TA16

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Reference: Work Assignment No. 06280.170.0002; State of New Mexico Environment Department, Santa Fe, New Mexico; LANL Permit Support; Draft TA-16 Screening Analysis Report, Task 2 Deliverable.

Dear Mr. Cobrain:

Enclosed please find the deliverable for the above-referenced work assignment. The deliverable consists of a draft report on the screening level air modeling and risk evaluation for TA-16 open burning operations performed by TechLaw, Inc. (TechLaw). The analysis was performed in general agreement with the approach presented in the TA-16 Burn Ground Air Pathway Assessment Protocol, Revision 1.0, submitted to the Hazardous Waste Bureau by the Los Alamos National Laboratory (LANL) in May 2007:

- The lists of emissions factors developed by LANL were used in the TechLaw analysis;
- The screening values identified in the LANL protocol document 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 Protocol included:

- 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 at the levels proposed in the LANL Protocol 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.

This deliverable has been submitted in draft form so that the analysis can be refined and/or augmented to further characterize the impact of process emissions and to facilitate the development of draft permit conditions for the TA-16 Burn Ground.

The document is formatted in Word. The deliverable was emailed to you on June19, 2007 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

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Submitted to:

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In response to:

Work Assignment No. 06280.170

June 19, 2007

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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. Note that TechLaw's estimates will be replaced 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 will be revised as appropriate based on LANL's refined air modeling analysis and comments received from interested parties.

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 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. 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, May 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 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
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
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

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
Particulate matter	liquids	2.00E-01
Phenanthrene	combust [b]	7.17E-06
Phenol	combust [b]	1.56E-05
Pyrene	liquids	2.00E-06

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

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.

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.

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 Protocol. 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, one to two burns a week are 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 Section 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 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 $\mu g/m^3$)

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 Protocol, 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, a human health risk assessment for the air pathway would 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 values; 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 is an area that personnel cannot enter while actual burning is taking place). 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 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. 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.

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 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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