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ENTERED

TA/16

June 19, 2008

DCN 06280.220.ID.010

Mr. David Cobrain
State of New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East
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Santa Fe, New Mexico 87505-6303

Reference: Work Assignment No. 06280.220.0002; State of New Mexico Environment Department, Santa Fe, New Mexico; LANL Permit Support; Revised Draft TA-16 Screening Analysis Report, Task 2 Draft Deliverable.

Dear Mr. Cobrain:

Enclosed please find the deliverable for the above-referenced work assignment. The deliverable consists of the final revision of the draft screening level air modeling and risk evaluation for TA-16 open burning operations performed by TechLaw, Inc. (TechLaw).

A draft version of the screening level analysis was submitted to the New Mexico Environment Department (NMED) on June 17, 2007. This deliverable was submitted as a draft so that the analysis could be refined and/or augmented to further characterize the impact of process emissions and facilitate the development of draft permit conditions for the TA-16 Burn Ground. Upon review, NMED requested that additional air dispersion modeling be performed to support the development of treatment limits for the draft permit. This additional modeling was described in a draft addendum submitted to NMED on August 20, 2007. The revised version submitted herein combines the two draft submittals into one document comprised of the main text (draft screening analysis) and addendum (draft addendum). It also addresses comments received from Ms. Rebecca Kay on June 13 and 18, 2008.

The analysis was performed in general agreement with the approach presented in the TA-16 Burn Ground Air Pathway Assessment Protocol, Revision 0 (LANL, 2007a) and Revision 1.0 (LANL, 2007b), submitted to the Hazardous Waste Bureau by the Los Alamos National Laboratory (LANL):

- The lists of emissions factors developed by LANL were used in the TechLaw analysis;
- The screening values identified in the LANL protocol documents were used in the TechLaw analysis; and
- Site-specific information available in LANL and NMED documents was used as appropriate to prepare the air modeling input files.

Notable exceptions to the LANL Protocols included:

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- Use of the Open Burn Open Detonation Model (OBODM) in a screening application in lieu of the CALPUFF modeling package proposed by LANL; and
- Use of separate compilations of emission factors for the open burning of bulk high explosives (HE) and the treatment of HE contaminated wastes rather than a single list of "worst case" emission factors applied to both processes.

The screening analysis showed that treatment of bulk HE at TA-16-399 in the amounts proposed in the LANL Protocols is likely protective of human health for workers at the TA-16 Burn Ground. A similar statement regarding treatment of HE and HE-contaminated wastes at TA-16-388 can not be made at this time. A number of potentially emitted constituents exceeded the applicable screening criteria at two different locations within the TA-16 Burn Ground. These constituents did pass the screening analysis at a third location approximately 460 meters to the west-southwest of TA-16-388; however, a definitive statement concerning the impact of open burning processes at TA-16-388 on on-site workers should not be made until a better understanding of potential worker exposures is developed.

The addendum submitted to NMED on August 20, 2007 consisted of a draft report on additional air dispersion modeling and risk-based screening analyses performed for TA-16 open burning operations by TechLaw since submittal of the Draft TA-16 Screening Analysis Report on June 18, 2007. The addendum was intended to augment the Screening Analysis Report as it represented an extension of the original analyses. Specifically, the document summarized analyses performed to illustrate the sensitivity of air modeling and risk-based screening results to the amount of waste treated at the TA-16 Burn Ground.

The document is formatted in Word. The deliverable was emailed to you on June 19, 2008 at dave.cobrain@nmenv.state.nm.us and to Ms. Rebecca Kay at Rebecca.Kay@nmev.state.nm.us. A formalized hard (paper) copy of this deliverable will be sent via U.S. Mail. If you have any questions, please call me at (770) 752-7585, extension 105 or Michael S. Smith at (678) 765-0815.

Sincerely,

Jasmine Schliesmann-Merkle

Jasmine Schliesmann-Merkle
Vice President

Enclosure
cc: Ms. Rebecca Kay, NMED
Mr. Michael S. Smith, TechLaw

TASK 2 DELIVERABLE

DRAFT SCREENING LEVEL AIR MODELING ANALYSIS AND RISK EVALUATION FOR OPEN BURNING OPERATIONS AT THE TA-16 BURN GROUNDS LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NEW MEXICO

LANL PERMIT SUPPORT

Submitted by:

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Submitted to:

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In response to:

Work Assignment No. 06280.220

June 9, 2007

Revised June 13, 2008
Revised June 19, 2008

DRAFT – NOT A FINAL WORK PRODUCT

TASK 2 DELIVERABLE

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JUNE 19, 2008

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1.0 INTRODUCTION

At the request of the Hazardous Waste Bureau (HWB) of the New Mexico Environment Department (NMED), TechLaw has performed a screening level analysis of the potential air quality impacts from the open burning of bulk high explosives (HE) and wastes contaminated by HE at the Technical Area 16 (TA-16) Burn Ground.

The purpose of the analysis is to provide HWB permitting staff with reasonable estimates of air quality impacts from open burning operations at the TA-16 Burn Ground that can be used in developing draft permit conditions. TechLaw understands these estimates will likely be replaced in the future by impacts developed by the Los Alamos National Laboratory (LANL) in a refined air modeling analysis scheduled for completion by late summer 2007. It is known that LANL's analysis will not be completed before a draft permit for LANL is due to be public noticed in August 2007. The permit conditions presented in the draft permit may be revised as appropriate based on LANL's refined air modeling analysis and/or comments received from interested parties.

This screening level analysis is based on TechLaw's understanding of information submitted to NMED by LANL and communication with NMED staff. Where information gaps were encountered, TechLaw applied professional judgment based on its experience in performing similar analyses for similar units with input from NMED to estimate missing parameter values.

The TA-16 Burn Ground consists of two units currently operating under Resource Conservation and Recovery Act (RCRA) interim status:

- TA-16-399 Burn Tray, which is used to treat bulk dry HE; and
- TA-16-388 Flash Pad, which is used to treat wet HE, combustibles and other HE-contaminated materials using an external heat source (propane), and bulk dry HE.

In this analysis, three separate scenarios were modeled and the results compared to appropriate risk-based screening levels. The model scenarios were:

- Treatment of bulk dry HE at TA-16-399;
- Treatment of bulk HE at TA-16-388; and
- Treatment of HE contaminated wastes at TA-16-388.

For the burning of bulk HE at TA-16-399, all constituents were below their respective screening criteria at a staging area located approximately 125 meters northwest of TA-16-388. Based on available information, this staging area is believed to be a viable location for an industrial/occupational receptor and, as such, it appears that treatment of 1,000 pounds of bulk HE twice a day, 5 days a week, for 52 weeks per year, or more concisely treatment of 520,000 pounds of bulk HE per year, at TA-16-399 should not negatively impact the health of an industrial worker at that location.

The results for treatment of bulk HE and HE-contaminated wastes at TA-16-388 are not as clear cut. All air and soil concentrations were determined to be below their respective screening levels

at a location approximately 460 meters west-southwest of TA-16-388; however, a significant number of constituents (8) exceeded their screening criteria at the staging area discussed above. While the results for TA-16-388 are encouraging, definitive statements on the impact of TA-16-388 open burning operations should not be made until more is learned about the potential for worker exposure in these areas.

In performing the screening analysis, the environmental impacts of treatment operations at the TA-16 Burn Ground were determined through the implementation of a five step process.

STEP 1
Emission factors were taken from the LANL Air Modeling Protocol (LANL, 2007b). LANL identified and extracted these values from the available scientific literature. Additional details on the development of the lists of emission factors are provided in Section 2.0. The identified emission factors were used to develop lists of worst-case pollutant-specific emission factors for the burning of bulk HE and the burning of wastes contaminated by HE.
STEP 2
Unitized air dispersion factors were determined by the Open Burn Open Detonation Model (OBODM) air dispersion model at a set of receptor points located within a 6 kilometer by 6 kilometer grid centered on TA-16-388 and TA-16-399. Unitized deposition factors were modeled for a subset of the air dispersion receptor grid to avoid estimating deposition in areas of complex terrain.
STEP 3
Constituent-specific impacts were calculated by multiplying constituent emission factors by the appropriate air modeling result. Impacts were calculated using the emission factors described in Step 1 and the unitized air modeling results described in Step 2.
STEP 4
Pollutant-specific air and soil concentration screening levels were identified for comparison to the air concentrations and deposition flux-based soil concentrations estimated in Step 3.
STEP 5
The impacts calculated in Step 3 were compared to the screening levels identified in Step 4. If the TA-16 Burn Ground impacts were less than the screening levels, impacts were considered acceptable and more comprehensive analyses such as a site-specific multipathway risk assessment were not required.

A discussion of each of these steps is presented below.

2.0 EMISSION FACTORS FOR OPEN BURNING

LANL has developed suites of emission factors for the burning of bulk HE and the burning of HE contaminated wastes (LANL, 2007a, 2007b). Because emission factors for the exact waste streams treated at TA-16 were not available, LANL identified emission factors for similar waste streams in the scientific literature and combined them to create a suite of worst-case emission factors for both of the treated waste streams. Emission factors were developed for those constituents that could potentially be emitted from open burning operations at LANL and that possess air concentration and soil concentration screening levels. Additional details on the

identification and specification of these emission factors is available in Section 3.0, Emission Factors for Open Burning, of the LANL Air Modeling Protocol (LANL, 2007b).

2.1 Emission Factors for Burning Bulk HE at TA-16-399 and TA-16-388

Only bulk HE is treated at TA-16-399; the maximum amount that can be burned at this unit is 1,000 pounds per event (1000 lb/burn). Up to 250 pounds of bulk HE can be treated in a single burn event at TA-16-388 (250 lb/burn).

The primary types of HE treated are cyclotetramethylenetetranitramine (HMX), 1,3,5-triamino 2,4,6-trinitrobenzene (TATB), trinitrotoluene (TNT), and cyclonite (RDX); however, emission factors are not available for the open burning of all of these explosives. TNT is the least oxygenated of the commonly treated high explosives and, as such, burns less completely than other forms of HE treated at the TA-16 Burn Ground. LANL extracted criteria pollutant emission factors for burning TNT from Chapter 6, Section 3, Table 6.3-1 of EPA's Compilation of Air Pollutant Emission Factors.

LANL used the Open Burn/Open Detonation Dispersion Model (OBODM) User's Guide (EPA, 1998a), as the primary source of emission factors for burning HE. Emission factors for the detonation of HE were not considered due to differences in the detonation and open burning processes. Two of the munitions included in the OBODM User's Guide contained HE similar to that treated at the TA-16 Burn Ground:

- M-43 contains RDX; and
- PBXN-110 contains HMX.

To capture potential emissions from the other types of HE treated at the TA-16 Burn Ground, LANL selected M31A1E1 as a conservative surrogate because this triple-based propellant included:

- Some of the explosives that were used historically at LANL which could be encountered in decommissioning projects;

- An explosive with a negative internal oxygen balance, which is an indicator of less robust combustion; thus, representing modern explosives such as TATB; and

- An obscurant, which is designed to create smoke. A constituent that smokes rather than burns should be indicative of more products of incomplete combustion and; thus, represent a conservative surrogate. The obscurant also contains metal constituents not found in modern explosives used at LANL but found in some older explosives.

The emission factors in the OBODM User's Guide were derived from burning munitions that contain a number of contaminants that are not present in HE treated at LANL. However, no attempt was made to eliminate non-characteristic emissions from the analysis. From among the

emission factors listed for these four types of explosives/munitions (TNT, M-43, PBXN-110, and M31A1E1), the highest pollutant-specific emission factor was chosen so that a list of "worst case" values was generated. The resulting list of emission factors was used in estimating constituent specific impacts from the burning of bulk HE at TA-16-388 and TA-16-399. The emission factors are listed in Table 2-1 in units of grams of pollutant emitted per gram of waste treated (g/g).

2.2 Emission Factors for Burning Wastes Contaminated with HE at TA-16-388

In addition to bulk HE, materials burned at TA-16-388 include HE-contaminated combustible solids and liquids and HE-contaminated non-combustible materials. The maximum amount of combustible material that can be treated in a single burn event at TA-16-388 is 250 pounds (250 lb/burn). Note that non-combustible materials such as scrap metal and soil are not included in this specification.

The identification of emission factors for the open burning of the HE-contaminated waste streams is summarized in Sections 2.2.1 through 2.2.3. The list was assembled using the same approach employed in developing Table 2-1: the highest pollutant-specific emission factor from among the waste types considered was selected resulting in a list of "worst-case" emission factors.

While propane is used as a supplemental fuel to improve the burning of HE-contaminated materials, LANL identified only criteria pollutant emission factors for the burning of propane. Thus, emissions from the open burning of propane were not included in this screening level analysis.

2.2.1 Emission Factors for Combustible Solids

LANL chose emission factors from the Diesel and Dunnage category in the OBODM User's Guide (EPA, 1998a) to represent emissions from the HE-contaminated solid waste treated at TA-16-388. The Diesel and Dunnage waste was believed to be a conservative surrogate as the actual combustible solids treated at TA-16-388 contain no vegetation, no diesel fuel, include a high heating value fuel, HE, and are burned with supplemental fuel (propane).

2.2.2 Emission Factors for Open Burning of Liquids

Historically, this waste stream consisted of oils and solvents contaminated with HE. Due to process changes and improvements in waste characterization, LANL has decreased the amount of this type of waste that is burned over the past few years. This waste stream is expected to consist primarily of solvents with high HE content (usually greater than 25%) from research operations. Small amounts of other liquids, such as kerosene or a similar petroleum product used to start pure HE burns at either unit are also covered by this category (LANL, 2007b).

LANL used the emission factors for burning fuel oil in Emissions of Organic Air Toxics from Open Burning to represent emissions from the burning of HE-contaminated liquids at TA-16-388. These emission factors did not include the ambient air quality standard (AAQS) pollutants;

however, and emission factors for those constituents were taken from Booher and Janke (LANL, 2007b).

2.2.3 Dioxin/Furan Emission Factors

LANL found no emission factors for dioxin/furans emitted during the open burning HE or HE-contaminated wastes. Although dioxin emissions from the TA-16 Burn Ground are expected to be low, LANL included a dioxin emission factor from the open burning of non-aluminized Ammonium Perchlorate (NAAP) propellant (EPA, 1998a). Further, while furan emission factors were also available for burning NAAP, the emission factors for Manufacturer's Waste were higher. As recommended by NMED HWB, the furan emission factors from the Manufacturer's Waste were included in the list of emission factors for HE-contaminated wastes.

2.3 Combined Worst-Case Waste Emission Factor

To provide a "worst case" list of emission factors for the open burning of HE-contaminated wastes, LANL chose the highest pollutant-specific emission factor from among the emission factors compiled for each type of HE-contaminated waste. In addition to reflecting emission factors with the highest magnitude, the list represents all the types of wastes that comprise the HE-contaminated wastes treated at TA-16-388 (LANL, 2007b).

The following example, paraphrased from the LANL Air Modeling Protocol (LANL, 2007b), illustrates how the "worst case" emission factors were selected:

> *Using acenapthene as an example, the emission factors for all categories of HE-contaminated wastes were examined. Emission factors for acenapthene were listed for the burning of combustible solids and burning of HE-contaminated liquids. The emission factor for burning liquids was higher than that for burning combustible solids (1.00x10-5 grams of acenapthene per gram of liquid treated versus 5.71x10-6 grams of acenapthene per gram of combustible solids treated). Acenapthene was not listed as an emitted pollutant for the other types of HE-contaminated wastes. Thus, the emission factor for burning liquids, 1.00x10-5 grams of acenapthene per gram of liquid treated, was chosen as the worst-case emission factor. As this emission factor becomes part of the composite "worst case" emission factors for burning HE-contaminated waste, it is applied to all HE-contaminated waste considered in the analysis, even though some waste types are not expected to emit acenapthene.*

Table 2-2 lists the contaminant, the waste category, and the "worst case" emission factor for the HE-contaminated wastes burned at TA-16-388.

Table 2-1. Emission Factors for Burning High Explosives (HE)

Contaminant	Highest Emission Factor (g/g) [a]	Source of Emission Factor
Barium	4.20E-07	M31A1E1
Benzene	4.88E-06	PBXN-110
Benzyl alcohol	1.91E-09	M31A1E1

Contaminant	Highest Emission Factor (g/g) [a]	Source of Emission Factor
1,3-Butadiene	4.98E-07	PBXN-110
Carbon monoxide	2.80E-02	TNT
Carbon tetrachloride	6.89E-08	M31A1E1
Chloromethane (methyl chloride)	2.84E-07	M31A1E1
Chromium	3.97E-07	M31A1E1
Cyclohexane	9.07E-08	M-43
Dibutyl phthalate	3.30E-07	M31A1E1
1,1-Dichloroethylene (vinylidene chloride)	2.15E-07	M31A1E1
Diethyl phthalate	6.58E-08	M31A1E1
Ethylbenzene	7.96E-07	PBXN-110
Ethyl chloride	6.89E-08	M31A1E1
Hexane	9.07E-08	M-43
Hydrogen chloride	9.97E-04	M-43
Methylene chloride	7.46E-07	M31A1E1
Nitrogen dioxide	7.50E-02	TNT
Particulate matter	9.00E-02	TNT
Styrene	2.57E-07	M31A1E1
1,1,1-Trichloroethane (methyl chloroform)	3.44E-08	M31A1E1
Toluene	5.44E-07	M-43
1,2,4-Trimethylbenzene	4.25E-07	PBXN-110
1,3,5-Trimethylbenzene	2.99E-07	PBXN-110
Vinyl chloride	2.23E-07	PBXN-110
Xylenes	1.67E-06	M31A1E1
Zinc	4.14E-07	M31A1E1

[a] EF (g/g) = emission factor in grams of pollutant per gram of waste

Table 2-2. Worst-Case Emission Factors for HE-Contaminated Wastes

Contaminant	Waste Type	EF (g/g) [a]
Acenaphthene	Liquids	1.00E-05
Acetaldehyde	Liquids	6.30E-05
Acetone	Liquids	3.50E-05
Acetophenone	combust [b]	1.74E-07
Acrolein	Liquids	3.90E-05
Aluminum	combust [b]	7.13E-07
Anthracene	Liquids	1.50E-05
Barium	HE [c]	4.20E-07
Benzaldehyde	Liquids	1.04E-04
Benzene	Liquids	1.02E-03
Benzo[a]anthracene	Liquids	5.00E-06
Benzo[a]pyrene	Liquids	5.00E-06
Benzo[b&k]fluoanthene	Liquids	7.00E-06
Benzyl alcohol	combust [b]	3.96E-05
1-3-Butadiene	combust [b]	1.34E-06
Butyl benzyl phthalate	combust [b]	1.22E-07

Contaminant	Waste Type	EF (g/g) [a]
Dioxin	NAAP [d]	1.49E-12
Ethylbenzene	combust [b]	5.49E-05
Ethyl chloride	HE [c]	6.89E-08
Fluoranthene	liquids	2.00E-05
Fluorene	liquids	1.00E-06
Formaldehyde	liquids	3.03E-04
Furan	MW [e]	1.50E-07
Hexane	combust [b]	1.60E-05
Hydrogen chloride	HE [c]	9.97E-04
Indeno[1,2,3-cd]pyrene	liquids	5.00E-06
Methylene chloride	HE [c]	7.46E-07
Methylcyclohexane	combust [b]	1.56E-04
Methyl ethyl ketone	liquids	1.30E-05
Methyl isobutyl ketone	liquids	1.10E-05
Napthalene	liquids	1.62E-04
Nitrogen dioxide	HE [c]	7.50E-02

Contaminant	Waste Type	EF (g/g) [a]
Carbon monoxide	Liquids	9.00E-02
Carbon tetrachloride	HE [c]	6.89E-08
Chloromethane (methyl chloride)	HE [c]	2.84E-07
Chromium	HE [c]	3.97E-07
Chrysene	Liquids	9.00E-06
Crotonaldehyde	Liquids	6.00E-06
Cyclohexane	combust [b]	2.67E-05
Dibenzo[ah]anthracene	combust [b]	2.00E-07
Dibutyl phthalate	HE [c]	3.30E-07
1,1-Dichloroethylene (vinylidene Cl)	HE [c]	2.15E-07
Diethylphthalate	combust [b]	7.00E-08
Dimethyl phthalate	combust [b]	1.88E-07
Dioctyl phthalate	combust [b]	9.19E-07

Contaminant	Waste Type	EF (g/g) [a]
Particulate matter	liquids	2.00E-01
Phenanthrene	combust [b]	7.17E-06
Phenol	combust [b]	1.56E-05
Pyrene	liquids	2.00E-06
Styrene	combust [b]	4.99E-05
Sulfur dioxide	liquids	2.50E-03
Toluene	combust [b]	1.22E-04
1,1,1-Trichloroethane (methyl chloroform)	HE [c]	3.44E-08
1,2,4-Trimethylbenzene	combust [b]	2.43E-04
1,3,5-Trimethylbenzene	combust [b]	5.57E-04
Xylenes	combust [b]	5.77E-04
Vinyl chloride	HE [c]	2.23E-07
Zinc	combust [b]	6.26E-05

[a] EF (g/g) = emission factor in grams of pollutant per gram of waste
[b] combust refers to emission factors for combustible solids
[c] HE = high explosives
[d] NAAP = Non-aluminized Ammonium Perchlorate
[e] MW = Manufacturer's Waste

3.0 DISPERSION AND DEPOSITION MODELING PROTOCOL

OBODM was selected for this screening level analysis. The model allows for a simplistic representation of local meteorology and includes a screening-level complex terrain algorithm. The buoyant plume rise calculation in OBODM is based on Briggs (Briggs, 1971).

3.1 General Model Approach

Unitized air concentration and gravitational deposition flux were estimated using OBODM. One-hour and annual air concentration factors were obtained from the model as were total annual gravitational deposition factors. Annual average dosage was also modeled and used in a bounding estimate of dry deposition for particle phase and particle bound emissions.

Modeling was performed for the three scenarios listed in Table 3-1. For each case, vapor, particle, and particle bound phases were modeled for a total of 9 primary model runs. Preliminary modeling was performed to determine which hour(s) of the operating day would generate the highest one-hour concentrations. The results of the preliminary modeling were incorporated into the primary model runs as described below. Some additional modeling runs were executed to focus on impacts at selected points of interest downwind of the modeled source locations.

The modeling analysis employed a year of meteorological data. Each modeled scenario accounted for hours of no emissions by varying the source strength in an hourly source strength file, a built-in feature of OBODM.

Table 3-1. Modeled Scenarios

Location	Waste Loading
TA-16-399	1,000 lb HE/burn
TA-16-388	250 lb HE/burn
TA-16-388	250 lb He-contaminated waste/burn

3.2 Source-Specific Information

When available, site-specific information was taken from the LANL Air Modeling Protocols. Other sources of information were used, as necessary, to assemble the input files needed to perform the modeling analysis.

Open burning at the TA-16 Burn Ground occurs from 8 AM to 5 PM local time in the summer, and 9 AM to 4 PM in the winter. The duration of a burn is typically less than 1 hour, but can be longer. Based on input from LANL, it was assumed that 1,000 pounds of bulk HE could be burned in one hour at TA-16-399. Likewise, 250 pounds of HE-contaminated wastes would be burned in one hour at TA-16-388. Thus, it was assumed that 250 pounds of bulk HE (a quarter of the amount burned at TA-16-399) would burn in 15 minutes at TA-16-388.

Typically, only one burn occurs daily but, to provide a conservative estimate, LANL recommended that two burns per day be modeled. These burns were assumed to be separated by at least 1 hour of preparation time. According to LANL, only one to two burns a week are typically conducted; however, the modeling analysis assumed 2 burns a day, 5 days a week for a total of 520 burns per year.

The location coordinates of the two open burn units in Universal TransMercator (UTM) Zone 13 coordinates, referenced to both NAD27 and NAD83, are provided in Table 3-2.

Table 3-2. Location of Modeled Sources

Unit	X-Coordinate		Y-Coordinate	
	NAD27	NAD83	NAD27	NAD83
TA-16-388 Flash Pad	379720	379670	3967617	3967821
TA-16-399 Burn Tray	379783	379733	3967736	3967939

A mass weighted particle size distribution from Dumbauld (Dumbauld et al., 1973) was used in the analysis as no particle size distribution data are available for the open burning of the wastes treated at the TA-16 Burn Ground. The mass weighted data were used in estimating the particle phase gravitation deposition for each modeled scenario. Surface area weighting factors were calculated for the particle size distribution as outlined in Chapter 3 of USEPA's Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (HHRAP) (USEPA, 2005) and used to estimate gravitational deposition for particle bound pollutants.

A 1995 meteorological data set, approved by the NMED Air Quality Bureau (NMAQB), and provided by NMAQB was used in this analysis. Maps and aerial photographs of the TA-16 Burn Ground and the surrounding area were used to estimate a surface roughness length of 60 centimeters for the modeling analysis.

3.3 Receptors

A 6 kilometer (km) by 6 km receptor grid was centered on the Burn Ground, with receptors spaced at 90 meter intervals. To account for the local geography, this grid was used in conjunction with the complex terrain algorithm in OBODM to model unitized vapor phase air concentration factors.

Due to the limitations of the complex terrain algorithm contained in OBODM, particle and particle bound phase modeling were conducted under an assumption of flat terrain. A subset of the larger grid featuring 99 locations and 90 meter spacing was used as examination of a topographic map indicated that the assumption of flat terrain might be reasonable close to the modeled sources (TA-16-388 and TA-16-399). Limited modeling of specific locations was performed using discrete receptor locations extracted from the large grid.

All raw digital receptor data were downloaded from a publicly accessible web site and referenced to NAD83. All conversions of locations specified in the LANL Air Modeling Protocol (LANL, 2007b) in NAD27 were converted to NAD83 using CORPSCON (USACOE, 2004).

3.4 Air Modeling Results

Initially, OBODM was used to determine which operating hours would generate the maximum one hour concentrations for each modeled scenario. For all burns conducted at TA-16-388, 11 AM and 3 PM local time were identified as potential candidates with 11 AM generating the overall maximum for the burning of HE-contaminated wastes and 3 PM leading to the maximum 1-hour concentrations for burning bulk HE. The maximum results at TA-16-399 were obtained for 2 PM and 4 PM with 4 PM generating the overall maximum 1 hour concentration.

These results were used to develop hourly source strength files for the three modeled scenarios. In these files, a source strength was entered for each hour represented in the meteorological data file. For modeling burns at TA-16-388, a value of 250 pounds was entered for 11 AM and 3 PM, five days a week. For all other hours 0 was entered. Similarly, the source strength file for TA-16-399 showed a value of 1,000 pounds at 2 PM and 4 PM five days a week and 0 for all other hours. Once the source strength files were prepared, the 9 primary modeling runs were executed. Tables 3-3 through 3-5 present the unitized air concentration factors obtained from OBODM for the vapor phase, the particle phase, and the particle bound phase, respectively.

Table 3-3. Unitized Vapor Phase Dispersion Factors for Open Burning Operations at the TA-16 Burn Ground (in μg/m^3)

Modeled Process	1-Hour Concentration	Annual Average Concentration
TA-16-388 Contaminated Waste	69493.1	196.29
TA-16-388 Bulk HE	49450.4	99.48
TA-16-399 Bulk HE	33129.3	128.02

Table 3-4. Unitized Particle Phase Dispersion Factors for Open Burning Operations at the TA-16 Burn Ground (in μg/m^3)

Modeled Process	1-Hour Concentration	Annual Average Concentration
TA-16-388 Contaminated Waste	55678.3	155.33
TA-16-388 Bulk HE	36763.0	68.03
TA-16-399 Bulk HE	21097.4	87.39

Table 3-5. Unitized Particle Bound Dispersion Factors for Open Burning Operations at the TA-16 Burn Ground (in μg/m^3)

Modeled Process	1-Hour Concentration	Annual Average Concentration
TA-16-388 Contaminated Waste	63289.1	160.83
TA-16-388 Bulk HE	36410.2	67.75
TA-16-399 Bulk HE	22963.3	76.47

Unitized annual average dosage and total annual gravitational deposition for the particle phase and the particle bound phase are listed in Tables 3-6 and 3-7, respectively.

Table 3-6. Unitized Factors for Particle Phase Dosage in (μg·hr)/m^3 and Gravitational Deposition in μg/m^2 for Open Burning Operations at the TA-16 Burn Ground

Modeled Process	Annual Average Dosage	Annual Gravitational Deposition
TA-16-388 Contaminated Waste	154.80	.17294E10
TA-16-388 Bulk HE	16.947	.33363E9
TA-16-399 Bulk HE	87.284	.18234E10

Table 3-7. Unitized Factors for Particle Bound Dosage in (μg·hr)/m^3 and Gravitational Deposition in μg/m^2 for Open Burning Operations at the TA-16 Burn Ground

Modeled Process	Annual Average Dosage	Annual Gravitational Deposition
TA-16-388 Contaminated Waste	160.25	.21148E9
TA-16-388 Bulk HE	16.889	.44494E8
TA-16-399 Bulk HE	76.38	.17259E9

These values were inserted into EXCEL® spreadsheets and constituent-specific air concentrations and deposition flux-based soil concentrations were calculated for comparison to appropriate screening levels.

4.0 SCREENING LEVELS

Modeled impacts were screened against a variety of sources. As proposed in the LANL Air Modeling Protocols, annual average air concentrations were compared to the USEPA Region 9 Preliminary Remediation Goals (PRGs) for air (EPA, 2004), available on-line at http://www.epa.gov/region09/waste/ sfund/prg/files/04prgtable.pdf. Screening levels were taken from the Air-Water Calculation worksheet on the PRG web site. As recommended in the OBOD Permitting Guidelines (USEPA Region 3, 2002), modeled impacts were compared to one tenth (0.1) of the PRGs. If all constituent-specific air concentrations were below this level, further analysis (e.g., human health risk assessment for the air pathway) may not be necessary. For constituents with carcinogenic and non-carcinogenic screening levels, both values were used; however, interest was focused on the most conservative screen, usually associated with the carcinogenic PRG value.

One-hour concentrations were compared to the acute inhalation exposure (AIEC) values found in the Companion Database to USEPA's HHRAP (USEPA, 2005), accessible on-line at http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm.

Deposition fluxes were used to calculate 10 year (life of the permit) soil concentrations for screening against the NMED Human Health Industrial/Occupational Soil Screening Levels (SSLs) (NMED, 2006). The USEPA Region 6 Human Health Medium-Specific Screening Levels (EPA, 2007) were used for contaminants not listed in the NMED SSL table. Because USEPA guidance uses a target risk of $1x10^{-6}$ and NMED uses a target of $1x10^{-5}$, the Region 6 values were multiplied by 10 for comparison to calculated soil concentrations.

A limited screening for ecological impacts was conducted by comparing calculated soil concentrations to the LANL Ecological Screening Levels (ESLs).

5.0 RESULTS

EXCEL® spreadsheets were used to calculate constituent-specific air concentrations and deposition fluxes for comparison to appropriate screening levels. Three spreadsheets were used for each modeled case:

- Maximum 1-hour concentrations were calculated and compared to AIEC values;
- Annual average air concentrations were calculated and compared to PRG based-values (0.1 x PRG); and
- Total annual gravitational deposition and particle dry deposition were calculated and compared to NMED SSLs or USEPA Region 6 MSSLs and LANL ESLs.

The initial screening was performed using the overall maximum 1-hour and annual average concentrations and the overall maximum gravitational deposition fluxes predicted by OBODM. These overall maximums occurred at a point between TA-16-388 and TA-16-399 where industrial exposures would be intermittent and of relatively short duration. This point is believed to be in an area that personnel cannot enter while actual burning is taking place. However, this has not been confirmed by LANL. For constituents that did not pass this initial screen, further screening was performed at two nearby locations. The first roughly coincided with a staging area within the TA-16 Burn Ground and was located approximately 125 meters northwest of TA-16-388. The second location was approximately 460 meters west-southwest of TA-16-388 near a building that may have recently been demolished.

The results for each modeled scenario are discussed below.

5.1 Burning HE-Contaminated Wastes at TA-16-388

The screening analyses performed for the treatment of HE-contaminated wastes at TA-16-388 assumed that 250 pounds of waste was burned twice day, 5 days a week, 52 weeks per year. Thus, a total of 1.3×10^5 pounds were assumed to be treated during the year.

Only acrolein exceeded its AIEC value with a hazard quotient (HQ) of 14.3. All other constituents passed the 1-hour air concentration screen.

Benzene, benzo(a)anthracene, benzo(a)pyrene, benz(b)fluoranthene, total chromium, crotonaldehyde, and formaldehyde exceeded their annual air screening level of 0.1 times the PRG. All other constituent-specific annual air concentrations were lower than their respective screening criteria.

All constituent-specific soil concentrations were beneath the NMED, USEPA Region 6, and LANL ESL soil screening values.

A second screening of these constituents was conducted at the location northwest of TA-16-388. Here, the annual average air concentrations for benzo(a)anthracene and benzo(b)fluoranthene fell

below their respective screening levels. The remaining constituents were screened a third time at the location west-southwest of TA-16-388. Due to reductions in the unitized annual air concentration factors predicted by OBODM at this location, the concentrations for all remaining constituents were well below their screening levels.

5.2 Burning Bulk HE at TA-16-388

As in the burning of HE-contaminated wastes, burns of bulk HE at TA-16-388 were assumed to occur twice a day, 5 days a week, for 52 weeks per year. At 250 pounds per burn, a total of 1.3×10^5 pounds of bulk HE was assumed to be treated annually.

No constituent-specific 1-hour concentrations exceeded their AIEC screening level.

Benzene exceeded its annual average air concentration screening level (0.1 x PRG) with a hazard quotient (HQ) of 4.1. Total chromium exceeded its screening levels with a HQ of 1.7. All other constituents were below their screening levels.

No exceedances of the NMED and USEPA Region 6, or LANL ESLs were identified.

When screened at the westernmost location, the annual average air concentrations for benzene and total chromium were found to be below their respective screening levels.

5.3 Burning Bulk HE at TA-16-399

The analysis at TA-16-399 assumed that 1,000 pounds of bulk HE was burned twice a day, 5 days a week, for 52 weeks per year. This resulted in an assumed loading of 5.2×10^5 pounds per year.

No constituent-specific 1-hour concentration exceeded its AIEC screening level.

Total chromium exceeded its annual average air concentration screening level (0.1 x PRG) with a HQ of 2.2. All other constituents were below their screening levels.

No exceedances of the NMED and USEPA Region 6 soil screening levels or the LANL ESLs were identified.

A second screening of total chromium was conducted at the location northwest of TA-16-388. The annual average air concentration for total chromium was determined to be less than the screening level at this point.

5.4 Discussion of Results

The majority of the constituents addressed in this screening analysis met or fell below their respective screening criteria when the overall maximum impacts predicted by OBODM were used as the basis for calculating constituent-specific air concentrations and deposition fluxes. However, some exceedances were noted for all modeled scenarios.

For the burning of bulk HE at TA-16-399, all constituents were below their respective screening criteria at a staging area located approximately 125 meters northwest of TA-16-388, a location that could support an actual industrial/occupational receptor. This result indicates that treatment of 1,000 pounds of bulk HE twice a day; 5 days a week, for 52 weeks per year at TA-16-399 should not negatively impact the health of an industrial worker at the staging area. This is equivalent to treating 520,000 pounds of bulk HE in a year.

At the point of maximum modeled impact and at the staging area, the treatment of bulk HE at TA-16-388 resulted in exceedances of the applicable screening criteria by two emitted constituents, benzene and total chromium. When screened at the location lying west-southwest of TA-16-388, the estimated air and soil concentrations were below all screening values.

A similar situation resulted when treatment of 250 pounds of HE-contaminated waste at TA-16-388 was considered. While all air and soil concentrations were determined to be below their respective screening levels at the western location, a significant number of constituents still exceeded their screening criteria at the staging area including acrolein, benzene, benzo(a)pyrene, total chromium, crotonaldehyde, and formaldehyde.

However, it is not clear if the western location represents a reasonable and conservative location for an industrial worker. If it does, or if exposures to workers closer to the TA-16 Burn Ground are mitigated by control measures, LANL could treat 250 pounds of bulk HE or HE-contaminated waste, twice a day, 5 days a week, for 52 weeks per year at TA-16-388 and likely not impact the health of workers at this location. Treatment at that level would represent 130,000 pounds of waste per year.

It is believed that confidence in this screening analysis could be raised by addressing key sources of uncertainty in an effort to achieve air and soil concentrations below screening levels at the staging area. Due to the uncertainty inherent in the emission factor analysis for open burning units, emission factors for constituents that exceeded their screening criteria in this analysis should be examined further to determine if they are based on detected quantities or method detection limits (e.g., total chromium). Modeling estimates could be improved by incorporating additional site information such as confirmed dimensions for the TA-16-388 pad. Further, the impact of assuming flat terrain near the modeled sources so that gravitational deposition and particle and particle bound phase air concentrations could be calculated by OBODM should be explored.

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ADDENDUM 1
SENSITIVITY OF AIR MODELING AND RISK-BASED SCREENING RESULTS TO TREATMENT QUANTITIES AT THE TA-16 BURN GROUNDS

June 19, 2007
Revised June 13, 2008
Revised June 19, 2008

DRAFT – NOT A FINAL WORK PRODUCT

ADDENDUM 1
SENSITIVITY OF AIR MODELING AND RISK-BASED SCREENING RESULTS TO TREATMENT QUANTITIES AT THE TA-16 BURN GROUNDS

SCREENING LEVEL AIR MODELING ANALYSIS AND RISK EVALUATION FOR OPEN BURNING OPERATIONS AT THE TA-16 BURN GROUNDS LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NEW MEXICO

JUNE 19, 2007
REVISED JUNE 13, 2008
REVISED JUNE 19, 2008

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ABSTRACT

The initial screening analysis described in the Draft Screening Report dated June 9, 2007 was expanded to identify the amount of waste that could be treated by each operation at the TA-16 Burn Ground and pass four screening analyses:

- Comparison of annual average peak air concentrations to 0.1 times the EPA Region 9 PRGs;
- Comparison of 1-hour average peak air concentrations to AIEC values;
- Comparison of 10-year soil concentrations to industrial NMED SSLs or EPA Region 6 MSSLs; and
- Comparison of 10 year soil concentrations to LANL ecological screening levels (ESLs).

Emission factors and site-specific information needed to conduct the analysis were taken from information provided to NMED by LANL. Where data gaps existed, the available information was adapted and/or augmented based on professional judgment. The Open Burn Open Detonation Model (OBODM) was used to predict the overall maximum unitized dispersion and deposition factors for three treatment operations conducted at the TA-16 Burn Ground. These factors were combined with constituent emission factors to estimate air concentrations and soil concentrations for comparison to screening levels. The amount of waste burned per treatment event and the frequency of treatment were independently varied to identify a range of operating values over which the modeled treatment processes would meet all screening criteria.

For the burning of bulk HE at TA-16-399, all constituents were below their respective screening criteria for treatment of 1,000 pounds of bulk HE, 20 times per year, with each burn lasting one hour. This translates into an annual treatment quantity of 20,000 pounds of bulk HE.

For the burning of bulk HE at TA-16-388, all constituents were below their respective screening criteria for treatment of 250 pounds of bulk HE, 72 times per year, with each burn lasting approximately 0.25 hours (15 minutes). This translates into an annual treatment quantity of 18,000 pounds of bulk HE.

As confirmed by air modeling and screening results for TA-16-388, it is believed that 8 burn events per year at 100 pounds per event represent viable lower processing limits for the open burning of bulk HE at TA-16-388 and TA-16-399.

For the open burning of HE-contaminated wastes at TA-16-388, the results were not as clear cut. When 80 one-hour burn events per year of 250 pounds of HE-contaminated waste were modeled (20,000 pounds per year), eleven potentially emitted constituents (i.e., acrolein, benzene, benzo(a)pyrene, chloroform, total chromium, crotonaldehyde, 1,2-dichloroethane, dioxin/furan TEQs, formaldehyde, trichloroethylene, and zinc) could not satisfy all of the appropriate screening criteria. Adjustments to the amount of waste treated per burn event and the frequency of burn events did not identify values at which this process could satisfy all screening criteria at the point of overall maximum impact predicted by OBODM. When the eleven constituents were removed from the analysis, this process satisfied all screening criteria at two extremes: 80 one-

hour burn events per year at 250 pounds of HE-contaminated waste per event (20,000 pounds per year) and 12 one-hour burn events per year at 50 pounds per event.

These results show that treatment of HE-contaminated wastes at TA-16-388 will likely require performance of a more refined risk-based analysis (e.g., site-specific, multi-pathway risk assessment) to demonstrate treatment quantities that are protective of human health and the environment and/or restrictions on the types of HE-contaminated wastes burned before final, defensible, and protective permit conditions can be developed.

1.0 INTRODUCTION

At the request of the Hazardous Waste Bureau (HWB) of the New Mexico Environment Department (NMED), TechLaw performed an expanded screening-level analysis of the potential air quality impacts from the open burning of bulk high explosives (HE) and wastes contaminated by HE at the Technical Area 16 (TA-16) Burn Ground. The purpose of the analysis was to identify the amount of waste that could be treated by each operation at the Burn Ground and pass all four screening analyses. Two units were considered:

- TA-16-399 Burn Tray, which is used to treat bulk dry HE; and
- TA-16-388 Flash Pad, which is used to treat wet HE, combustibles and other HE-contaminated materials using an external heat source (propane), and bulk dry HE.

These additional analyses illustrate the sensitivity of the air dispersion modeling results and the results of four risk-based screening analyses to changes in the amount of waste treated at the TA-16 Burn Ground. The impact due to variation of two parameters was examined:

- The amount of waste treated per burn event; and
- The amount of waste treated per year by each modeled process.

Three separate treatment operations were modeled and the results compared to appropriate screening levels:

- Treatment of bulk dry HE at TA-16-399;
- Treatment of bulk HE at TA-16-388; and
- Treatment of HE contaminated wastes at TA-16-388.

The same five-step process described in Section 1.0, Introduction, of the Screening Level Air Modeling Analysis report (Draft Screening Report) was employed. Changes to the methodology are highlighted in Table A-1.

Table A-1. Additions or Modifications Made to the Five-Step Process

STEP	DESCRIPTION OF ADDITIONS/MODIFICATIONS
1	The majority of the emission factors were taken from the LANL Air Modeling Protocol (LANL, May 2007). The emission factors for burning HE-contaminated liquids were augmented by emission factors submitted to NMED by LANL for the burning of HE-contaminated solvents during 2000. These additional emission factors were incorporated into the analysis to, hopefully, provide an additional degree of conservatism by expanding the number of potentially emitted constituents.
2	Unitized air dispersion and deposition factors were determined by the Open Burn Open Detonation Model (OBODM) air dispersion model at a set of ninety-nine receptor points located within a roughly 810 meter by 990 meter grid centered at a point between TA-16-388 and TA-16-399. **Only results at the predicted maximum point of impact were considered in this analysis.**
3	Constituent-specific impacts were calculated by multiplying constituent emission factors by the appropriate air modeling result.
4	Additional LANL ecological screening levels (ESLs) were identified and incorporated into the ecological screening analysis.
5	The impacts calculated in Step 3 were compared to the screening levels identified in Step 4.

2.0 EMISSION FACTORS FOR OPEN BURNING

In addition to the emission factors used in the initial screening analysis, oil and solvent emissions estimates for 2000 submitted to NMED by LANL via Table 6, TA-16-388 Oil/Solvent Emissions, of Appendix B, Technical Area 16 Burn Ground Data and Summary Tables (LANL, 2001) were incorporated into the expanded screening analysis. This expanded the list of potentially emitted constituents from the treatment of HE-contaminated wastes and in a few cases, resulted in a more conservative (i.e., higher) value for a constituent emission factor. The emission factors for the treatment of bulk HE remained as before. Additional details on the development of emission factors for the expanded screening analysis are provided below.

2.1 Emission Factors for Burning Bulk HE at TA-16-399 and TA-16-388

The expanded screening analysis employed the same emission factors described and presented in the Draft Screening Report for treating bulk HE at TA-16-399 and TA-16-388. The list is repeated here in Table A-2.

2.2 Emission Factors for Burning Wastes Contaminated with HE at TA-16-388

HE-contaminated combustible solids and liquids and HE-contaminated non-combustible materials are treated at TA-16-388. As described in Section 2.0, Emission Factors for Open Burning, of the Draft Screening Report, the highest pollutant-specific emission factor from among the waste types considered was selected resulting to generate a list of "worst-case" emission factors for the open burning of HE-contaminated wastes.

2.2.1 Emission Factors for Combustible Solids

The expanded screening analysis considered the list of emission factors in Table 2-1 of the Draft Screening Report for treating HE-contaminated combustible solids at TA-16-388.

2.2.2 Emission Factors for Open Burning of Liquids

As part of a Notice of Deficiency (NOD) response, LANL submitted estimated emissions from the treatment of oils and solvents at TA-16-388 for calendar year 2000 to NMED (LANL, 2001). To add an additional layer of conservatism to the expanded screening analyses, these estimated emissions were used to develop additional emission factors for the treatment of HE-contaminated liquids at TA-16-388. Inclusion of this additional source of data added 26 potentially emitted constituents to the list of emission factors and increased the value of the emission factor for five constituents (acetone, hydrogen chloride, methylene chloride, methyl ethyl ketone, and toluene) addressed in the initial screening analysis. Information from Table 5, Hazardous Constituents (Other than HE) and Quantities of Oil/Solvent Waste Treated at TA-16-388 in 2000, and Table 6, TA-16-388 Oil/Solvent Emissions (LANL, 2001) was used to develop emission factors in units of grams per gram (gram of constituent emitted per gram of material treated). The information provided by LANL in Table 6 of the NOD response (LANL, 2001) and the emission factors calculated from that data are listed in Table A-3.

2.2.3 Dioxin/Furan Emission Factors

The dioxin/furan emission factors described and presented in the Draft Screening Report were utilized, without modification, in the expanded screening analysis.

2.3 Combined Worst-Case Waste Emission Factor

"Worst Case" emission factors for the open burning of HE-contaminated wastes were specified by choosing the highest pollutant-specific emission factor from among those compiled for the types of wastes comprising LANL's HE-contaminated waste stream. For the expanded screening analysis, the additional emission factors for oil and solvent burns presented in Table A-3 were combined with the emission factors listed in Tables 3-2 through 3-4 of LANL's air modeling protocol (LANL, 2007) to obtain the emission factors presented in Table A-4. This expanded list of emission factors was used in estimating constituent-specific air quality impacts for the treatment of HE-contaminated wastes at TA-16-388.

Table A-2. Emission Factors for Burning High Explosives (HE)

Contaminant	Highest Emission Factor (g/g) [a]	Source of Emission Factor
Barium	4.20E-07	M31A1E1
Benzene	4.88E-06	PBXN-110
Benzyl alcohol	1.91E-09	M31A1E1
1,3-Butadiene	4.98E-07	PBXN-110
Carbon monoxide	2.80E-02	TNT
Carbon tetrachloride	6.89E-08	M31A1E1
Chloromethane (methyl chloride)	2.84E-07	M31A1E1
Chromium	3.97E-07	M31A1E1
Cyclohexane	9.07E-08	M-43
Dibutyl phthalate	3.30E-07	M31A1E1
1,1-Dichloroethylene (vinylidene chloride)	2.15E-07	M31A1E1
Diethyl phthalate	6.58E-08	M31A1E1
Ethylbenzene	7.96E-07	PBXN-110
Ethyl chloride	6.89E-08	M31A1E1
Hexane	9.07E-08	M-43
Hydrogen chloride	9.97E-04	M-43
Methylene chloride	7.46E-07	M31A1E1
Nitrogen dioxide	7.50E-02	TNT
Particulate matter	9.00E-02	TNT
Styrene	2.57E-07	M31A1E1
1,1,1-Trichloroethane (methyl chloroform)	3.44E-08	M31A1E1
Toluene	5.44E-07	M-43
1,2,4-Trimethylbenzene	4.25E-07	PBXN-110
1,3,5-Trimethylbenzene	2.99E-07	PBXN-110
Vinyl chloride	2.23E-07	PBXN-110
Xylenes	1.67E-06	M31A1E1
Zinc	4.14E-07	M31A1E1

[a] EF (g/g) = emission factor in grams of pollutant per gram of waste

Table A-3. TA-16-388 Estimated Oil/Solvent Emissions for 2000

Contaminant	ER (lb/yr) [a]	EF (g/g) [b]	Contaminant	ER (lb/yr) [a]	EF (g/g) [b]
Acetone	1E+00	1.07E-03	Hydrogen Chloride	1E+00	1.07E-03
Acetonitrile	1E+00	1.07E-03	Isopropyl Alcohol	5E-01	5.34E-04
Ammonium Hydroxide	1E+00	1.07E-03	Mercury	2E-02	2.14E-05
BDNF Ether	6E-01	6.41E-04	Methanol	9E+00	9.62E-03
Butyl Acetate	2E-01	2.14E-04	Methylene Chloride	3E-01	3.21E-04
Butyl Nitrite	1E-03	1.07E-06	Methyl Ethyl Ketone	4E-02	4.27E-5
Chloroform	2E-01	2.14E-04	Nitric Acid	1E+00	1.07E-03
Chromium	2E-04	2.14E-07	Potassium Hydroxide	1E+00	1.07E-03
DMSO	5E-02	5.34E-05	Sodium Hydroxide	4E+00	4.27E-03
1,2-Dichloroethane	2E+00	2.14E-03	Sulfuric Acid	5E+00	5.34E-03
Ethyl Acetate	2E+00	2.14E-03	Tetrahydrafuran	3E-01	3.21E-04
Ethanol	2E+00	2.14E-03	Toluene	1E+00	1.07E-03
2,4-Dinitrotoluene	3E-01	3.21E-04	Trichloroethylene	5E-01	5.34E-04

[a] ER (lb/yr) = estimated annual emissions
[b] EF (g/g) = emission factor in grams of pollutant per gram of waste

Table A-4. Worst-Case Emission Factors for HE-Contaminated Wastes

Contaminant	Waste Type	EF (g/g) [a]
Acenaphthene	Liquids	1.00E-05
Acetaldehyde	Liquids	6.30E-05
Acetone	Oil/solvent	1.07E-03
Acetonitrile	Oil/solvent	1.07E-03
Acetophenone	combust [b]	1.74E-07
Acrolein	Liquids	3.90E-05
Aluminum	Combust [b]	7.13E-07
Ammonium Hydroxide	Oil/solvent	1.07E-03
Anthracene	Liquids	1.50E-05
Barium	HE [c]	4.20E-07
BDNF Ether	Oil/solvent	6.41E-04
Benzaldehyde	Liquids	1.04E-04
Benzene	Liquids	1.02E-03
Benzo[a]anthracene	Liquids	5.00E-06
Benzo[a]pyrene	Liquids	5.00E-06
Benzo[b&k]fluoanthene	Liquids	7.00E-06
Benzyl alcohol	Combust [b]	3.96E-05
1-3-Butadiene	Combust [b]	1.34E-06
Butyl Acetate	Oil/solvent	2.14E-04
Butyl benzyl phthalate	Combust [b]	1.22E-07
Butyl Nitrite	Oil/solvent	1.07E-06
Carbon monoxide	Liquids	9.00E-02
Carbon tetrachloride	HE [c]	6.89E-08
Chloroform	Oil/solvent	2.14E-04

Contaminant	Waste Type	EF (g/g) [a]
Ethyl Acetate	Oil/solvent	2.14E-03
Ethylbenzene	Combust [b]	5.49E-05
Ethyl chloride	HE [c]	6.89E-08
Ethanol	Oil/solvent	2.14E-03
Fluoranthene	Liquids	2.00E-05
Fluorene	Liquids	1.00E-06
Formaldehyde	Liquids	3.03E-04
Furan	MW [e, f]	1.50E-07
Hexane	Combust [b]	1.60E-05
Hydrogen chloride	Oil/solvent	1.07e-03
Indeno[1,2,3-cd]pyrene	Liquids	5.00E-06
Isopropyl Alcohol	Oil/solvent	5.34E-04
Mercury	Oil/solvent	2.14E-05
Methanol	Oil/solvent	9.62E-03
Methylene chloride	Oil/solvent	3.21E-04
Methylcyclohexane	Combust [b]	1.56E-04
Methyl ethyl ketone	Oil/solvent	4.27E-05
Methyl isobutyl ketone	Liquids	1.10E-05
Napthalene	Liquids	1.62E-04
Nitric Acid	Oil/solvent	1.07E-03
Nitrogen dioxide	HE [c]	7.50E-02
Particulate matter	Liquids	2.00E-01
Phenanthrene	Combust [b]	7.17E-06
Phenol	Combust [b]	1.56E-05

Contaminant	Waste Type	EF (g/g) [a]
Chloromethane (methyl chloride)	HE [c]	2.84E-07
Chromium	HE [c]	3.97E-07
Chrysene	Liquids	9.00E-06
Crotonaldehyde	Liquids	6.00E-06
Cyclohexane	Combust [b]	2.67E-05
Dibenzo[ah]anthracene	Combust [b]	2.00E-07
Dibutyl phthalate	HE [c]	3.30E-07
1,2-Dichloroethane	Oil/solvent	2.14E-03
1,1-Dichloroethylene (vinylidene Cl)	HE [c]	2.15E-07
Diethylphthalate	Combust [b]	7.00E-08
Dimethyl phthalate	Combust [b]	1.88E-07
2,4-Dinitrotoluene	Oil/solvent	3.21E-04
DMSO	Oil/solvent	5.34E-05
Dioctyl phthalate	Combust [b]	9.19E-07
Dioxin	NAAP [d, f]	1.49E-12

Contaminant	Waste Type	EF (g/g) [a]
Potassium Hydroxide	Oil/solvent	1.07E-03
Pyrene	Liquids	2.00E-06
Sodium Hydroxide	Oil/solvent	4.27E-03
Styrene	Combust [b]	4.99E-05
Sulfuric Acid	Oil/solvent	5.34E-03
Sulfur Dioxide	Liquids	2.50E-03
Tetrahydrafuran	Oil/solvent	3.21E-04
Toluene	Oil/solvent	1.07E-03
1,1,1-Trichloroethane (methyl chloroform)	HE [c]	3.44E-08
Trichloroethylene	Oil/solvent	5.34E-04
1,2,4-Trimethylbenzene	Combust [b]	2.43E-04
1,3,5-Trimethylbenzene	Combust [b]	5.57E-04
Xylenes	Combust [b]	5.77E-04
Vinyl chloride	HE [c]	2.23E-07
Zinc	Combust [b]	6.26E-05

[a] EF (g/g) = emission factor in grams of pollutant per gram of waste
[b] combust refers to emission factors for combustible solids
[c] HE = high explosives
[d] NAAP = Non-aluminized Ammonium Perchlorate
[e] MW = Manufacturer's Waste
[f] Dioxin and Furan data were converted to a Dioxin/Furan TEQ emission factor for some screening analyses. Isomer-specific values were used in screening 1-hour air concentrations.

3.0 DISPERSION AND DEPOSITION MODELING USING OBODM

3.1 General Model Approach

At the request of NMED HWB, additional air modeling was performed to assist in determining:

- The amount of waste that could be treated per event by each of these processes and still pass the screening analyses; and
- The frequency of treatment that would result in these processes passing the screening analyses.

Unitized dispersion and deposition factors were estimated using OBODM. One-hour and annual air concentration factors were obtained from the model as were total annual gravitational deposition factors. Annual average dosage was also modeled and used in a bounding estimate of dry deposition for vapor, particle phase, and particle bound emissions.

Modeling was performed for three treatment scenarios: treatment of bulk HE at TA-16-399, treatment of bulk HE at TA-16-388, and treatment of HE-contaminated wastes at TA-16-399. Based on information supplied to NMED by LANL (2007), it was assumed that a maximum of 20,000 pounds of waste would be treated each year at the TA-16 Burn Ground. For each case, vapor, particle, and particle bound phases were modeled.

The first modeling run assumed an annual treatment quantity of 20,000 pounds of waste for each of the three treatment scenarios. The hourly source strength file and source group features of OBODM were utilized so that all three treatment scenarios could be addressed in a single modeling run. Table A-5 summarizes the treatment amounts addressed in the initial modeling run.

The results obtained from the initial model run demonstrated that 20,000 pounds of bulk HE could be treated at TA-16-399 every year at 1,000 pounds per treatment event and pass all identified screening criteria. Thus, treatment could occur up to twenty times during the year.

Based on this result, the remainder of the air modeling focused on the treatment of bulk HE and HE-contaminated wastes at TA-16-388.

Table A-5. Treatment Scenarios Modeled in the Expanded Screening Analysis

Treatment Scenario	OBODM Source Number	Quantity of Waste Stream Treated Annually (lb/yr)	Quantity of Waste Treated per Event (lb/event)
Bulk HE burn at TA-16-399	1	20,000	1,000 lb/event
Bulk HE burn at TA-16-388	2	20,000	250 lb/event
HE-contaminated waste burn at TA-16-399	3	20,000	250 lb/event

The additional cases modeled for the open burning of bulk HE at TA-16-388 are listed in Table A-6. Table A-7 lists those cases modeled for burning HE-contaminated wastes at TA-16-388.

Table A-6. Additional Cases Modeled for the Treatment of Bulk HE at TA-16-388

OBODM MODEL FILES	OBODM Source Number	Annual Treatment Quantity (lb/yr)	Treatment Events per Year	Treatment Quantity per Event (lb/event)
S230K**	2	30,000	80	375
S2280**	2	22,400	80	280
S2270**	2	21,600	80	270
S2260**	2	20,800	80	260
IND20**	2	20,000	80	250
S2240**	2	19,200	80	240
IND20**	2	20,000	80	250
*S218K***	*2*	*18,000*	*72*	*250*
IND15**	2	15,000	60	250
IND22**	2	2,000	8	250
S28C1C**	2	800	8	100

Table A-7. Additional Cases Modeled for the Treatment of HE-Contaminated Wastes at TA-16-388

OBODM MODEL FILES	OBODM Source Number	Annual Treatment Quantity (lb/yr)	Treatment Events per Year	Treatment Quantity per Event (lb/event)
S3275**	3	22,000	80	275
S3260**	3	20,800	80	260
*IND20***	*3*	*20,000*	*80*	*250*
S3240**	3	19,200	80	240
S3200**	3	16,000	80	200
IND82**	3	8,000	80	100
IND22**	3	2,000	20	100
S31K1C**	3	1,000	10	100
S36C1C**	3	600	6	100
S32K50**	3	2,000	40	50
S36C50**	3	600	12	50
*IND20***	*3*	*20,000*	*80*	*250*
IND15**	3	15,000	60	250
IND10**	3	10,000	40	250
S35K**	3	5,000	20	250
S32-5K**	3	2,500	10	250
S31250	3	1,250	5	250
S3500**	3	500	2	250
S3250**	3	250	1	250

3.2 Source-Specific Information

When available, site-specific information for the air dispersion and deposition effort was extracted from information provided to NMED by LANL. Other sources of information were used, as necessary, to assemble the input files needed to perform the air modeling analysis.

As in the initial screening analysis, total burn times for individual burn events were assumed not to exceed one hour. The burn time for treatment of 1,000 pounds of bulk HE at TA-16-399 was assumed to take 60 minutes; thus, the treatment of 250 pounds of bulk HE at TA-16-388 was taken as 0.25 hours (15 minutes). For both of these treatment processes, a burn rate of 126 grams per second was specified in the OBODM input file. In the expanded screening analysis, several model runs were conducted where the amount of bulk HE treated at TA-16-388 exceeded

250 pounds. In these cases, the total burn time was calculated with the burn rate set to 126 g/sec. For all cases, the burn time did not exceed 1 hour and the burn rate was left at 126 g/sec.

When burning HE-contaminated wastes at TA-16-388, a burn rate of 31.5 g/sec was assumed for each 250-pound treatment event giving a total burn time of 1 hour. For treatment events in excess of 250 pounds addressed in the expanded screening analysis, adjustments were made to the burn rate in order to keep the total burn time at 1 hour. For example, when modeling 275 pounds of HE-contaminated waste, a burn rate of 34.6 g/sec [(275 lbs·453.59 g/lb)/3600 sec = 34.6 g/sec] was specified in the OBODM input file.

Other information used in specifying the characteristics of the modeled treatment processes remained unchanged and is described in Section 3.2, Source-Specific Information, of the Draft Screening Report.

3.3 Receptors

An 810 meter by 990 meter receptor grid was centered on the Burn Ground, with receptors spaced at 90 meter intervals. This grid was used in conjunction with the complex terrain algorithm in OBODM to model unitized vapor phase dosage and air concentration factors. Due to the limitations of the complex terrain algorithm contained in OBODM, particle and particle bound phase modeling were conducted under an assumption of flat terrain.

To ensure a conservative analysis, only the overall maximum modeling results predicted by OBODM were considered in the expanded screening analysis. Overall maximum impacts consistently occurred at (379780; 3967920) for TA-16-399 and (379690; 3967830) for TA-16-388. These points are approximately 51 meters and 22 meters from TA-16-399 and TA-16-388, respectively.

3.4 Air Modeling Results

All three treatment scenarios were addressed in one input file. By using OBODM's source group feature, impacts were calculated and printed separately for each treatment scenario. A single hourly source strength file was developed. Source strengths for each treatment scenario were entered for each hour represented in the meteorological data file. Based on a total annual treatment amount of 20,000 pounds for each scenario, 20 entries of 1,000 pounds each were made for TA-16-399, 80 entries of 250 pounds each were made for burning bulk HE at TA-16-388, and 80 entries of 250 pounds each were entered for treating HE-contaminated wastes at TA-16-388. The specific hours were determined by examining the top fifty maximums for 1-hour vapor air concentration obtained during the initial modeling conducted for the initial screening analysis as described in the Draft Screening Report. For operations at TA-16-399, the top 20 hours were chosen. For both operations at TA-16-388, the hours chosen from the top 50 results were augmented by randomly choosing additional hours during the year. This combined source strength hourly file was modified and renamed as needed to account for the variations in annual treatment amounts and per treatment amounts addressed in the expanded screening analysis.

Modeling results obtained from OBODM were inserted into EXCEL® spreadsheets for calculation of constituent-specific air concentrations, deposition flux-based soil concentrations, and, ultimately, comparison to appropriate screening levels.

When the results from the initial modeling run were compared to the screening criteria, the treatment of 20,000 pounds of bulk HE at TA-16-399 passed all four screening analyses. The unitized dispersion and deposition factors predicted by OBODM for that treatment scenario are listed in Table A-8.

Table A-8. Unitized Air Dispersion and Deposition Factors for Treating 20,000 Pounds of Bulk HE at TA-16-399 per Year

OBODM MODEL FILES	Modeled Phase	Annual Treatment Quantity (lb/yr)	Treatment Events per Year	Treatment Quantity per Event (lb/event)	1-Hour Peak Air Concentration ($\mu g/m^3$)	Annual Average Dosage ($\mu g/m^3$)	Annual Average Peak Air Concentration ($\mu g/m^3$)	Total Annual Gravitational Deposition ($\mu g/(m^2 \cdot yr)$)
IND20VA	Vapor	20,000	20	1,000	33,129.3	49.394	49.574	---
IND20PP	Particle	20,000	20	1,000	21,297.7	31.738	31.854	0.65526E+9
IND20PB	Particle Bound	20,000	20	1,000	22,164.2	28.939	29.039	0.14156E+9

Neither scenario at TA-16-388 could pass all screening criteria at the location of the overall predicted maximum impact. For burning bulk HE, the annual average air concentration for total chromium exceeded the screening criterion. Further, the screening analysis showed that 11 constituents potentially emitted during the open burning of HE-contaminated wastes could not meet the screening criteria. After discussing these results with NMED, it was determined that additional modeling would be performed to determine the per-treatment amount and annual treatment amount at which each treatment scenario at TA-16-388 would pass all screening criteria. Tables A-9 and A-10 list the modeled one hour and annual average air concentration unitized dispersion factors for the treatment of HE-contaminated wastes and the burning of bulk HE, respectively.

Table A-9. Sensitivity of Predicted Unitized Air Dispersion Factors to Changes in Treatment Quantify per Event and Frequency of Treatment for the Open Burning of HE-Contaminated Waste at TA-16-388

OBODM MODEL FILES	Annual Treatment Quantity (lb/yr)	Treatment Events per Year	Treatment Quantity per Event (lb/event)	1-Hour Vapor Peak Air Concentration (μg/m³)	1-Hour PP Peak Air Concentration (μg/m³)	1-Hour PB Peak Air Concentration (μg/m³)	Ann Avg Vapor Peak Air Concentration (μg/m³)	Ann Avg PP Peak Air Concentration (μg/m³)	Ann Avg PB Peak Air Concentration (μg/m³)
--- Sensitivity of OBODM Results to Changes in Treatment Quantity per Event ---									
S3275**	22,000	80	275	73394.3	56810.2	63139.5	120.85	95.36	97.049
S3260**	20,800	80	260	71870	55696.4	62504.2	122.7	95.667	99.093
*IND20**	*20,000*	*80*	*250*	*70639.2*	*54813.2*	*61911.7*	*123.84*	*95.767*	*100.43*
S3240**	19,200	80	240	71036.6	55112.5	62258.9	123.99	95.847	100.55
S3200**	16,000	80	200	72826.5	56459.4	63822.8	124.6	96.175	101.07
IND82**	8,000	80	100	79845.7	61727.1	69953.9	126.29	96.99	102.5
IND22**	2,000	20	100	79845.7	61727.1	69953.9	64.022	48.636	53.451
--- Sensitivity of OBODM Results to Changes in Frequency of Treatment ---									
*IND20**	*20,000*	*80*	*250*	*70639.2*	*54813.2*	*61911.7*	*123.84*	*95.767*	*100.43*
IND15**	15,000	60	250	70639.2	54813.2	61911.7	116.05	90.319	94.352
IND10**	10,000	40	250	70639.2	54813.2	61911.7	93.142	72.9	75.864
S35K**	5,000	20	250	70639.2	54813.2	61911.7	61.388	46.816	51.224
S32-5K**	2,500	10	250	70639.2	54813.2	61911.7	41.82	32.138	35.337
S31250	1,250	5	250	70639.2	54813.2	61911.7	24.877	18.858	21.306
S3500**	500	2	250	70639.2	54813.2	61911.7	13.096	9.8184	11.159
S3250**	250	1	250	70639.2	54813.2	61911.7	8.1223	6.3025	7.1187

None of the cases examined in the expanded screening analysis passed all screening criteria for the treatment of HE-contaminated wastes. Examination of Table A-9 shows that when the amount of waste treated per event was increased and the frequency of treatment was held at 80 events per year, one hour average concentrations increased while annual average air concentrations decreased slightly. When the amount of waste treated per event was decreased (from 250 pounds per event), both the one-hour and annual air concentrations increased.

When the amount treated per event was held at 250 pounds and the frequency of treatment was decreased, one hour concentrations remained the same while annual average concentrations decreased. However, the annual average concentrations did not fall to a level that allowed all potentially emitted constituents to pass the screening criteria, even at one event per year.

Table A-10. Sensitivity of Predicted Unitized Air Dispersion Factors to Changes in Treatment Quantify per Event and Frequency of Treatment for the Open Burning of Bulk HE at TA-16-388

OBODM MODEL FILES	Annual Treatment Quantity (lb/yr)	Treatment Events per Year	Treatment Quantity per Event (lb/event)	1-Hour Vapor Peak Air Concentration (μg/m³)	1-Hour PP Peak Air Concentration (μg/m³)	1-Hour PB Peak Air Concentration (μg/m³)	Ann Avg Vapor Peak Air Concentration (μg/m³)	Ann Avg PP Peak Air Concentration (μg/m³)	Ann Avg PB Peak Air Concentration (μg/m³)
--- Sensitivity of OBODM Results to Changes in Treatment Quantity per Event ---									
S230K**	30,000	80	375	51330.8	39406.4	37628.9	59.067	45.235	43.448
S2280**	22,400	80	280	52668.2	40327.2	38600.2	59.635	45.627	43.89
S2270**	21,600	80	270	52833.9	40441.1	38720.5	59.703	45.674	43.943
S2260**	20,800	80	260	53005.7	40559	38845.2	59.773	45.723	43.998
IND20**	20,000	80	250	53184	40681.4	38974.6	59.846	45.773	44.055
S2240**	19,200	80	240	53369.3	40808.6	39109.2	59.921	45.825	44.113
--- Sensitivity of OBODM Results to Changes in Frequency of Treatment (i.e., Annual Treatment Quantity) ---									
IND20**	20,000	80	250	53184	40681.4	38974.6	59.846	45.773	44.055
*S218K***	*18,000*	*72*	*250*	*53184*	*40681.4*	*38974.6*	*53.419*	*41.412*	*39.495*
IND15**	15,000	60	250	53184	40681.4	38974.6	50.269	39.026	37.152
IND22**	2,000	8	250	53184	40681.4	38974.6	27.135	20.553	19.932
S36C50**	600	12	50	87173.3	67203.2	76351.6	40.669	30.447	34.280

Treating bulk HE at TA-16-388 satisfies all screening criteria when the process is limited to burning 18,000 pounds per year at 250 pounds per event. The OBODM results for this upper limit are listed in Table A-11. Further modeling and successful screening of the results established viable lower process limits of 8 events per year and 100 pounds per event. Table A-12 lists the results obtained from OBODM for this case.

Table A-11. Unitized Air Dispersion and Deposition Factors for Treating 18,000 Pounds of Bulk HE at TA-16-388 per Year

OBODM MODEL FILES	Modeled Phase	Annual Treatment Quantity (lb/yr)	Treatment Events per Year	Treatment Quantity per Event (lb/event)	1-Hour Peak Air Concentration (μg/m³)	Annual Average Dosage (μg/m³)	Annual Average Peak Air Concentration (μg/m³)	Total Annual Gravitational Deposition (μg/(m²·yr))
S218KVA	Vapor	18,000	72	250	53,184.0	13.361	53.419	---
S218KPP	Particle	18,000	72	250	40,681.4	10.360	41.412	0.25471E+9
S218KPB	Particle Bound	18,000	72	250	38,974.6	9.8795	39.495	0.58553E+8

Table A-12. Unitized Air Dispersion and Deposition Factors for Treating 800 Pounds of Bulk HE at TA-16-388 per Year

OBODM MODEL FILES	Modeled Phase	Annual Treatment Quantity (lb/yr)	Treatment Events per Year	Treatment Quantity per Event (lb/event)	1-Hour Peak Air Concentration ($\mu g/m^3$)	Annual Average Dosage ($\mu g/m^3$)	Annual Average Peak Air Concentration ($\mu g/m^3$)	Total Annual Gravitational Deposition ($\mu g/(m^2 \cdot yr)$)
S218KVA	Vapor	800	8	100	57,272.9	2.8212	28.454	---
S218KPP	Particle	800	8	100	43,472.3	2.1259	21.439	0.5014E+8
S218KPB	Particle Bound	800	8	100	41,941.7	2.0734	20.909	0.12006E+8

4.0 SCREENING LEVELS

The limited screening for ecological impacts conducted as part of the initial screening analysis was expanded to include additional constituents. In the initial screening analysis, only those potentially emitted constituents with a LANL Ecological Screening Level (ESL) listed in Supplement H-1, Deposition Modeling, of the LANL TA-16 Part B Application, Revision 4 (LANL, 2003) were screened. In the expanded screening analysis, all potentially emitted constituents with an ESL listed in EXCEL® spreadsheet file ESLs R2.2.xls (LANL, 2005) were included. For constituents with multiple values, the most conservative value was chosen for the expanded ecological screen.

All other screening values were as described in Section 4.0, Screening Levels, of the Draft Screening Report.

5.0 RESULTS

EXCEL® spreadsheets were used to calculate constituent-specific air concentrations and deposition fluxes for comparison to appropriate screening levels. As in the initial screening analysis, three spreadsheets were used to perform the four separate screening analyses:

- Maximum 1-hour concentrations were calculated and compared to AIEC values;
- Annual average air concentrations were calculated and compared to one-tenth of the EPA Region 9 PRG values[1]; and
- Total annual gravitational deposition, dry deposition, and 10-year soil concentrations were calculated and compared to NMED SSLs or USEPA Region 6 MSSLs[2] and LANL ESLs.

To ensure the conservative nature of this effort, all screening analyses utilized the overall maximum unitized dispersion and deposition factors predicted by OBODM. For each modeled case, OBODM predicted dispersion factors for 1-hour and annual average concentrations, and

[1] Screening predicted annual air concentrations against 0.1 times the Region 9 PRGs agrees with the approach presented in the *Draft Final Open Burning/Open Detonation Permitting Guidelines* from EPA Region 3.

[2] For screening, the Region 6 MSSL values were multiplied by 10 to adjust for the difference in risk target levels between the MSSLs (10^{-6}) and the NMED SSLs (10^{-5}).

annual average dosage, and deposition factors for total annual gravitational deposition. These overall maximums occurred at points in close proximity to TA-16-388 and TA-16-399 where actual industrial exposures are believed to be intermittent and of relatively short duration (i.e., in an area that personnel cannot enter while actual burning is taking place); however, this has not been confirmed by LANL.

The results for each treatment scenario are discussed below.

5.1 Burning HE-Contaminated Wastes at TA-16-388

When using the overall maximum unitized dispersion and deposition factors predicted by OBODM, treatment of HE-contaminated wastes at TA-16-388 did not pass the four screening analyses regardless of the adjustments made to the treatment quantities. Table A-7 lists the cases examined for this treatment scenario.

Starting with 20,000 pounds per year (80 burn events @ 250 lbs/event), the same 11 constituents failed the screening analyses (i.e., the estimated concentration exceeded the appropriate screening criteria) for the treatment of HE-contaminated wastes. Table A-13 lists the constituents and identifies the screening criteria exceeded. As shown in Table A-10, the 1-hour and annual average unitized dispersion factors increase as the amount of waste treated per event increases. Thus, it is assumed that the screening criteria would not be satisfied in these cases. As the frequency of treatment events is reduced, the annual average unitized dispersion and deposition factors decrease and long term average air and soil concentrations approach the screening criteria.

Examination of Table A-13 shows that 8 of the constituents are associated with the open burning of HE-contaminated liquids (i.e., oils, solvents, and liquid fuels), two are associated with the burning of HE-contaminated combustible solids (dioxin/furan TEQs and zinc), and one, total chromium, is associated with the open burning of HE.

At 10 burn events per year (2,500 lb/yr and 250 lb/event), only 7 constituents exceed a screening criterion; at 2 burn events per year (500 lb/yr and 250 lb/event) and at 1 event per year (250 lb/yr and 250 lb/event), only 4 constituents fail. At these small treatment quantities (500 and 250 lb/yr) the following constituents fail:

- Acrolein fails the 1-hour air concentration screen;
- 1,2-dichloroethylene, trichloroethylene, and dioxin/furan TEQ fail the annual average air concentration screen; and
- Dioxin/Furan TEQ fails the ecological screening.

Table A-13. Potentially Emitted Constituents That Do Not Meet the Screening Criteria for Treating More Than 2,500 Pounds per Year of HE-Contaminated Waste at TA-16-388

Constituent	Source of Emission Factor	Parameter Exceeding Screening Criterion	Screening Criterion
Acrolein	Liquids	1-Hour Average Peak Air Concentration	AIEC
		Annual Average Peak Air Concentration	0.1 x PRG
Benzene	Liquids	Annual Average Peak Air Concentration	0.1 x PRG
Benzo(a)pyrene	Liquids	Annual Average Peak Air Concentration	0.1 x PRG
Chloroform	Oil/Solvents	Annual Average Peak Air Concentration	0.1 x PRG
Chromium (total)	HE	Annual Average Peak Air Concentration	0.1 x PRG
Crotonaldehyde	Liquids	Annual Average Peak Air Concentration	0.1 x PRG
1,2-Dichloroethane	Oil/Solvents	Annual Average Peak Air Concentration	0.1 x PRG
Dioxin/Furan TEQs[3]	OBODM Data Base	Annual Average Peak Air Concentration	0.1 x PRG
		10-year Soil concentration	10 x (Region 6 MSSL)
		10-year Soil Concentration	LANL ESL
Formaldehyde	Liquids	Annual Average Peak Air Concentration	0.1 x PRG
Trichloroethylene	Oil/Solvents	Annual Average Peak Air Concentration	0.1 x PRG
Zinc	Solids	10-year Soil Concentration	LANL ESL

[3] While dioxin and furan TEQs are summed in the expanded screening analyses, it is the furan TEQ emissions that lead to concentrations in excess of the screening levels. When taken alone, dioxin TEQ emissions lead to concentrations that satisfy all screening criteria.

Based on the results of the screening analyses for this treatment operation, and in accordance with the governing guidelines for permitting open burning operations under RCRA Subpart X, a site-specific, multi-pathway risk assessment for the treatment of HE-contaminated wastes at TA-16-388 should be performed before final permit conditions are established for the open burning of HE-contaminated wastes at TA-16-388. The risk assessment should be performed according to the procedures set forth in:

- USEPA Region 3 *Draft Final Open Burning/Open Detonation Permitting Guidelines*; and
- USEPA September 2005 version of the *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*.

Note that any site-specific, multi-pathway risk assessment performed for the TA-16 Burn Ground must consider the combined impact of treatment of HE-contaminated wastes at TA-16-388, the treatment of bulk HE at TA-16-388 and the treatment of bulk HE at TA-16-399 on potential receptor locations.

An additional screening analysis was performed for the treatment of HE-contaminated wastes at TA-16-388 in which the eleven constituents listed in Table A-13 were removed from consideration. After elimination of these eleven constituents, this treatment scenario satisfied all screening criteria at:

- A high limit of 20,000 lb/yr, 80 events per year at 250 lb/event; and
- A low limit of 12 events per year at 50 lb/event.

Based on the use of the overall maximum air quality impacts predicted by OBODM, this treatment process would require restrictions on the types of HE-contaminated wastes burned and/or performance of a more refined risk-based analysis (e.g., site-specific, multi-pathway risk assessment) to demonstrate treatment quantities that are protective of human health and the environment before defensible and permittable operating parameters could be established.

5.2 Burning Bulk HE at TA-16-388

When using the overall maximum unitized dispersion and deposition factors predicted by OBODM, treatment of bulk HE at TA-16-388 passes all four screening analyses at 18,000 pounds treated annually with up to 250 pounds treated per event. Thus, up to 80 treatment events can be conducted per year.

Additional air modeling and screening of the results established viable lower process limits of 8 events per year and 100 pounds per event for the open burning of bulk HE at TA-16-388.

Thus, subject to the lower treatment levels discussed above, any quantity of bulk HE can be treated at TA-16-388 on a weekly or monthly basis as long as the 250 pounds per event and the 18,000 pounds per year treatment levels are not exceeded.

These treatment quantities assume that only bulk HE is treated and all operations occur at TA-16-388; no other treatment operations have been accounted for in identifying these values.

Note that when 20,000 pounds of bulk HE are treated at TA-16-388, total chromium does not pass the screen for annual average air concentration; all other constituents pass the annual average air concentration screen and all constituents, including total chromium, pass the soil concentration screen, the 1-hour air concentration screen, and the ecological screen using LANL's ESLs. The emission factor for total chromium used in the initial and expanded screening analyses is associated with the open burning of HE.

5.3 Burning Bulk HE at TA-16-399

When using the overall maximum results predicted by OBODM, up to 20,000 pounds of bulk HE may be treated per year at TA-16-399 with up to 1,000 pounds per treatment event. Any quantity of bulk HE can be treated at TA-16-399 on a weekly or monthly basis as long as these per treatment and annual treatment levels are not exceeded.

In the initial and expanded screening analyses the major differences in the air modeling for the open burning of bulk HE at TA-16-399 and TA-16-388 are limited to the maximum allowable quantity to be treated per burn event and the location of the burn trays. Based on the similarities between the two processes, the lower processing quantity limits established in the expanded screening analysis for the open burning of bulk HE at TA-16-388 (8 events per year and 100 pounds per event) are believed to represent viable lower process limits for the open burning of bulk HE at TA-16-399 as well.

All values cited in this section assume that only bulk HE is treated and all operations occur at TA-16-399. No other treatment operations were considered in determining that the levels cited in this discussion satisfied all screening criteria.

5.4 Discussion of Results

This expanded screening analysis has demonstrated that:

- For bulk HE, 20 burn events per year can be conducted at TA-16-399 at up to 1,000 pounds per event and the screening criteria considered in this analysis should not be exceeded.

- For bulk HE, 72 burn events per year can be conducted at TA-16-388 at up to 250 pounds per event and the screening criteria considered in this analysis should not be exceeded.

- Even one burn event per year of at 250 pounds per event will not satisfy all the screening criteria considered in this analysis. Further, reducing the treatment quantity to 100 pounds per event will not satisfy all screening criteria.

- When the eleven constituents listed in Table A-13 are eliminated from consideration, the open burning of HE-contaminated waste at TA-16-388 will satisfy all screening criteria at

a high limit of 20,000 lb/yr, 80 events per year, and 250 lb/event; and a low limit of 12 events per year, and 50 lb/event.

Based on the results of the expanded screening analysis, treatment of HE-contaminated wastes at TA-16-388 requires performance of a more refined risk-based analysis (e.g., site-specific, multi-pathway risk assessment) to demonstrate treatment quantities that are protective of human health and the environment and/or restrictions on the types of HE-contaminated wastes burned before final, defensible, and protective permit conditions can be developed. The two major factors influencing the outcome of the screening analyses for the open burning of HE-contaminated waste at TA-16-388 are:

- Uncertainties in the emission factors used in the analyses; and
- Use of the overall maximum impacts predicted by OBODM as the basis for calculating constituent-specific air concentrations, deposition fluxes, and soil concentrations.

Eleven of the potentially emitted constituents from the open burning of HE-contaminated wastes consistently exceeded the appropriate screening criteria for annual treatment quantities between 20,000 and 2,500 pounds. Eight of these constituents were associated with the open burning of HE-contaminated liquids (i.e., oils, solvents, and liquid fuels), two were associated with the burning of HE-contaminated combustible solids (dioxin/furan TEQs and zinc), and one was associated with the open burning of HE. At 10 burn events per year (2,500 lb/yr and 250 lb/event), only 7 of the 11 constituents still exceeded a screening criterion; however, at levels as low as 1 event per year (250 lb/yr and 250 lb/event), 4 of constituents still failed to satisfy the screening criteria. A cursory check of the modeled plume rise for this process showed that the rise for the burning of HE-contaminated waste was an order of magnitude less than achieved for the open burning of bulk HE. This would, at least partially, explain the higher modeling results obtained for this process relative to those obtained for burning bulk HE.

Any refined air modeling and risk-based analyses performed on this process should concentrate on eliminating uncertainty in the emission factor analysis. Careful consideration should be given to developing a suite of potentially emitted constituents that are without question, a realistic but conservative representation of what is expected to be emitted from the open burning operations. This conservatism should be expressed in the number of potentially emitted constituents, the numerical values of the emission factors, and the toxicity of the potentially emitted constituents.

Further, the refined analyses should include full justification of the locations chosen for assessing exposures. The analyses should also demonstrate how exposures at overall maximum impact points predicted by air dispersion modeling are mitigated and/or eliminated.

Note that any site-specific, multi-pathway risk assessment performed for the TA-16 Burn Ground must consider the combined impact of treatment of bulk HE at TA-16-388, the treatment of HE-contaminated wastes at TA-16-388 and the treatment of bulk HE at TA-16-399 on potential receptor locations. Combined impacts were not addressed in the expanded screening analysis.

In closing, the expanded screening analysis was performed to assist NMED HWB permit writers in further understanding the open burning processes conducted at the TA-16 Burn Ground and to provide information helpful in development of draft permit conditions. The air modeling and screening analyses were based on information submitted to NMED by LANL; however, numerous gaps in the information were noted (e.g., dimensions of the burn trays used at the TA-16-388 flash pad). Supplemental information from the open scientific literature and professional judgment were used where these gaps impacted the analyses (e.g., the burn tray modeled at TA-16-388 was assumed to have the same dimensions as the tray used at TA-16-399). It should be expected that the results of more refined air modeling and risk-based analyses will differ from those presented herein. The degree to which this will occur is unknown.

6.0 REFERENCES

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