutants are established by regulation and cited in 40 CFR 51.166. These maximum allowable increases in pollutant concentrations may be exceeded once per year at each site, except for the annual increment that may not be exceeded. The highest, second-highest increase in estimated concentrations for the short term averages as determined by a model should be less than or equal to the permitted increment. The modeled annual averages should not exceed the increment.

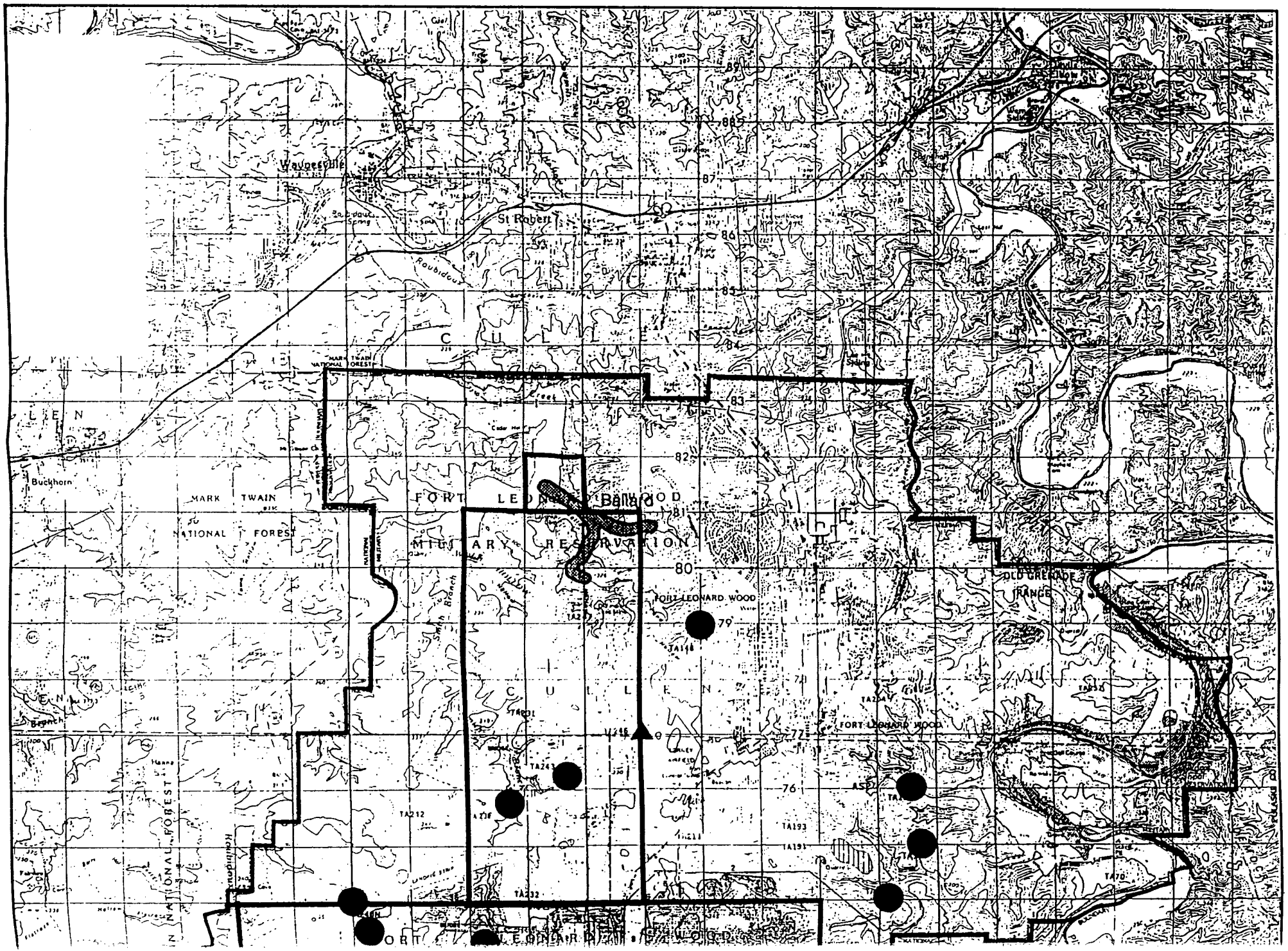
Screening techniques defined in Sections 4 and 5 can sometimes be used to estimate short term incremental concentrations for the first new source that triggers the baseline in a given area. However, when multiple increment-consuming sources are involved in the calculation, the use of a refined model with at least 1 year of on-site or 5 years of off-site NWS data is normally required. In such cases, sequential modeling must demonstrate that the allowable increments are not exceeded temporally and spatially, i.e., for all receptors for each time period throughout the year(s) (time period means the appropriate PSD averaging time, e.g., 3-hour, 24-hour, etc.).

The PSD regulations require an estimation of the SO_2, particulate matter, and NO_2 impact on any Class I area. Normally, Gaussian models should not be applied at distances greater than can be accommodated by the steady state assumptions inherent in such models. The maximum distance for refined Gaussian model application for regulatory purposes is generally considered to be 50km. Beyond the 50km range, screening techniques may be used to determine if more refined modeling is needed. If refined models are needed, long range transport models should be considered in accordance with Section 7.2.6. As previously noted in Sections 3 and 7, the need to involve the Federal Land Manager in decisions on potential air quality impacts, particularly in relation to PSD Class I areas, cannot be overemphasized.

11.2.3.4 Emissions Trading Policy (Bubbles)

EPA's final Emissions Trading Policy, commonly referred to as the "bubble policy," was published in the Federal Register in 1986.[89] Principles contained in the policy should be used to evaluate ambient impacts of emission trading activities.

Emission increases and decreases within the bubble should result in ambient air quality equivalence. Two levels of



Waynesville
St Robert
Roubidoux
C U L L E N
MARK TWAIN NATIONAL FOREST
Buckhorn
MARK TWAIN
NATIONAL FOREST
FORT LEONARD WOOD
MILITARY RESERVATION
Ballard
FORT LEONARD WOOD
OLD GRENADE RANGE
C U L L E N
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TA212
TA193
TA191
TA232
TA70
NATIONAL FOREST

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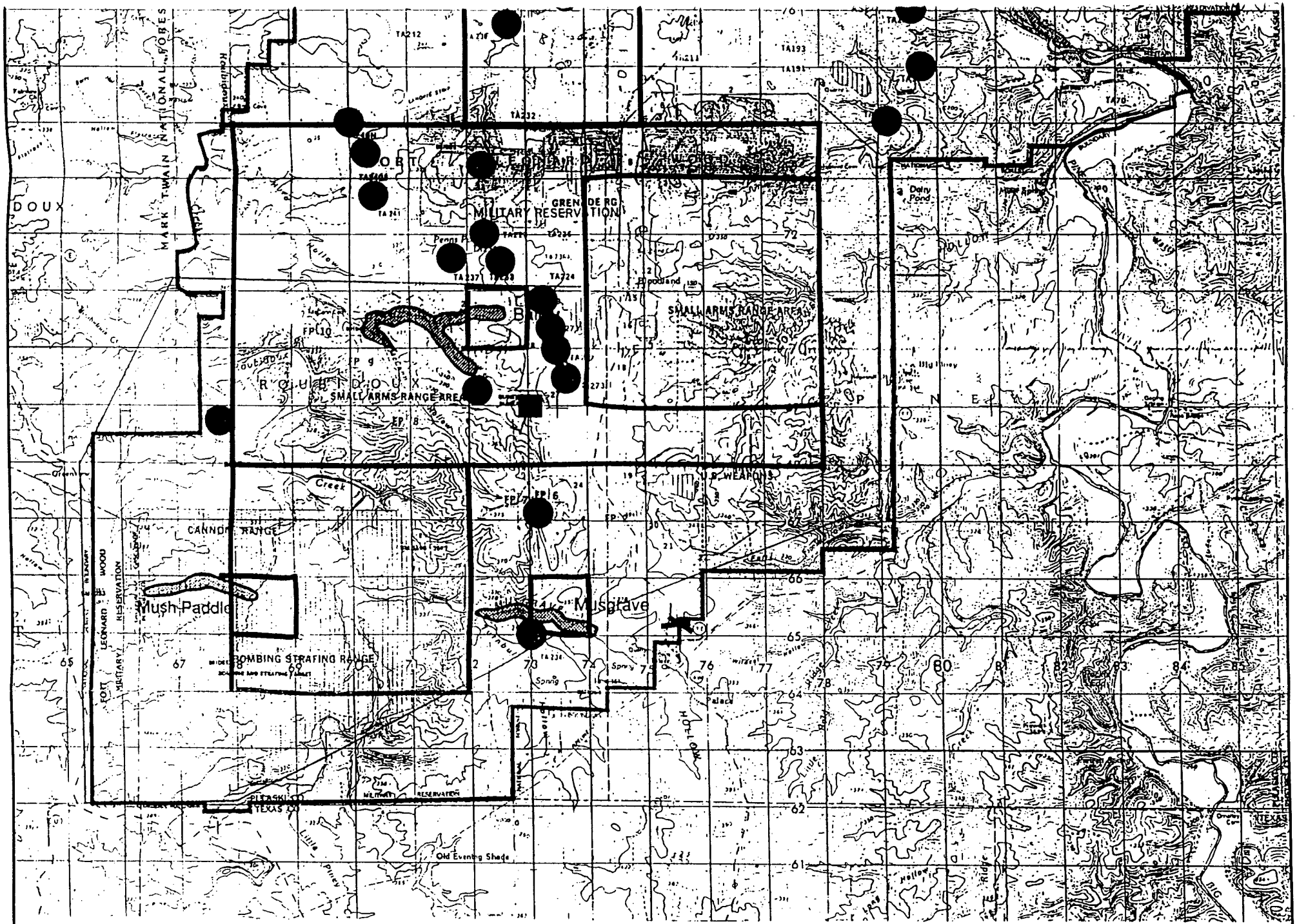
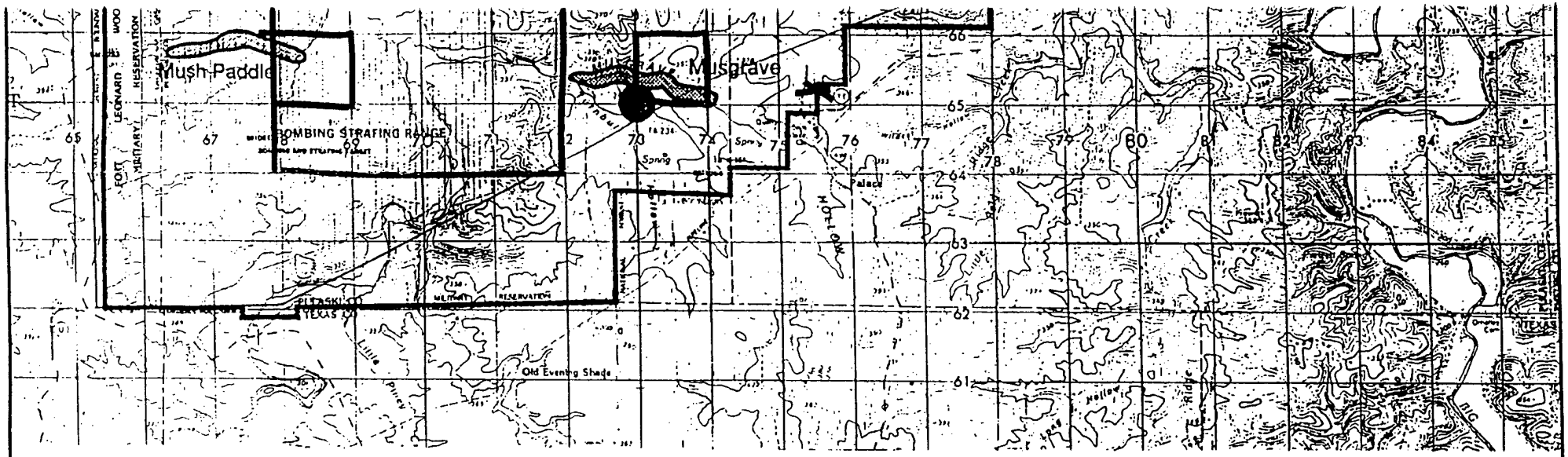
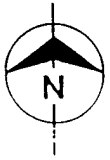

MILITARY RESERVATION
SMALL ARMS RANGE AREA
SMALL ARMS RANGE AREA
Mush Paddle
Musgrave
BOMBING STRAFING RANGE
CANNON RANGE
Old Evening Shade
Scale: Kilometers
0 1 2 3
LEGEND
Potential Smoke Grenade Training Sites
Key Map



LEGEND

- Potential Smoke Grenade Training Sites
- Potential Flame Field Expediency Training Site
- Proposed CDTF
- Potential Vehicle Training Sites
- Potential Smoke Training Sites



Key Map

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Figure 1
POTENTIAL PARTICULATE MATTER EMISSION SOURCES

(3)

FOG OIL TRAINING AMBIENT AIR MONITORING PLAN SUMMARY

The Table of Contents of the Fog Oil Ambient Air Monitoring Plan is provided as an overview as to the type of information and level of detail that is required in this plan. The plan is currently in draft status and is anticipated to be approved in March, 1997. A summary of this plan is provided in the Monitoring Plan and Adaptive Management Strategy Summary, Appendix K.

DRAFT

Ambient Air Monitoring and Quality Assurance Manual

for Fort Leonard Wood
Smoke Training PSD Permit (Revised)

October, 1996

DRAFT

prepared by
AeroMet Engineering, Inc.
2100 East Broadway, Ste. 225

Monitoring Plan Approval Signatures

Project Coordinator/Officer

AeroMet Engineering, Inc.

Project Coordinator/~~Officer~~

Burns & McDonnell Engineering Company

Missouri DNR Representative

MoDNR, APCP

2.0 TABLE OF CONTENTS

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Distribution List for Approved Quality Assurance Project Plan:

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Mr. John Kunkel, AeroMet Engineering, Inc.
Missouri Department of Natural Resources, APCP.

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FOG OIL TRAINING SOIL AND VEGETATION PLAN SUMMARY

The Table of Contents of the Fog Oil Soil and Vegetation Monitoring Plan is provided as an overview as to the type of information and level of detail that is required in this plan. The plan is currently in draft status and is being reviewed by the Missouri Department of Natural Resources. A summary of this plan is provided in the Monitoring Plan and Adaptive Management Strategy Summary, Appendix K.

Soil and Vegetation Sampling Plan for Fort Leonard Wood, Missouri

DRAFT

September 1996

Contract No. DACW41-95-D-0016

Project No. 95-809-4-004

DRAFT

Burns & McDonnell

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Final Report

Characterization of CDTF Decontaminated Wastewater and the Estimated Risk of Transportation

Prepared for
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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.

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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.

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

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	100	24 Hours
		0.001	100	
		0.01	100	
		0.1	100	
		1.0	60	
		10	0	
Pimephales promelas	11/19/96	Control	100	24 Hours
		0.001	100	
		0.01	100	
		0.1	100	
		1.0	100	
		10	0	

[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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(606) 276-3506

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

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

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.: 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	5	5			7.7	7.6		7.6	7.3	7.0		7.0	359			396
	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	<0.02	N/A	<6.25%
Analyst		SH	SH	KAW	LS	SH	SH

Comments: PW

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:
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			~~11920~~
	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.
2520 Regency Road
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(606) 276-3506

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			538
10.0	6	0				8.8			8.1	7.2			7.7	~~1510~~ ie 1510			1575
	7																
	8																
Analyst		TS				SH			JS	SH			JS	SH			TS

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~~ 94	~~120~~ 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	6				8.6			8.3	7.2			7.4	1510			1560
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		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	540			604
	18	5	2														
	19	5	1														
	20	5	4														
4.0	21	5	0			8.5			7.7	7.6			8.0	549			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				
160%	11-19-96	~~170~~	~~118~~	3.9	<0.02	N/A	1.5%
4%		170	118				
Analyst		SH	SH	KAH	LS	RP	RP

Comments: RP

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

Acute Daphnid Test-48 Hour Survival

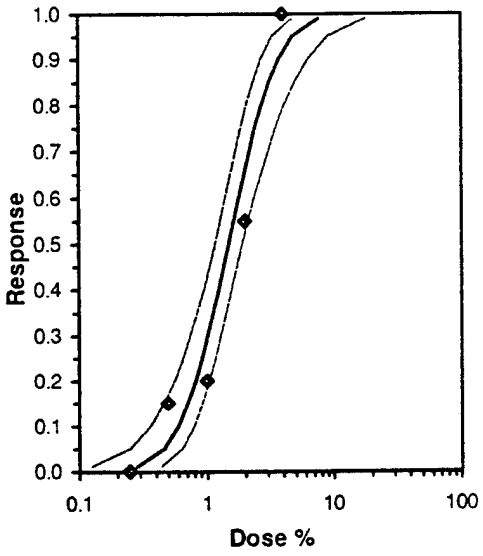
Start Date:	12/3/96 14:00	Test ID:	4320	Sample ID:	PARS-Parsons
End Date:	12/5/96 14:00	Lab ID:		Sample Type:	
Sample Date:		Protocol:	EA-EPA/600/4-90/027F	Test Species:	CD-Ceriodaphnia dubia
Comments:					

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: 4:1 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	352
	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	404
	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	4	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	JS	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

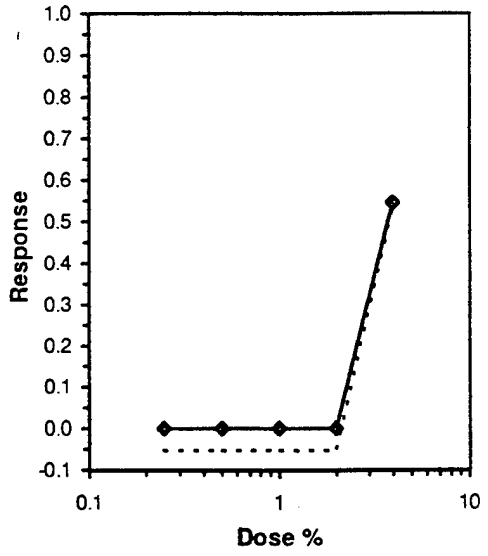
Acute Fish Test-96 Hour Survival

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 #s 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: CDTF Effluent Testing Ft. McClellan Alabama

SAMPLERS: (Signature) John C Nicodemus – [signature]

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 ~~11:30 AM~~ 2:02 PM BC	[signature]	[signature]	11/19/96 1645	Charles E. Booth
Fed Ex	11/20/96 9:30	[signature]	[signature]		
		Received for Laboratory by: (Signature) SHARON HAMILTON	11-20-96 1010AM		

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

Distribution Original Accompanies Shipment. Copy returned with Report.

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 E Nicodemus - [signature]

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

LAB USE ONLY CHECKED BY: T. Horsley
TEMP ON RECEIPT: 0 °C
ICE PRESENT ✓ Yes ___ No
CUSTODY SEALS ✓ Intact ___ Broken ___ NA
PRESERVATION CONFIRMED: ___ Yes ✓ No (See Remarks) Preserved at lab

96111482

Add 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	11/19/96 203 11:30 Am	[signature]	[signature]	11/19/96 1645	Charles E. Bunter
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

DATE.....11-18-1996
ANALYST.....GREG PETERS
LOT NUMBER.....96323WW

TYPE OF SAMPLE.....WASTE WATER
BROUGHT BY.....JON NICODEMUS
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

TA FOR REAL SAMPLES...

RT VX	AREA VX	RT GB	AREA GB
AL SAMPLE (SPIKED)...			
1.704	2677303	2.134	1612558
JUSTMENT OF REAL SAMPLE (SPIKED)...			
1.704	1350645.5	2.134	0
AL 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

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

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

Shu M. Thum
signature

16 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

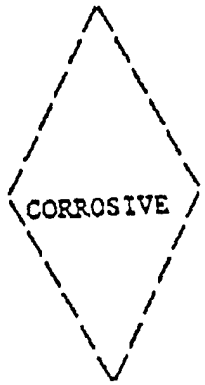
SECTION VI. NEUTRALIZATION

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 famale 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 prassure 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 Deontaminating 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.

While the Edgewood Research, Development and Engineering Center, Department of the Army believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Edgewood Research, Development and Engineering Center assumes legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

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:

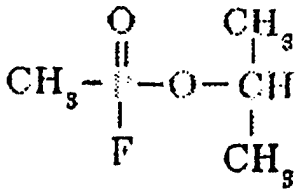
Isopropyl ester of methylphosphonofluoridic acid
Methylisopropoxfluorophosphine oxide
Isopropyl Methylfluorophosphonate
O-Isopropyl Methylisopropoxfluorophosphine oxide
Methylfluorophosphonic acid, isopropyl ester
Isopropoxymethylphosphonyl fluoride

Isopropyl methylfluorophosphate
Isopropoxymethylphosphoryl fluoride
GB
Sarin
Zarin

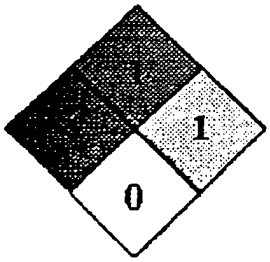
CHEMICAL FAMILY: Fluorinated organophosphorous compound

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.

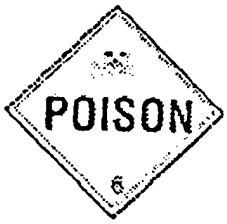
DOT HAZARD CLASSIFICATION: 6.1, Packing Group I,

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.

While the Edgewood Research Development, and Engineering Center, Department of the Army believes that the data contained herein are factual and the opinions expressed are those of the experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Edgewood Research Development, and Engineering Center assume legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of this data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

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:

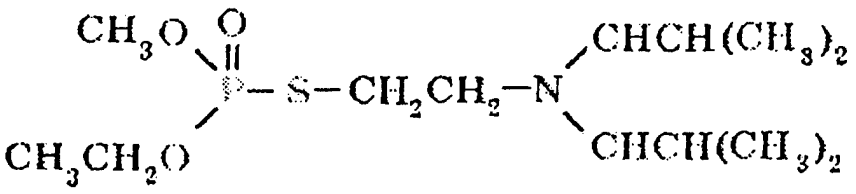
O-ethyl-S-(2-iisopropylaminoethyl) methyl phosphonothiolate

TRADE NAME AND SYNONYMS:

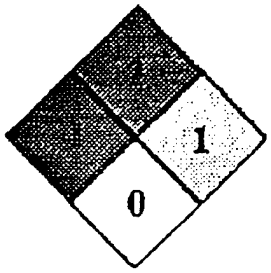
Phosphonothioic acid, methyl-, S-(2-bis(1-methylethylamino)ethyl) 0-ethyl ester
O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothiolate
S-2-Diisopropylaminoethyl O-ethyl methylphosphonothioate
S-2((2-Diisopropylamino)ethyl) O-ethyl methylphosphonothiolate
O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothioate
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.

While the Edgewood Research Development and Engineering Center, Department of the Army believes that the data contained herein are factual and the opinions expressed are those of the experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Edgewood Research Development, and Engineering Center assume legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Appendix E: CASRAM Transportation Model Report

CASRAM Modeling on Risk Assessment of CDFT Wastewater Transportation

Prepared by

D. F. Brown and W. E. Dunn
Engineering and Environmental Sciences
1711 Lincoln Road
Champaign, IL 61821

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.

Craig, D. K., J. S. Davis, R. DeVore, R., J. D. Hansen, A. J. Petrocchi and T. J. Powell, 1995: "Alternative Guideline Limits For Chemicals Without Environmental Response Planning Guidelines," Amer. Ind. Hyg. Assn. J. 56, 919-925.

Dunn, W. E., D. F. Brown and A. J. Policastro, 1996: "Technical Documentation in Support of the 1996 North American Emergency Response Guidebook", NTIS UILU-ENG-97-4001, prepared for US Department of Transportation, Office of Hazardous Materials Technology, University of Illinois, Urbana, IL.

Harwood, D. W. and E. R. Russell, 1990: "Present Practices of Highway Transportation of Hazardous Materials, FHWA/RD-89/013, prepared for Federal Highway Administration, Office of Safety and Traffic Operations, Midwest Research Institute, Kansas City, MO.

Johnson, P. E., et al., 1993: "HIGHWAY 3.1–An Enhanced Highway Routing Model, ORNL/TM-12124, prepared for U.S. Department of Energy, Office of Environmental Restoration and Waste Management, Oak Ridge National Laboratory, Oak Ridge, TN.

Woudenberg, F. and P. Van Der Torn, 1992: "Emergency Exposure Limits: A Guide To Quality Assurance and Safety," Quality Assurance: Good Practice, Regulation, and Law , 1, 249-293.

Appendix F: Chemistry of CDTF Water Supply

[redacted] TTHM INPUT FORM [redacted] Well

PWS ID 0000133 (8-9)

TRANSCODE 03

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 & ADDRES
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. 1 (21)

ANAL. DATE CODE MO.DA.YR. 08-27-96 (22-27) (28-30)

SAMPLE DATE MO.DA.YR. 08-21-96

TIME 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

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 & ADDRESS

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

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

UNREGULATED SOC'S

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

* 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 RESULTS

PWSID # 0000133

PUBLIC WATER SYSTEM NAME: ANNISTON WATER & SEWER BOARD
SYSTEM ADDRESS: P.O. BOX 2268
ANNISTON AL 36202
COUNTY: CALHOUN
COLLECTOR'S NAME: DON MILLER
SAMPLE DATE: 01-30-96
LAB ID # & NAME: 40160 MID-SOUTH TESTING, INC.
LOG NUMBER: 20046-2

TYPE OF SYSTEM:
COMMUNITY X
NTNT
NC

well

SAMPLE TYPE: DRINKING WATER COLDWATER

DISTRIBUTION X
CHECK
PLANT
RAW
SPECIAL

(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 & ADDRESS

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

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 & SEWE
SYSTEM ADDRESS: P.O. BOX 2268
ANNISTON AL 36202
COUNTY: CALHOUN

TYPE OF SYSTEM:
COMMUNITY X
NTNT
NC

SAMPLE TYPE: DRINKING WATER [REDACTED]

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 Customer

PWS ID	TRANSCODE		
0000133	03 (8-9)	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
CONTAMINANT ID 2 9 5 0 (10-13)	ANAL.METH. 2 0 5 (14-15)		

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 1200	LAB ID # & NAME:
1 (21)	08-27-96 (22-27) (28-30)	08-21-96	(38-41)	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