TA 16

DEPARTMENT OF ENERGY
National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

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NMED Hazardous Waste Bureau

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Mr. John Kieling
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303

Subject: Response to "Notice of Deficiency Technical Review of the March 29, 2007 Protocol for Air Dispersion Modeling at TA-16"

Dear Mr. Kieling:

The purpose of this letter is to provide the National Nuclear Security Administration (NNSA) and the Los Alamos National Security, LLC (LANS) response to the Notice of Deficiency (NOD) issued by the Hazardous Waste Bureau of the New Mexico Environment Department (NMED-HWB) on April 18, 2007. The NOD required further information and an expanded modeling scope for the air pathway assessment being conducted for the Technical Area (TA) 16 Burn Ground. The enclosed documents contain responses to each of the 22 comments contained within the NOD (Attachment 1) and a revised modeling protocol document (Attachment 2).

The NOD requires that a response to the NOD, revised protocol document, and a report on the model's input/output parameters, results of the modeling, and analysis of the model results be submitted by June 1, 2007. This letter transmits the response to the comments in the NOD, and the revised modeling protocol. Using the revised protocol, NNSA and LANS will prepare a report containing dispersion and deposition modeling information, documentation of input/output parameters, modeling results, and the impacts analysis based on the modeling results.

Some of the comments within the NOD were discussed and clarified during a conference call on April 26, 2007 between Rebecca Kay and Steve Pullen of your staff, Michael Smith of TechLaw Inc., and Ann Sherrard, Luciana Vigil-Holterman, Bill Blankenship and myself representing NNSA/LANS. In the revised modeling protocol (Attachment 2) NNSA/LANS has further explained some technical issues for the air dispersion pathway analysis, performed an analysis on the effects of plume rise, and committed to conducting and updating ground level deposition analysis. The modeling protocol has been changed extensively and represents an increase in the scope of the TA-16 air pathway assessment.

On May 15, 2007, LANS requested an extension for the submittal of the modeling report to July 20, 2007. In a conversation with Rebecca Kay and David Cobrain of your staff on May 30, 2007, it was learned that this extension request would be denied because submitting the report by July 20, 2007 would not provide NMED-HWB sufficient time to adequately review the modeling report and still release the draft permit in August, 2007. In that discussion, it was agreed that LANL would transmit the enclosed documents on June 1, 2007 and the modeling report will be transmitted during the public comment period on the draft renewal of the LANL Hazardous Waste Facility Permit with no consequences for the delay. NNSA/LANS will also provide the modeling report upon completion to give NMED-HWB the opportunity for review prior to formal submittal during the public comment period. As agreed with NMED-HWB, model runs will commence in accordance with the enclosed revised model protocol and NMED-HWB will verbally communicate any issues that arise during the review.

If you should have any questions or concerns regarding this submittal, please feel free to contact me at (505) 667-5794 or Jack Ellvinger, LANS, at (505) 667-0633.

Sincerely,

Gene Turner

Gene Turner
Environmental Permitting Manager

EO: 2GT-035

cc:
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Attachment 1

Response to "Notice of Deficiency Technical Review of the March 29, 2007 Protocol for Air Dispersion Modeling at TA-16," dated April 18, 2007

LA-UR-07- 3522

LA-UR-07-3522

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Title: Response to "Notice of Deficiency Technical Review of the March 29, 2007 Protocol for Air Dispersion Modeling at Technical Area 16"

Author(s): Water Quality and RCRA Group
Los Alamos National Laboratory

May 2007

Intended for: New Mexico Environment Department-
Hazardous Waste Bureau

Los Alamos
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Form 836 (7/06)

INTRODUCTION

The following information is the response by the National Nuclear Security Administration (NNSA) and the Los Alamos National Security, LLC, owner/co-operators of Los Alamos National Laboratory (LANL), to the "Notice of Deficiency Technical Review of the March 29, 2007 Protocol for Air Dispersion Modeling at TA-16," issued by the New Mexico Environment Department (NMED) on April 18, 2007. This document consists of responses to the comments contained in the Notice of Deficiency (NOD). NMED's original comments are included in this document as italicized text for ease for review. A second attachment (Attachment 2) includes a revised modeling protocol document titled, "Technical Area (TA) 16 Burn Ground Air Pathway Assessment Protocol, Revision 1.0." Some of NMED's comments in the NOD were clarified during an April 26, 2007 conference call between Rebecca Kay (NMED), Steve Pullen (NMED), Michael Smith of TechLaw Inc., Gene Turner (NNSA), Ann Sherrard (LANL), Bill Blankenship (LANL), and Luciana Vigil-Holterman (LANL). LANL responses to NMED comments reflect the discussions during this conference call.

NOD COMMENTS AND RESPONSES

General Comments:

1. *Due to the differences in the two types of wastes streams treated by open burning at the Los Alamos National Laboratory (LANL) TA-16 Burn Ground, the combined worst case emission factor approach proposed by the Permittees in Section 3.3 must be applied independently to the two waste streams. Their differing energy contents make it likely that the characteristics of the two types of burns conducted at TA-16 are quite different. This must be reflected in the air modeling analysis.*

   Two lists of the worst-case emission factors must therefore be developed and form the basis of the model to run. A list, similar to Table 3-1 in the Document, shall be submitted for the open burning of bulk or pure High Explosives (HE) at TA-16-399 and TA-16-388. Another list similar to Table 3-6 shall be submitted for the open burning of wastes contaminated by HE at TA-16-388.

LANL Response:

Section 4 of the protocol document (Attachment 2) has been revised to clarify how each of the units and waste streams will be represented by model runs. Section 5 has been added to the revised modeling protocol to clarify how impacts will be calculated.

As stated in Section 4 of Attachment 2, model runs will be conducted using a 1 gram/second (g/s) emission rate and plume dispersion characteristics, including combustion rate associated with the following fuel or propane quantities:

- 1000 pounds (lb) of HE treated per hour at TA-16-399
- 250 lb of HE treated per hour at TA-16-388

- 250 lb of HE treated per hour at TA-16-388, using only the energy released from the propane burners for determining plume rise

The conditions that create the highest on-site and off-site impacts will be identified by these runs and conversion factors will be calculated to translate pollutant specific emission factors into air quality and deposition impacts. As described in Section 3 of Attachment 2, Table 3-6 includes the worst-case emissions factors for all of the wastes described including the open burning of pure HE located in Table 3-1. When calculating impacts (see Section 5 of Attachment 2), use of the worst-case emission factors simplifies the analysis and allows for NMED to easily set limits for the total amounts of waste that can be treated. Using worst-case emission factors avoids multiple calculations showing impacts from various amounts of the different waste streams, which can become complex, time-intensive, and confusing when setting limits. The use of the worst-case emission factor also provides the most conservative analysis.

2. *Additional information regarding the input parameters and the setting of modeling options for the air dispersion modeling runs is needed. Revise the Document to provide this information in sufficient detail to:*

   - *determine the types of air quality impacts that will be modeled (e.g., air concentrations and/or deposition);*
   - *identify the source algorithm(s) used in modeling each process; and*
   - *convey the characteristics of the processes being modeled.*

LANL Response:

As discussed in the April 26, 2007 conference call, deposition modeling will be rerun using the same assumptions as the air concentration modeling so as to address NMED's interest in a worst-case impacts analysis rather than the single year previously modeled. Section 2.3 of Attachment 2 has been added to describe the screening levels that will be used for the ground level deposition analysis. Section 4 of the revised protocol addresses the model input parameters for deposition. Section 5.2 has been added to Attachment 2 to describe deposition impacts calculations.

NMED and LANL also discussed in the April 26, 2007 conference call specific information needed regarding source algorithms and process characteristics. Section 4 of Attachment 2 has been revised to clarify the following:

- The source will be modeled as an area source.

- Section 4.1 of Attachment 2 clarifies that CALMET, the meteorological preprocessor distributed with CALPUFF, will be used to process the meteorological data.

- The modeling will also include dry deposition mechanisms, the process by which atmospheric gases and particles are transferred to the surface as a result of

physical processes including, random turbulent air motions, gravitational settling, and vegetative scavenging.

- A description of the methodology to incorporate the buoyant rise of the emission source is included in the revised modeling protocol.

3. *The Permittees shall submit in their air dispersion modeling report electronic versions of all air dispersion modeling input and output files and all model-ready ancillary files (e.g., meteorological, terrain) necessary to re-create the air dispersion modeling runs.*

LANL Response:

LANL will provide NMED with input files and an example of a model run input and output along with the compiled program files. These files will be included with the modeling report that will be submitted to NMED at the time of completion and formally during the public comment period on the draft renewal LANL Hazardous Waste Facility Permit.

4. *Based on the information provided to NMED, it is not clear how the Permittees will relate the air modeling analysis described in the Document to the deposition modeling submitted to NMED in Supplement H-1 (from the LANL TA-16 Part B Application, June 2003). In its letter of February 28, 2007, NMED required that the Permittees ensure that the input parameters are consistent between the dispersion and the deposition models. If no additional deposition modeling and/or screening of the impacts due to deposition of emitted constituents is performed, the Permittees must demonstrate that the previous deposition analysis (June 2003) is compatible with the analysis described in the Document. This demonstration must show that:*

   - *similar waste streams and quantities of wastes are addressed in both analyses;*
   - *similar emission profiles (and emission factors) are used in both analyses;*
   - *essentially identical meteorological datasets are used in all air dispersion modeling runs across both analyses; and*
   - *modeled input parameter values for each type of process modeled are essentially identical for both analyses.*

LANL Response:

As discussed in General Comment 2, LANL will rerun the deposition modeling with the same parameters as the current air dispersion modeling and the use of a worst-case rather than a single year's emissions analysis. This will provide and update deposition impacts analysis and comparison to the June 2003 analysis will not be necessary. The deposition impacts analysis will be transmitted as part of the modeling report that will update the

deposition information contained within Supplement H-1 of the application; therefore, comparison to the application will not be necessary.

5. *The input parameter list appearing at the top of page 4 of Supplement H-1, Deposition Modeling, suggests that the open burn processes at TA-16 were modeled as point sources (i.e., stacks) in the 2003 air deposition analysis. No rationale supporting this approach was provided. Use of the point source algorithm in CALPUFF may be appropriate if it can be shown that the buoyant rise of the plume was modeled appropriately. If this same approach is envisioned for the air modeling analysis described in the Document, must be thoroughly discussed and justified. Depending on the process parameters and appropriate specification of model inputs, other possible approaches for the application of CALPUFF to the open burning processes at the TA-16 Burn Ground could include the use of the area source algorithm or modeling plume rise with another source model and providing that plume rise as a "plug-in" to the dispersion and deposition algorithms in CALPUFF (Strimaitis, 2007) (see also comment 14 below).*

LANL Response:

Please see LANL's responses to General Comments 2 and 4.

Specific Comments

1. *It is not clear why only a single set of UTM coordinates is provided for TA-16-399 and TA-16-388 (Section 1.0, p. 1 of 14). The two open burn areas are located at a significant distance apart and therefore should be modeled as separate locations. Provide additional information on the locations of TA-16-399 and TA-16-388 using their individual location coordinates. The Permittees shall use these two separate sets of coordinates in the air dispersion modeling of both processes.*

LANL Response:

Section 1.0 of the revised modeling protocol (Attachment 2) shows a set of UTM coordinates for each unit.

2. *In Section 2.1 (p.2 of 14), the Permittees comment that only SO_2 Ambient Air Quality Standards were used in this analysis because hydrogen sulfide and total reduced sulfur are not emitted by open burning.*

   In the bang box tests, no emission factors were developed for H2S or other reduced sulfur compounds. Hydrogen sulfide (and other reduced sulfur compounds) is not expected, but its presence or absence in the emission products has not been

confirmed. The authors of Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD) (Mitchell and Suggs, 1998) note that sulfur recovery was low, but variable in all tests and state on page 31 that:

"The low and variable recoveries for S... should be investigated further. It is possible that the S was converted to compounds, such as SO_3, H_2SO_4, H_2S, metallic sulfates, or even free S (S_8); none of which were target analytes."

Similar statements are found in related documents describing the current state-of-the-art and future research needs in developing emission factors for Open Burn/Open Detonation (OB/OD) (Mitchell, 1999; Anderson 1999).

Because the presence or absence of reduced sulfur compounds has not been confirmed in emissions testing for open burn processes, the Permittees must provide reference citations from the scientific literature to support the statement that hydrogen sulfide and/or other total reduced sulfur are not emitted during open burning.

LANL Response:

No emission factors for reduced sulfur compounds have been identified in any of the external combustion sources located in the Environmental Protection Agency (AP-42) Compilation of Air Pollutant Emission Factors (AP-42, 1995). Based on the April 26, 2007 conference call with NMED and their consultant, it was agreed that the analysis should be based on available emission factors. LANL has revised the air dispersion modeling protocol (Attachment 2) to clarify that only published emission factors will be used in the air dispersion model report. Section 3.0 of Attachment 2 clarifies this by stating: "The contaminants listed are those that have an emission factor for a constituent with an air quality or deposition limit." The original bullet concerning reduced sulfur compounds is not applicable and has been deleted.

3. *In Section 3.1 (p.3 of 14) the Permittees identify the primary types of HE treated as HMX, TATB, TNT, and RDX and that the types of materials addressed in the Open Burn/Open Detonation Dispersion Model (OBODM) User's Guide (Bjorklund et al, 1998) that would be most similar to those treated at LANL are:*

   - *M-43, which contains RDX;*
   - *PBXN-110, which contains HMX; and*
   - *M3 1AlE1, a mixture of explosives.*

   The listed surrogates (M-43, PBXN-110, and M31A1E1) do not contain TATB or TNT, although in the second paragraph of Section 3.1 it is noted that emission factors for a limited number of emitted constituents from the open burning of TNT are specified as described.

Further, based on the primary types of HE listed (HMX, TATB, TNT, and RDX) it is not clear why emission factors from the M31A1E1 open burn tests were selected. The Permittees must revise the Document to include additional information on the constituents and/or components included in the pure HE burned at TA-16-399 and TA-16-388 and the selection of appropriate emission factors for the HE treated at TA-16. This information should be focused on demonstrating that:

- *M31A1E1 is an appropriate surrogate for the pure HE burned at TA-16-399 and TA-16-388; and*
- *The group of proposed surrogates adequately and conservatively represent the actual emissions from open burns of the types of HE treated at TA-16.*

This information should be presented in a format similar to the information presented in Table 7 of Appendix B, Response to Notice of Deficiency; TA-16 Part B Application Revision 3.0, January 31, 2000: February 2002. LANL may utilize the information from Table 7 only if the information provided is still applicable.

LANL Response:

As discussed during the April 26, 2007 conference call, additional clarification for the use of the HE mixture M31A1E1 has been added to Section 3.1 of Attachment 2 to address this comment.

4. *It is noted in Section 3.1 (p.3 of 14) that the TNT emission factor for Particulate Matter has been included in Table 3-1, Emission Factors for Burning HE. However, no information on how this factor will be used in the screening analysis is provided. Revise the Document to indicate the compounds or constituents that will be characterized using this emission factor (e.g., total suspended particulate (TSP), PM_{10}, $PM_{2.5}$).*

LANL Response:

Section 2.1 of the revised modeling protocol (Attachment 2) provides the reasoning behind not modeling $PM_{2.5}$ and Section 3.0 clarifies the use of PM_{10} and TSP emission factors.

5. *Section 3.2 (p.4 of 14) indicates that materials burned at TA-16-388 may consist of pure HE or HE-contaminated combustible solids, liquids, or non-combustibles. The Document suggests that three unique open burning operations occur at TA-16:*

   - *burning of large quantities of pure HE at TA-16-399;*
   - *burning of smaller quantities of pure HE at TA-16-388; and*
   - *burning of HE-contaminated combustible solids, liquids, or non-combustibles at TA-16-388.*

Due to their unique nature (e.g., different locations, different amounts of waste processed per event, different heat contents, and different process temperatures) it is anticipated that these three operations will be modeled separately. This is not, however, clearly stated in the Document. The Permittees must revise the Document to indicate that these three operations will be modeled separately.

LANL Response:

Section 4.2 of the revised modeling protocol (Attachment 2) has been modified to address the model runs for large quantities of HE at TA-16-399 and smaller quantities of HE and other wastes at TA-16-388.

6. *The Permittees state in Section 3.2 (p.4 of 14) that the maximum amount of burnable material that can be treated at TA-16-388 is 250 lb/burn. For burns of HE-contaminated combustible solids and liquids, it is not clear if the 250 lb/burn specification applies to the amount of HE treated during the burn event or to the total weight of the waste in the burn pan. Revise section 3.2 to clarify whether or not the 250 lb/burn is the maximum amount of HE that can be burned at this unit per event. In addition, ensure that any altered application language is submitted with the model report.*

LANL Response:

The text within Attachment 2 has been changed to clarify that materials that do not burn (e. g. metal and soil) are not included in the 250 lb burn limit for TA-16-388.

7. *There is a reference to "dry waste" in the discussion at the top of page 5 (of 14) in Section 3.2.1:*

   > *"These emission factors, shown in Table 3-2, should be much higher than for LANL combustibles, which in contrast are characterized by dry waste... "*

   This statement is confusing because the Permit application states that the HE-contaminated solids treated at TA-16-388 could be wet or dry (see TA-16 Part B Application, Attachment G, Section G. 1.1, Revision 4.0, June 2003). The Permittees must revise the Document to eliminate any confusion regarding the physical characteristics of the HE-contaminated solid waste streams burned at TA-16-388.

LANL Response:

During the April 26, 2007 conference call, NMED clarified that there was some confusion of whether the reference to "dry" waste in Section 3.2.1 also applied to wet HE. Section 3.2.1 of the modeling protocol refers only to combustible solids. Wet HE emission factors are discussed in Section 3.1. The reference to "dry" in Section 3.2.1 was

only directed at combustible solids. Based on the April 26, 2007 conference call, the reference to "dry" has been deleted from Attachment 2.

8. *To determine if the approach in Section 3.2.3 (p.5 and 6 of 14) is adequate, the organics present in the Permittees' contaminated solvent waste stream must be compared to those present in the materials for which emission factors were derived in the cited references. If there is agreement, the proposed emission factors from these references will suffice. If not, applicable emission factors must be applied. Revise the Document to include a list of the organic constituents associated with the oils and solvents in the liquids contaminated with HE that are treated at TA-16-388.*

   This information must be presented in a format similar to the information presented in Table 5 of Appendix B, "Response to Notice of Deficiency; TA-16 Part B Application Revision 3.0, January 31, 2000: February 2002." The Permittees may utilize the information from Table 5 only if the information provided is still applicable. The Permittees must also review Table 6 from Appendix B of the above-referenced document in order to determine if additional emission factors identified in Table 6 and excluded from Table 3.3 of the Document (e.g., methylene chloride) should be added to Table 3.3.

LANL Response:

Based on the conference call on April 26, 2007, Section 5.3 has been added to the revised modeling protocol (Attachment 2) to describe a method of estimating acceptable releases of individual regulated solvents referenced in the most recent LANL General Part A Permit Application (LANL, 2006). It is anticipated that the analysis described in Section 5.3 will allow a reality check to see whether setting limits for individual solvents is necessary.

9. *The reference in Section 3.2.3 (p.6 of 14) to section 2.1 appears to be a typographical error. The reference should be made to Section 3.1. Review the text and revise the section reference.*

LANL Response:

The typographical error within Section 3.2.3 of Attachment 2 has been revised.

10. *Based on NMED's present level of knowledge of the solid waste stream contaminated by HE, it is not clear why emission factors for the burning of aluminized ammonium perchlorate propellant were proposed as surrogates for the dioxin/furan emissions for the burning of wastes contaminated by HE at TA-16-388 (Section 3.2.4, p.6 of 14). The dioxin/furan emission factors cited in Appendix D of Emission Factors for the*

Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD) (Mitchell & Suggs, 1998) for aluminized propellant manufacturing waste are more conservative and may be more applicable to burning solids contaminated by HE at TA-16-388. Some of the constituents of the manufacturing waste stream (e.g., plastic gloves, anti-static polyethylene, paper/wood/cloth) are believed to be components of the contaminated solids burned at TA-16-388. The application of the dioxin/furan emission factors for the aluminized propellant manufacturing waste will result in more conservative estimates of the dioxin/furan emissions from the process to be modeled. The Permittees stated in their February 2002 "Response to Notice of Deficiency; TA-16 Part B Application Revision 3.0, January 31, 2000" that "the most similar waste stream [for polyethelene plastics] was the Aluminized Propellant Manufacturing Waste Surrogate (AP Waste) Burn)." The Permittees shall therefore utilize the dioxin/furan emission factors for the aluminized propellant manufacturing waste in the air dispersion modeling analysis.

LANL Response:

The Non-aluminized Ammonium Perchlorate (NAAP) Propellant data from the OBODM were used for dioxins/furans because the NAAP had a dioxin emission factor and there was no dioxin emission factor for Ammonium Perchlorate Manufacturing Waste (APMW). The dioxin air quality screening limit is 4.5E-08 micrograms per cubic meter ($\mu g/m^3$). The furan air quality screening limit is 3.7E+00 $\mu g/ m^3$, which is eight orders of magnitude higher than the dioxin limit. Therefore, the NAAP data was deemed to be a more conservative source of emission factors. As discussed during the April 26, 2007 conference call, the use of the OBODM NAAP data for dioxin is appropriate. However, in order to provide an even more conservative analysis, LANL will use the OBODM APMW for furans, because its emission factors are higher for furans than the NAAP furan factors.

11. *While NMED acknowledges that propane is a relatively clean burning fuel, a reference to the scientific literature supporting the statement that "...propane is a very clean-burning fuel and products of incomplete combustion should be minimal" (section 3.2.5, p.6 of 14) should be provided. Revise the Document to include references to the scientific literature that support this statement.*

LANL Response:

Propane is an approved, alternative clean fuel listed in the 1990 Clean Air Act as well as the National Energy Policy Act of 1992. Based on conversation during the April 26, 2007 conference call, this is not germane to the emission factors and the statement that propane is a clean fuel has been deleted from Attachment 2.

12. *The statement that "emissions from burning the propane are additive to the emissions from burning the waste", Section 3.2.5, p.6 and 8 of 14, suggests that the propane*

emission factors must be added to the emissions from waste burning. For a more complete and transparent description of the emission factor analyses, the Permittees must revise the air modeling protocol to describe how the proposed emission factors for propane are incorporated into the emission factors listed in Table 3-6, Worst-Case Emission Factors for Combined Wastes.

LANL Response:

The analysis of impacts for propane has been clarified in Section 5 of Attachment 2.

13. *According to the Permittees, "the highest emission factor for each contaminant was selected from all of the wastes burned. Table 3-6 shows the contaminant, the waste type that had the highest emission factor, and the emission factor from the tables above" (Section 3.3 and Table 3-6, p.7 and 8 of 14). Based on the information contained in the Document, it is not clear to NMED how the worst-case emission factors listed in Table 3-6 will be applied in the air modeling analysis. The Permittees must clarify this.*

    Due to the differences in the open burning processes at LANL, the combined worst case emission factor approach proposed by the Permittees in Section 3.3 should be applied only to the waste streams burned at TA-16-388 that are contaminated with HE. The burning of pure HE at TA-16-399 and TA-16-388 should be analyzed using emission factors developed for the open burning of pure HE. NMED notes that emission factors for burning pure HE are listed in Table 3-1 of the Document.

    The Permittees must revise the Document to eliminate confusion regarding the application of the emission factors listed in Table 3-6 and indicate which processes will be analyzed using the emission factors listed in Table 3-6. The Permittees must also revise the text to specifically state that the open burning of pure HE at TA-16-399 and TA-16-388 will be analyzed using emission factors developed for the open burning of pure HE. The Permittees must ensure that the air dispersion modeling analysis employs two separate lists of worst case emission factors as stated above and submit the results to NMED as part of the response to this NOD.

LANL Response:

Due to conversation during the April 26, 2007 conference call, Section 5 has been added to Attachment 2 to explain how impacts analysis will be handled. Section 3.3 of the modeling protocol (Attachment 2) has been revised to describe how Table 3-6 emission factors were developed.

14. *Within Section 4.1, (p.9 and 10 of 14), the Permittees have provided a discussion supporting the use of CALPUFF for modeling air quality impacts from open burning operations at the TA-16 Burn Ground. The text describes the limitations of applying*

OBODM in the complex terrain at and surrounding the TA-16 Burn Ground and provides an overview of the treatment of complex terrain by the CALPUFF model. The discussion notes that the buoyant plume rise is addressed by the Briggs formulation in the two different air dispersion models.

NMED acknowledges that CALPUFF provides a more rigorous treatment of surrounding terrain and can offer a more thorough treatment of meteorological conditions in the modeling domain. However, NMED remains concerned that, as previously discussed with the Permittees, the application of CALPUFF to the sources being modeled at the TA-16 Burn Ground, especially open burns of pure HE at TA-16-399 and TA-16-388, has not been adequately justified. No new information addressing NMED's concern has been furnished in the Document.

The Permittees must include the heat content of the charge to be burned, as this influences burn time, and the reactions that occur in the plume during initial plume rise. If the heat content is high and burn times are short, the buoyant plume rise may not be modeled adequately (Bjorklund et al, 1996 and Strimaitis, 2007). Based on the process temperatures provided by the Permittees (Section 4.2 of the Document), it is clear that the heat content of a pure HE burn is higher than the heat content when burning waste streams contaminated by HE.

The Permittees must revise the Document to provide additional information justifying the use of CALPUFF in modeling the open burning of pure HE and waste streams contaminated with HE at the TA-16 Burn Grounds. At a minimum, this information must provide estimates of the heat content and burn time for these two unique waste streams and demonstrate that the application of the CALPUFF model will result in an adequate representation of initial mixing, air entrainment, and buoyant plume rise of the processes to be modeled.

Note that CALPUFF provides "plug in" capabilities, allowing the plume rise to be modeled by another source model (e.g., OBODM, POLU); the result is then used as an input to the CALPUFF dispersion and deposition routines (Strimaitis, 2007). This type of "hybrid" application may offer an approach that reflects the inherent strengths of a source model developed specifically for open burn processes similar to those conducted at LANL and the air dispersion and deposition algorithms in CALPUFF.

LANL Response:

As discussed with NMED during the April 26, 2007 conference call, Sections 4.1 and 4.4 of the modeling protocol (Attachment 2) have been revised to address how key plume rise parameters will be specified for modeling.

15. *To provide a more complete and transparent air modeling analysis, the Permittees must run the model utilizing the most recent meteorological data set for Los Alamos. NMED is concerned that the proposed 1995 meteorological data set in Section 4.2 (p.*

10 of 14) is outdated and should be replaced with the most current data available. If the 1995 meteorological data set is used, this application should be fully justified in the air dispersion modeling protocol. If it is not used, the Permittees must submit the new model ready complete data set to NMED.

As NMED's February 28, 2007 letter noted, "the Permittees must ensure that the input parameters are consistent between the dispersion and the deposition models." The Permittees must indicate whether the meteorological dataset used in the deposition analysis (TA-16 Part B Application, Supplement H-1 (June 2003)) is the same as the one being used in the air dispersion modeling analysis. If this is not the case, the Permittees must re-run the deposition model with the same input data as the dispersion model. This includes, but is not limited to, the meteorological data set.

LANL Response:

NMED's Air Quality Bureau clarified that the 1995 meteorological data set is appropriate as discussed during the April 26, 2007 conference call. As described in the response to General Comment 2, the deposition modeling will be performed with the same input parameters as the air dispersion modeling.

16. *Note that simulating a one hour burn in the air modeling analysis, as mentioned in section 4.2 (p.10 of 14), will result in a permit condition that limits burn times to one hour. If burns are anticipated to last longer than one hour, the anticipated maximum longer burn time must be modeled.*

LANL Response:

The intent of assuming 1-hour burns is to provide a conservative analysis for the shortest and most time-sensitive averaging period for air quality limits. Some burns can take more than 1 hour but assuming all emissions occur within an hour results in a higher 1-hour impact. If a burn takes two hours to treat a volume of waste, lower 1-hour impacts would be expected because hourly emissions would be halved. Based on the conference call with NMED on April 26, 2007, LANL will use the conservative 1-hour assumption for the short-term impacts analysis and NMED will not establish a 1-hour burn time as a permit term.

17. *It is not clear whether the Permittees are proposing to use 750 °C as the sole burn temperature to be modeled or only as the temperature achieved when the propane burners are utilized (i.e., the open burning of wastes contaminated with HE at TA-16-388). The Permittees must revise Section 4.2 (p.10 of 14) to specify a temperature for each process to be modeled. Based on NMED's current understanding of the open burning processes at the TA-16 Burn Ground, three temperatures should be proposed: one for modeling burns of pure HE at TA-16-399, one for modeling burns of pure HE at TA-16-388, and one for modeling burns of wastes contaminated by HE at TA-16-388.*

Further, it is not clear how the modeling results achieved using the lowest temperature in the cited ranges will be applied in the air modeling analysis. Use of a lower temperature in defining the emission source generally results in overall maximum impacts of higher numerical value closer to the source; increasing the source temperature will move the overall maximum impact further from the source but will also reduce its numerical value. If the Permittees are proposing to use the overall maximum modeled concentration for both on-site and off-site receptors, use of the lowest-temperature in the cited ranges is likely to be appropriate for this type of screening analysis. Therefore, Section 4.2 must be revised to specifically state this.

If unique modeling results will be used for screening on-site and off-site receptors, it is not clear how the use of the lowest temperature cited will result in the most conservative analysis for both receptor locations. Revise the Document to provide additional information on the specification of source definition temperatures for the air modeling analysis. The Permittees must demonstrate that the chosen temperatures will result in a conservative analysis of health impacts for on-site and off-site receptors. If such a demonstration cannot be provided, each process at the TA-16 Burn Ground must be modeled using the lowest cited temperature for the process and the overall modeled maximum impact must be used in screening both on-site and off-site receptors.

The revised Document and the model's input/output parameters, results, and analysis must be submitted to the NMED no later than June 1, 2007. The Permittees must submit the results of the model applications with the revised Document and input parameters.

As stated in NMED's February 28, 2007 letter, NMED expects the Permittees to model emissions using the maximum amount of energetic material per period provided in the Permit application. Any altered application language must be specifically identified in the response submitted with the model report.

LANL Response:

Section 4 of the modeling protocol document (Attachment 2) has been revised to include more specific information about other parameters as discussed with NMED during the April 26, 2007 conference call regarding the effect of effluent temperature on plume rise. Appropriate temperatures for each of the burn scenarios in Table 4-1 of Attachment 2 will be used; however, burn temperature is not the only parameter influencing buoyant plume rise. Section 4.3 of Attachment 2 provides additional information about other important plume rise parameters.

One issue that surfaced was a question regarding the effects of burn temperature. If heat generation rate and burn area (footprint size) are held constant, then a measured *increase* in the effluent temperature indicates a decrease in updraft velocity and a *decrease* in plume rise, which is counter-intuitive. The equation for updraft velocity has been added to Section 4.4 of Attachment 2 in response to Specific Comment 14 and clarifies that ΔT appears in the denominator. If heat production and burn area are constant, then a higher

effluent temperature (larger ΔT) implies that the air passing through the column is being heated more effectively and less volumetric flow is being driven to carry away the combustion energy. This behavior arises because the heat capacity of air, which is relatively constant property, determines how much energy can be absorbed per unit mass and what the corresponding temperature increase will be.

REFERENCES

AP-42, 1995. "Compilation of Air Pollutant Emission Factors, Fifth Edition, Volume I," http://www.epa.gov/ttn/chief/ap42, January 1995.

LANL, 2006. "Los Alamos National Laboratory General Part A Permit Application, Revision 5.0," LA-UR-07-0050, Los Alamos, New Mexico, April 2006.

Attachment 2

Technical Area (TA) 16 Burn Ground Air Pathway Assessment Protocol, Revision 1

LA-UR-07- 3523

LA-UR-07-3523

Approved for public release; distribution is unlimited.

Title: Technical Area (TA) 16 Burn Ground Air Pathway Assessment Protocol, Revision 1.0

Author(s): Water Quality and RCRA Group
Los Alamos National Laboratory

May 2007

Intended for: New Mexico Environment Department-HazardousWasteBureau

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Form 836 (7/06)

1.0 INTRODUCTION

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

- the TA-16-399 Burn Tray, which is used to treat bulk dry high explosives (HE) and
- the TA-16-388 Flash Pad, which is used primarily to treat wet HE, combustibles, or other HE-contaminated materials using an external heat source (propane) but can also be used to treat HE.

The location coordinates of open burn units in Universal TransMercator (UTM) Zone 13, coordinates are:

Unit	X-Coordinate	Y-Coordinate
TA-16-388 Flash Pad	379720.1133	3967617.404
TA-16-399 Burn Tray	379783.1419	3967735.864

When the TA-16 Part B Permit Renewal Application was submitted in June 2003, open burning impacts from the treatment of RCRA wastes were covered by an air permit issued under New Mexico Environmental Department's Open Burning Regulation (20.2.60 NMAC). The TA-16 RCRA application referenced the air permit as the means of assessing and regulating air emissions impacts. The Open Burning regulation changed in 2003, excluded all burning activities covered under RCRA and the Open Burning permit for the TA-16 Burn Ground was withdrawn. Therefore, Los Alamos National Laboratory (LANL) will be submitting an air quality and impacts analysis to support the TA-16 Part B Permit Renewal Application. This modeling protocol document discusses how the air quality impacts estimates will be performed in accordance with The Environmental Protection Agency's (EPA's) Draft Final Open Burning/Open Detonation Permitting Guidelines (EPA, 2002b, http://www.epa.gov/reg3wcmd/OBOD_Guidelines.pdf), referred to hereinafter as the EPA OBOD Permitting Guidelines. The permit application also contained a deposition impact assessment based on wastes that were treated at the TA-16 Burn Ground during a single year. The deposition modeling will be updated to reflect the same worst-case waste quantities used for the air quality dispersion analysis rather than an assessment of a single year's waste.

Determining the air quality impacts and pollutant deposition from the TA-16 Burn Ground is a five part process.

STEP 1: Pollutant-specific air quality and deposition screening levels are identified and compared to impacts resulting from the TA-16 Burn Ground operations (see Steps 4 and 5). The sources of the screening levels are described in Section 2 of this document.

STEP 2: Emission factors (EFs) are identified from the available literature for pollutants with screening levels. The EFs listed for general waste types treated at the TA-16-Burn Ground are discussed in Section 3 of this document. These waste-specific EFs have been used to develop worst-case pollutant-specific EFs that can conservatively be applied to all waste streams treated.

STEP 3: The air quality and deposition impacts from releasing a standard 1 gram per second (g/s) of any pollutant are calculated by the air dispersion model at all receptor points for different impact averaging periods (e.g., hourly, daily, monthly, annual). The model selection, its inputs, and other pertinent modeling information are described in Section 4 of this document.

Initially, both TA-16-388 and -399 will be modeled with their individual source and waste characteristics to determine which causes the worst-case on-site and off-site impacts (note that one unit may be responsible for worst-case on-site impacts and the other unit may be responsible for worst-case off-site impacts). The highest on- and off-site impact receptors and any other receptors of interest for each averaging period are identified and receptor-specific conversion factors (CFs) are calculated. The CFs are used to convert the amounts of pollutant released to air concentrations or deposition values.

STEP 4: Impacts are calculated using the EFs described in Step 2, the averaging-period CFs derived from the modeling described in Step 3, and the amount of waste burned during each averaging period of interest. The method of calculating impacts is described in Section 5.

STEP 5: The impacts calculated in Step 4 are compared to the air quality and deposition screening levels described in Step 1. If the TA-16 Burn Ground impacts are less than these screening levels, impacts are acceptable and more comprehensive analyses such as risk assessment are not required.

2.0 SCREENING LEVELS

Air quality impacts will be evaluated against ambient air quality standards (AAQS) and toxic air pollutant screening levels. Deposition modeling will be evaluated against the New Mexico Environment (NMED) and EPA human health risk factors and LANL Ecological Screening Levels (ESLs).

2.1 Ambient Air Quality Standards

The New Mexico Environment Department (NMED) and EPA have ambient air quality standards (AAQS) for particulate matter, lead, sulfur compounds, carbon monoxide, and nitrogen dioxide. If both NMED and EPA have AAQS for the same compound, the lowest standard will be used.

Several AAQS will be eliminated for the following reasons:

- There is a federal standard for ozone but the dispersion models for OB sources do not simulate photochemical reactions and ozone formation impacts are not considered significant (EPA, 2002b, http://www.epa.gov/reg3wcmd/OBOD_Guidelines.pdf).
- Particulate matter that is 2.5 micrometers (μm) or smaller in size ($PM_{2.5}$) is difficult to model because it includes not only the fine particles emitted directly by the source but precursors that may result in secondarily-formed fine particles through chemical reactions in the atmosphere. Also EFs for $PM_{2.5}$ and its precursors are largely unavailable. Given these difficulties, EPA policy states that modeling which shows

compliance for the particulate matter that is 10 μm or smaller in size (PM_{10}) ambient standard is an acceptable surrogate for a $PM_{2.5}$ analysis (Seitz, 1997).

- The New Mexico Air Quality Bureau's (NMAQB's) air quality modeling guidance for permitting requires modeling for two of the four averaging periods for the TSP standard, 24-hour (hr) and annual TSP standard. Therefore, LANL will follow the NMED guidance and model for these averaging periods.

2.2 Toxic Air Pollutant Screening Levels

EPA's OBOD Permitting Guidelines (EPA, 2002b, http://www.epa.gov/reg3wcmd/OBOD_Guidelines.pdf) suggest evaluating both long-term (chronic and cancer) and short-term (acute) risk-based impacts:

- Long-term impacts will be evaluated using the air EPA Region 9 Preliminary Remediation Goals (PRGs) (EPA, 2004, http://www.epa.gov/region09/waste/sfund/prg/files/04prgtable.pdf). The Air-Water Calculation worksheet located on the PRG webpage list pathway-specific values for air. According to the OBOD Permitting Guidelines, if modeled impacts do not exceed one tenth (0.1) of the PRGs, then a human health risk assessment for the air pathway is not warranted. If both chronic and cancer PRGs are listed for a pollutant, the lower cancer PRG will be used.
- Short-term impacts will be evaluated using the acute (1 hr) inhalation exposures (AIEC) from the Companion Database to EPA's Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA, 2005, http://www.epa.gov/Region6/6pd/rcra_c/protocol/volume_1/vol1pro.htm). This database includes all of the other acute inhalation sources of information listed in Section 4.1.4 of the OBOD Permitting Guidelines.

2.3 Deposition Screening Levels

Screening levels for deposition will be compared to an estimated 10 year (yr) impact so as to show a quantitative estimate over the anticipated lifetime of the permit. Deposition of pollutants will be compared to:

- the NMED Human Health Industrial/Occupational Soil Screening Levels (SSLs) (NMED, 2006, ftp://ftp.nmenv.state.nm.us/hwbdocs/HWB/guidance_docs/NMED_June_2006_SSG.pdf).
- the EPA Region 6 Human Health Medium-Specific Screening Levels (EPA, 2007, http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screenvalues.pdf), which are used for contaminants not appearing on the NMED SSL table. EPA guidance uses a 10^{-6} cancer risk level and NMED uses a 10^{-5} cancer risk level for chemical carcinogens. In order to equalize the deposition pollutant assessment, EPA carcinogen screening levels are multiplied by 10 to reflect higher impact levels needed to cause a 10^{-5} cancer risk.
- The LANL ESLs.

These screening levels were chosen because they have been accepted by NMED for other impacts analysis, such as corrective action.

3.0 EMISSION FACTORS FOR OPEN BURNING

This section describes the types of waste streams treated at the TA-16 Burn Ground, the sources of EFs, and proposed EFs for each waste stream. The contaminants listed are those that have an EF for a constituent with an air quality or deposition screening level. No EFs are shown for pre-treatment and post-treatment emissions such as fugitive dust because no equipment operates off-road, earth-moving operations are not part of the open burning activities, and ash generation is negligible.

If EFs were available only for total suspended particulate (TSP) for a waste category, the EF was also used as a conservative estimate of PM_{10}. If only PM_{10} EFs were available, they were also used to estimate TSP. This should not skew the results significantly because burning would be expected to primarily produce particles ≤ 10 μm. According to EPA (1998b, http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/drispec.pdf) more than 95% of particulate matter from agricultural burning was PM_{10}. EFs used for both TSP and PM_{10} are listed as "Particulate matter" in the following tables.

3.1 Emission Factors for TA-16-399

TA-16-399 burns only HE. The maximum amount of HE that can be burned at this unit is 1000 pounds per burn (lb/burn). The types of HE treated at the TA-16 Burn Ground vary depending primarily on research and development (R&D) and stockpile stewardship activities. The primary types of HE treated are cyclotetramethylenetetranitramine (HMX), 1,3,5 triamino 2,4,6 trinitrobenzene (TATB), trinitrotoluene (TNT), and cyclonite (RDX).

EFs are not available for all of these explosives. TNT is the least oxygenated of the commonly treated explosives. As a result it burns less completely ("dirtier") than other explosives treated at the TA-16 Burn Ground. Criteria pollutant EFs for burning TNT are available in Chapter 6, Section 3, Table 6.3-1 of EPA's Compilation of Air Pollutant Emission Factors (AP-42, 1983, http://www.epa.gov/ttn/chief/ap42/ch06/final/c06s03.pdf), hereinafter referred to as AP-42.

There are no toxic air pollutant EFs for TNT in AP-42; therefore, the EFs for burning explosives available from the Open Burn/Open Detonation Dispersion Model (OBODM) User's Guide (EPA, 1998a, http://www.epa.gov/scram001/userg/nonepa/obodmvol1.pdf) will be used. EFs for the detonation of HE have not been considered because detonation has processes such as fragment formation that do not occur during burning. Two of the burn tests contained types of HE treated at LANL (as well as other materials not treated at LANL):

- M-43, which contains RDX and
- PBXN-110, which contains HMX.

However, these EFs do not represent all of the types of HE that could be treated. The HE mixture M31A1E1 was selected as a surrogate conservative EF for other explosives because the burn test for M31A1E1 contained:

- Some of the explosives that were used historically which may be encountered in decommissioning projects.

- An explosive with a negative internal oxygen balance, which is an indicator of less robust combustion. This acts as a representative of modern explosives such as TATB, for which there was no EF.
- An obscurant, which is designed to create smoke. A constituent that smoked rather than burned should have higher products of incomplete combustion, which are often toxic air pollutants. This obscurant also contained metal constituents not found in modern explosives used at LANL but found in some older explosives.

As evidenced by the high number of M31A1E1 EFs found in Table 3-1, it is more conservative than the RDX and HMX burns for many of the constituents.

The EFs in the OBODM User's guide were derived from burning mixtures that contain a number of contaminants that would not be present in LANL HE; however, no attempt will be made to eliminate non-characteristic emissions from this analysis. Instead, they will be used as published to provide a conservative emissions estimate. The highest pollutant-specific EF for any of the three explosives that has a corresponding air quality limit will be used to provide a worst-case EF. Table 3-1 provides the EFs in grams of pollutant per gram of waste (g/g) and identifies the burn of origin.

3.2 Emission Factors for TA-16-388

Materials burned at TA-16-388 may consist of pure HE, HE-contaminated combustible solids and liquids, or HE-contaminated non-combustible materials. The maximum amount of combustible material that can be treated on TA-16-388 is 250 lb/burn. Non-combustible materials (e.g., scrap metal, soil) that are not consumed during burning are not limited and are not accounted for within the treatment limit.

The EFs for pure HE treated at TA-16-388 are the same as those described in Section 3.1. The EFs for the other waste streams treated at TA-16-388 are described in Sections 3.2.1 through 3.2.3. A worst-case combined EF is derived from all of the waste streams by using the highest pollutant-specific EF listed for any of the waste streams. Propane is used as a supplemental fuel to improve burning of HE-contaminated materials. Its EFs are shown separately in Section 3.2.4.

3.2.1 Emission Factors for Combustible Solids

EFs from the Diesel and Dunnage category in the OBODM User's Guide (EPA, 1998a, http://www.epa.gov/scram001/userg/nonepa/obodmvol1.pdf) will be used to simulate LANL's HE-contaminated solid waste. The Diesel and Dunnage waste consisted of scrap wood, dead branches from trees and shrubs, Styrofoam™ packing material, other combustibles, and diesel fuel. These EFs, shown in Table 3-2, should be much higher than for LANL combustibles, which in contrast have no vegetation, no diesel, high heating value from the HE in the waste, and are burned with supplemental fuel (propane burners).

3.2.2 Emission Factors for Open Burning of Liquids

This waste stream historically consisted of oils and solvents contaminated with HE. Due to changes in processes and better waste characterization, this waste

stream has decreased considerably over the past few years. Significant quantities of oils are not expected to be treated in the future unless they result from a spill that comes into contact with significant quantities of HE. This waste stream is expected to consist primarily of solvents with high HE content (usually greater than 25 percent (%)) 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.

During the documentation review, no EFs were identified for burning HE-contaminated liquids. Therefore, the EFs for burning fuel oil in Emissions of Organic Air Toxics from Open Burning, (EPA, 2002a, http://www.epa.gov/nrmrl/pubs/600r02076/ 600sr02076.pdf) were used. Fuel oil is a petroleum product that is not as refined as the solvents used in HE research so the fuel oil EFs should be conservative. These EFs did not contain the AAQS pollutants. For these, the EFs in Booher and Janke (1997) were used.

3.2.3 Dioxin/Furan Emission Factors

Dioxins and furans are formed from burning almost any kind of material. Common sources that may be present in New Mexico include forest fires, residential wood combustion, and residential oil heating (EPA, 1997, http://www.epa.gov/ttn/chief/ le/dioxin.pdf). Chlorine donors are needed but the amount of dioxin formed is not directly proportional to chlorine concentration. Dioxin/furan formation is favored by low excess air and low temperatures (Gullet and Seeker, 1997, http://www.ejnet.org/ dioxin/dioxinpr2.pdf). Because HE burns hot, with considerable oxygen in the fuel and a good air supply from the ambient air, dioxin/furan formation from the TA-16 Burn Ground should be minimal.

During documentation review, no EFs were identified for dioxin/furan formation from burning HE or HE-contaminated wastes. Recent measurements taken during the detonation of explosives cartridges (AP-42, 2006, http://www.epa.gov/ttn/ chief/ap42/ch15/index.html) show that total dioxin/furan EFs range from zero to a few parts per billion per pound of material detonated. However, these EFs were not used because the detonation mechanism is different than burning.

Although dioxin emissions from the TA-16 Burn Ground are expected to be low and EFs were not available, LANL simulated worst-case impacts by using a dioxin EF from burning a Non-aluminized Ammonium Perchlorate (NAAP) propellant (EPA, 1998a, http://www.epa.gov/scram001/userg/ nonepa/obodmvol1.pdf). This waste consisted of 25.87% chlorine (Mitchell and Suggs, 1998).

Although furan EFs were also available for burning NAAP, the OBODM User's Guide furan EFs were higher for Manufacturer's Waste. The Manufacturer's Waste consists of 65% aluminized AP (69% AP, 19% aluminum), 20% plastic material (polyethylene gloves), 11% paper/wood/cloth and 4% diesel fuel].

Propellants are not high explosives and are not treated at the TA-16 Burn Ground, but were the most similar material for which dioxin and furan EFs could be

located. The dioxin/furan EFs shown in Table 3-4 were assumed to apply to all waste streams treated, even those with no chlorine.

3.2.4 Emission Factors for Open Burning of Propane

Propane is burned to improve combustion of HE-contaminated waste streams. Emissions from burning the propane are additive to the emissions from burning the waste (see the example in Section 5). The EFs were obtained from Chapter 1.5, Table 1.5-1 of AP-42 (AP-42, 1996, http://www.epa.gov/ttn/chief/ap42/ch01/final/ c01s05.pdf).

3.3 Combined Worst-Case Waste Emission Factor

In order to give a worst-case scenario estimate of emission from open burning, the highest EF for each contaminant was selected from all of the wastes burned (Tables 3-1 through 3-4). Table 3-6 shows the contaminant, the waste type that had the highest EF, and the EF from the tables above.

Using acenapthene as an example of how the worst-case EFs were developed, the EF for all the waste streams were examined. Acenapthene was found to be emitted from the burning of combustible solids (Table 3-2) and from the burning of liquids (Table 3-3). The EF for burning liquids (1.00 E-05 grams of acenapthene per gram of liquid treated) is higher than the EF for burning combustible solids (5.71E-06 grams of acenapthene per gram of combustible solids treated). Acenapthene is not shown as a pollutant emitted from burning the other waste streams. As shown in Table 3-6, the EF for burning liquids (1.00 E-05 grams of acenapthene per gram of liquid treated) is used for the worst-case EF. Even though some waste types do not emit acenapthene, the worst case EF will be applied to all wastes when impacts are calculated and analyzed in Steps 4 and 5. This technique provides a very conservative analysis (i.e., impacts are overestimated). This technique also greatly simplifies the analysis because there is no need to estimate how much of each waste type will be treated over the 10-year permit period; each waste stream is already represented in Table 3-6.

Note that impacts from burning propane are not included in this EF. Propane emissions will be calculated separately and added to the waste impacts as described in Section 5.

Table 3-1. Emission Factors for Burning High Explosives (HE)

Contaminant	Highest EF (g/g) [a]	Source of EF [a]
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 3-2. Emission Factors for Burning Combustible Solids

Contaminant	EF (g/g) [a]
Acenaphthene	6.71E-06
Acetophenone	1.74E-07
Aluminum	7.13E-07
Anthracene	1.02E-07
Barium	1.61E-07
Benzene	7.84E-05
Benzo[a]anthracene	9.81E-07
Benzo[b]fluoranthene	7.84E-07
Benzo[k]fluoranthene	7.46E-07
Benzo[a]pyrene	7.42E-07
Benzyl alcohol	3.96E-05
1-3-Butadiene	1.34E-06
Butyl benzyl phthalate	1.22E-07
Carbon monoxide	2.98E-02
Chrysene	9.33E-07
Cyclohexane	2.67E-05
Dibenz[ah]anthracene	2.00E-07
Dibutyl phthalate	1.46E-07
Diethyl phthalate	7.00E-08
Dimethyl phthalate	1.88E-07

Contaminant	EF (g/g) [a]
dioctyl phthalate	9.19E-07
Ethylbenzene	5.49E-05
Fluoranthene	7.85E-07
Hexane	1.60E-05
Indeno[1,2,3-cd]pyrene	2.83E-07
Methylcyclohexane	1.56E-04
Napthalene	8.38E-05
Nitrogen dioxide	5.07E-05
Particulate matter	5.44E-03
Phenanthrene	7.17E-06
Phenol	1.56E-05
Pyrene	7.06E-07
Styrene	4.99E-05
Sulfur dioxide	1.88E-04
Toluene	1.22E-04
1,2,4-Trimethylbenzene	2.43E-04
1,3,5-Trimethylbenzene	5.57E-04
Xylenes	5.77E-04
Zinc	6.26E-05

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

Table 3-3. Emission Factors for Burning Liquids

Contaminant	EF (g/g) [a]
Acenaphthene	1.00E-05
Acetaldehyde	6.30E-05
Acetone	3.50E-05
Acrolein	3.90E-05
Anthracene	1.50E-05
Benzaldehyde	1.04E-04
Benzene	1.02E-03
Benzo[a]anthracene	5.00E-06
Benzo[a]pyrene	5.00E-06
Benzo[b&k]fluoanthene	7.00E-06
Carbon monoxide	9.00E-02
Chrysene	9.00E-06
Crotonaldehyde	6.00E-06
Ethylbenzene	1.00E-05

Contaminant	EF (g/g) [a]
Fluoanthene	2.00E-05
Fluorene	1.00E-06
Formaldehyde	3.03E-04
Indeno[1,2,3-cd]pyrene	5.00E-06
Methyl ethyl ketone	1.30E-05
Methyl isobutyl ketone	1.10E-05
Napthalene	1.62E-04
Nitrogen dioxide	1.20E-05
Particulate matter	2.00E-01
Pyrene	2.00E-06
Sulfur dioxide	2.50E-03
Toluene	4.20E-05
1,2,4- Trimethylbenzene	3.20E-05
Xylenes	2.50E-05

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

Table 3-4. Emission Factors for Dioxins and Furans

Contaminant	Constituent	EF (g/g) [a]	Total EF (g/g) [a]
Dioxin	1234678-Heptachlorinated dibenzo-p-dioxin (1234678-HpCDD)	1.49E-12	**1.49E-12**
Furans	Octachlorinated dibenzofuran (OCDF)	3.95E-08	
	1234678 Heptachlorinated dibenzofurans (HpCDF)	3.42E-08	
	1234789 HpCDF	7.89E-09	
	123478 Hexachlorinated dibenzofurans (HxCDF)	2.13E-08	
	123678 HxCDF	9.47E-09	
	234578 HxCDF	5.77E-09	
	12378 Pentachlorinated dibenzofurans (PeCDF)	7.89E-09	
	23478 PeCDF	1.88E-08	
	2378 Tetrachlorinated dibenzofurans (TCDF);	5.52E-09	
	Total Furans		**1.50E-07**

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

Table 3-5. Emission Factors for Propane

Contaminant	EF (lb/1000 gal)[b]
Carbon monoxide	1.9E+00
Nitrogen dioxide	1.4E+01
Sulfur dioxide[a]	1.80E-02
Particulate matter	4.00E-01

[a] Based on a sulfur content of 0.18 grains/100 cubic feet.
[b] EF (lb/1000 gal) = emission factor in pounds of waste per 1000 gallons of propane

Table 3-6. Worst-Case Emission Factors for Combined Wastes

Contaminant	Waste Type	EF (g/g)
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	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	3.96E-05
1-3-Butadiene	combust	1.34E-06
Butyl benzyl phthalate	combust	1.22E-07
Carbon monoxide	liquids	9.00E-02
Carbon tetrachloride	HE	6.89E-08
Chloromethane (methyl chloride)	HE	2.84E-07
Chromium	HE	3.97E-07
Chrysene	liquids	9.00E-06
Crotonaldehyde	liquids	6.00E-06
Cyclohexane	combust	2.67E-05
Dibenzo[ah]anthracene	combust	2.00E-07
Dibutyl phthalate	HE	3.30E-07
1,1-Dichloroethylene (vinylidene Cl)	HE	2.15E-07
Diethylphthalate	combust	7.00E-08
Dimethyl phthalate	combust	1.88E-07
Dioctyl phthalate	combust	9.19E-07

Contaminant	Waste Type	EF (g/g) [a]
Dioxin	NAAP [d]	1.49E-12
Ethylbenzene	combust	5.49E-05
Ethyl chloride	HE	6.89E-08
Fluoanthene	liquids	2.00E-05
Fluorene	liquids	1.00E-06
Formaldehyde	liquids	3.03E-04
Furan	MW [e]	1.50E-07
Hexane	combust	1.60E-05
Hydrogen chloride	HE	9.97E-04
Indeno[1,2,3-cd]pyrene	liquids	5.00E-06
Methylene chloride	HE	7.46E-07
Methylcyclohexane	combust	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	7.50E-02
Particulate matter	liquids	2.00E-01
Phenanthrene	combust	7.17E-06
Phenol	combust	1.56E-05
Pyrene	liquids	2.00E-06
Styrene	combust	4.99E-05
Sulfur dioxide	liquids	2.50E-03
Toluene	combust	1.22E-04
1,1,1-Trichloroethane (methyl chloroform)	HE	3.44E-08
1,2,4-Trimethylbenzene	combust	2.43E-04
1,3,5-Trimethylbenzene	combust	5.57E-04
Xylenes	combust	5.77E-04
Vinyl chloride	HE	2.23E-07
Zinc	combust	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

4.0 DISPERSION AND DEPOSITION MODELING PROTOCOL

This section discusses the justification for the choice of the dispersion model, and provides information on the source-specific input parameters, the meteorological data set, and receptors.

4.1 Model Selection

Two dispersion models have been considered for application to the air pathway assessment for the TA-16 Burn Ground, the OBODM and CALPUFF. To apply either model to the open burn sources at LANL, one must consider the complex terrain of the Pajarito Plateau, the surrounding Jemez Mountains, and the adjacent Federal Class 1 area, Bandelier National Monument. The complex terrain has a dramatic effect on the wind fields, which drive the dispersion of pollutant sources. While the OBODM would seem a logical choice because it has been designed for application to open burn and open detonation treatment units, there are several assumptions and limitations in OBODM that make CALPUFF the better model for the TA-16 Burn Ground.

OBODM only allows for a simplistic representation of the local meteorology and does not treat complex terrain in a rigorous manner. OBODM uses one vertical profile of wind speed and direction for the entire spatial extent of the modeled domain extent. The input consists of a single power-law velocity profile, a wind speed, assumed to be at 10 meter elevation, and optionally the direction as a function of height. The CALPUFF modeling system uses a more rigorous meteorological package, CALMET, where local surface meteorological observations and upper air data are used in conjunction with digital elevation (terrain) data to produce a diagnostic wind field for use in the CALPUFF dispersion analysis.

OBODM has a complex terrain *screening* procedure, and its limitations are stated in the documentation (Bjorklund et.al., 1998). OBODM treats the terrain in an approximate manner by calculating a "blocking factor" for the wind field and resultant pollutant transport. The OBODM model was developed at the United States Army Dugway Proving Ground, where the terrain is relatively flat, with isolated hills or small mountains. The terrain at LANL is more complex and thus OBODM is deemed inappropriate to compute the complex wind fields present at LANL. If a model does not produce an accurate wind field, then any dispersion analysis will not be meaningful.

CALPUFF computes the wind fields (streamlines) around the terrain (mountains) and thus the pollutants are transported and deposited in a more realistic manner in response to the terrain. There are three different methods to incorporate the terrain in CALPUFF, and we propose using the Complex Terrain algorithm for Sub-Grid scale features (CTSG) methodology. This method imports the Digital Elevation Model (DEM) data directly into the model. The CTSG accepts the flow field produced by the flow model (CALMET), including the wind and temperature structure) in the vicinity of the terrain feature as the incident flow toward that feature. It then proceeds to simulate the changes in the flow and the rate of dispersion that are induced by that terrain feature. At the core of CTSG is the modeling approach adopted in CTDM, the complex terrain model developed in EPA's Complex Terrain Model Development program. CTSG is designed to produce a puff

algorithm that contains those elements of the CTDM approach that have the greatest impact on ground-level concentrations (Scire et.al., 2000).

With regard to the buoyant plume rise formulation, both OBODM and CALPUFF are based on the Briggs formulation (Briggs, 1970, 1971, 1973, 1975), and are considered equal with respect to capturing the source term buoyancy effects of open burns. The CALPUFF model calculates the plume rise in stable conditions as:

$$\Delta h = \left[\frac{3F_m}{u\beta_j^2 S^{1/2}} + \frac{6F}{u\beta_j^2 S} \right]^{1/3} \tag{1}$$

where

$\beta_2 = 0.36$ is the stable entrainment parameter

$\beta_j = \frac{1}{3} + \frac{u}{w}$ is the jet entrainment parameter

$F_m = \frac{T_a}{T_s} w^2 r^2$ is the "momentum flux"

$F = \frac{g}{T_s} w r^2 \left(T_s - T_a\right)$ is the "buoyancy flux"

S is an atmospheric stability parameter

u is the wind speed

w is the vertical updraft velocity

r is the horizontal burn radius

T_s is the combustion gas temperature

T_a is the ambient air temperature

Note the final plume rise Δh is a combination of both buoyant and momentum effects. The CALPUFF area sources can also include a radiative heat transfer correction; area sources account for temperature dependant air properties (density and specific heat) rather than a strict Boussinesq approximation; CALPUFF area sources may be any size. There are similar plume rise formulations for unstable and neutral conditions in the CALPUFF modeling system that are documented in the User's Guides (Scire et. al., 2000). The appropriate formulation (unstable, neutral or stable), will be used and is dependant on the meteorological conditions being modeled.

Finally, the Burn Ground does not operate continuously. CALPUFF can use full terrain and meteorological input for non-continuous sources. However, the OBODM can only be used in a screening mode for non-continuous operations and is not fully able to use on-site terrain and meteorology (Heath et.al., 2006).

Based on the above factors, CALPUFF, version 5.711a, is a better model for determining ambient air quality and deposition impacts for the TA-16 Burn Ground than the OBODM.

4.2 General Model Approach

Using the CALPUFF modeling system, LANL will calculate the airborne concentrations and deposition on the ground due to the burning of HE and HE-contaminated wastes. These calculations will include modeling the terrain and its effect on the wind fields and resultant dispersion. Modeling will be conducted using a standard 1 g/s pollutant emission rate and source-specific parameters such as the energy generation rate, the cross-sectional burn area, and the plume temperature. Details on the buoyant plume rise are discussed within Section 4.3. The modeling will also include dry deposition mechanisms, the process by which atmospheric gases and particles are transferred to surfaces, including random turbulent air motion, gravitational settling, and vegetative scavenging. A full resistance model is provided in CALPUFF for the computation of dry deposition rates of gases and particulate matter accompanied by a library of species-specific data for many primary air pollutants. Consistent with previous TA-16 Burn Ground calculations, a lognormal size distribution will be used to represent particulate emissions (e.g., metallic oxides); oxides of nitrogen will be used to represent nonmetallic inorganics (e.g., acids and bases that would be volatilized during treatment); and toluene will be used to represent emissions from the burning of organic compounds (e.g., vapors emitted from the burning of solvents).

The burn scenarios shown in Table 4-1 will be used to identify source and waste attributes that lead to the highest on-site and off-site impacts per unit of waste burned for each screening level averaging period. These scenarios represent burning of pure HE at TA-16-399, burning of pure HE at TA-16-388, and propane-assisted burning of wastes at TA-16-388. In this analysis, the amount of fuel is important for determining burn rate and source configuration. The energy releases for burns with supplemental propane fuel will be calculated assuming that the heat released is only from the propane and will not take credit for the energy and additional plume rise caused by burning the waste material. Effluent temperatures and burn rates will be specified by reviewing existing data describing prototypical burn activities.

The model will result in the calculation of a CF that will be used as described in Section 5. LANL proposes using the most conservative dispersion factors for the evaluation of all emissions, regardless of their physical origin or actual burn characteristics. It is not likely that the same conditions will maximize exposures for both on- and off-site receptors. It is possible that one unit may create the highest CFs for on-site impacts and that the other unit may create the highest off-site CFs, depending on the averaging periods.

4.3 Source-Specific Information

The open burning of high explosives at the TA-16 Burn Ground occurs during the workday, 0800-1700 local time in the summer, and 0900-1600 in the winter. The duration

of the burn is typically less than 1 hour, but can be longer. Conservatively, for modeling the TA-16 Burn Ground, we will simulate a 1-hr burn. Typically, only one burn occurs daily but, to provide a conservative estimate, it was assumed that two burns a day could occur. Burns are assumed to be separated by at least 1 hour of preparation time. Typically, one to two burns a week are conducted; however, to provide a more conservative analysis, it was assumed that 2 burns a day would be conducted 5 days a week (520 burns/yr). Specific burn times will be randomly sampled from an annual set of hourly meteorology data to begin during daytime hours and allowing at least 1 hour of preparation time between burns.

Several attributes of a burn scenario like the type of fuel and the combustion gas temperature can affect the amount of plume rise that the CALPUFF modeling system predicts using the Briggs plume rise formulation. The following discussion is provided to explain how these physical features are used to specify the updraft velocity that is required as input by the model. The basic concept of the following derivation is that energy released by the fuel must be absorbed by entrained air, which causes a temperature increase.

The energy released in the burn may be expressed as:

$$\dot{e} = \dot{m} c_p \Delta T$$

where $\dot{e}$ is the energy released (W/s), $\dot{m}$ is the mass flow rate (kg/s), c_p the specific heat at constant pressure for air, and ΔT the temperature difference between the burning HE and the ambient air (K). The energy released due to combustion may also be expressed as the product of the heat released by burning (heat of combustion) the material/fuel and the burn rate of the material. The mass flow may be expressed as the product of the ambient air density and a volumetric flow rate; the volumetric flow rate for an open burn may be expressed as the product of the burn area and the vertical velocity due to the burning of the material. This vertical velocity is the input required in CALPUFF. Solving for the vertical velocity in terms of these parameters may be expressed mathematically:

$$\dot{e} = \dot{m} c_p \Delta T$$

but

$$\dot{e} = H_c R$$

and

$$\dot{m} = \rho \dot{V}$$

where H_c is the heat of combustion of the fuel, R is the burn rate, ρ is the density of ambient air, and $\dot{V}$ is the volumetric flow rate. Substitution yields:

$$H_c R = \rho \dot{V} c_p \Delta T$$

$$\frac{H_c R}{\rho_a c_p} = \dot{V} \Delta T$$

If we only consider the vertical velocity w for a high temperature source, ignoring horizontal velocity components, the volumetric flow rate $\dot{V}$ becomes

$$\dot{V} = Aw$$

where A is the area of the burning source. Substituting and solving for the vertical velocity, w, yields:

$$w = \frac{H_c R}{\rho_a c_p A \Delta T} \tag{2}$$

This vertical velocity w incorporates the HE heat of combustion, burn rate, source area, and temperature difference. Equation (2) describes how LANL will compute the buoyant emission source vertical velocity that the CALPUFF model requires.

The 1995 meteorological data for LANL has already been approved by NMAQB and will be used for this analysis. Also, NMAQB-approved impacts from other sources will be included.

4.4 Receptors

LANL is situated on the Pajarito Plateau of the Jemez Mountain range located in north-central New Mexico. The local geography is rugged with elevations generally declining from 7800 feet (ft) near the western border to 6800 ft along the eastern border. As shown in Figure 1, the plateau is striated with narrow canyons that can be several hundred feet deep. A 20 kilometer (km) by 20 km receptor grid will be centered on the Burn Ground, with receptors spaced at 100 meter intervals. Additional discrete receptors at public areas such as residential areas, hospitals, and Bandelier National Monument will be included.

For complex terrain modeling analyses, the receptor elevations will be determined from DEM data, as shown in Figure 1.

Table 4-1. Proposed Modeling Scenarios

Location	Waste Loading
TA-16-399	• 1000 lb HE/burn[1]
TA-16-388	• 250 lb HE/burn
TA-16-388	• 250 lb waste/burn[2] • 100 gal propane/burn[3]

[1] pounds of high explosives per burn
[2] pounds of waste per burn
[3] the heat released is assumed to result only from the burning of propane

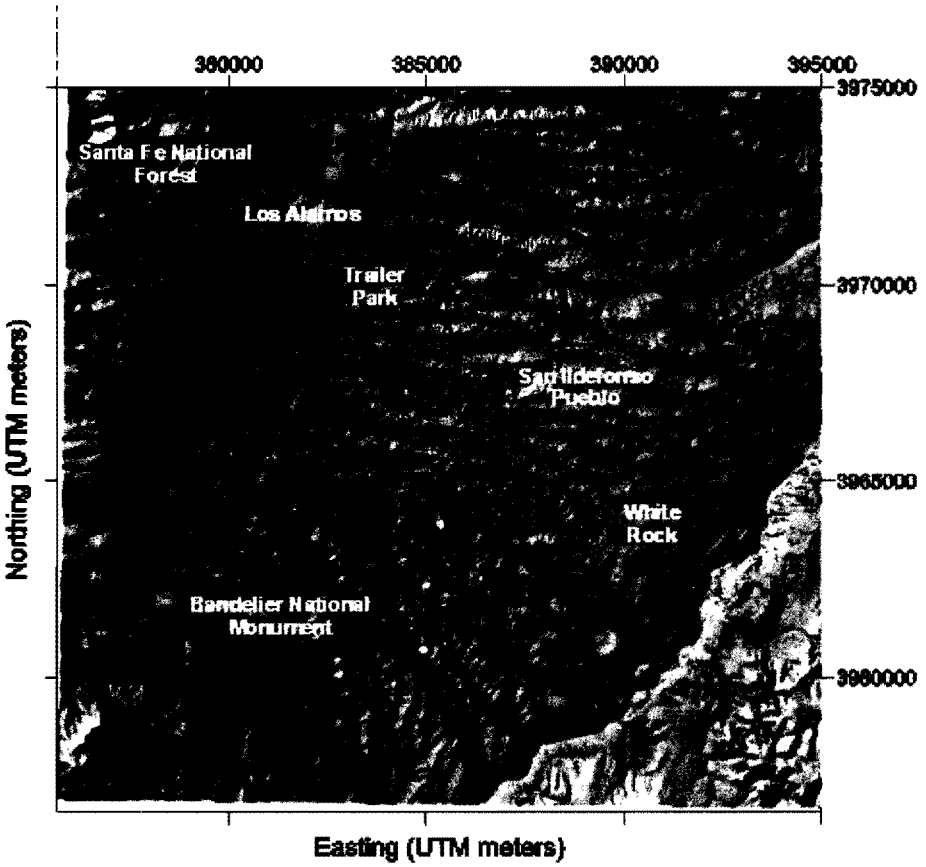

Figure 1: Siting of Los Alamos National Laboratory (green boundary) and burn pad (red box) relative to residential communities and public recreation areas. Four, primary meteorology stations are also shown (red circles).

5.0 IMPACTS ANALYSIS

The modeling results (in the form of conservative atmospheric CFs , see Section 4.2) will be used to compare the impacts of pollutants emitted from the TA-16 Burn Ground to air quality screening levels (Section 5.1) and to deposition screening levels (Section 5.2). The CFs will also be used to determine how much of an individual solvent could be treated before air quality screening levels were reached.

5.1 Air Quality Impacts Calculations

CALPUFF estimates air quality impacts in micrograms per meter cubed ($\mu g/m^3$) for a 1 g/s emission rate, from which a CF ($\mu g/m^3$ per g/s of a pollutant emitted) is calculated. As noted in Section 4-2, the single most conservative CF for on-site impacts and the single most conservative CF for off-site impacts for each averaging period will be used in the impacts analyses.

CFs will be applied to the amounts of waste burned during a specific averaging period. For example, the hourly impact of burning 250 lb of waste would be calculated as follows:

$$\frac{EF \text{ g pollutant}}{\text{g waste}} \times \frac{454 \text{ g waste}}{\text{lb waste}} \times \frac{250 \text{ lb waste}}{\text{hr}} \times \frac{1 \text{ hr}}{3600 \text{ s}} \times \frac{CF \ \mu\text{g pollutant/m}^3}{\text{g pollutant/s}} = \frac{I \ \mu\text{g pollutant}}{\text{m}^3}$$

where:

EF = emission factors from Table 3-6
CF = conversion factors from g/s of pollutant emitted to $\mu g/m^3$ concentrations of the pollutant in air for a 1-hr averaging period
I = calculated air pollutant concentration in $\mu g/m^3$

The amount of waste used for the impact calculations will be dependent on which unit and waste combinations produced the highest impacts, which may be different units/wastes for on-site versus off-site receptors. For example, if TA-16-388 produces the highest impacts during the burning of non-bulk HE wastes, the impacts calculation will assume 250 lb of burnable waste (this does not include non-combustibles associated with the waste, such as scrap metal or soil) and 100 gallons (gal) of propane per hour. If TA-16-399 produces the highest impacts for a waste stream, 1000 lb of waste will be used in the calculations. See Section 4.2 for additional information on how the worst case impacts will be determined.

Annual impacts assessments will assume 20,000 lb of burnable waste and 15,000 gal of propane. Because the types and quantities of wastes treated vary from year-to-year, the impacts analysis will use only the worst-case EFs located within Table 3-6 for all wastes, thereby avoiding the need to estimate the quantities of each type of waste stream for the next 10 years. The EFs from Table 3-5 will be used for propane. To obtain the final impacts, the waste and propane impacts will be added and compared to the air quality screening levels.

The following example illustrates how 1-hr impacts from burning waste and propane would be calculated at the highest impact receptor using nitrogen dioxide as the pollutant of interest and assuming the following:

- the fictional hourly CF for the highest on-site receptor is 10 μg pollutant/m^3 per g/s of material burned
- the amount of waste burned is 250 lb/hr
- the amount of propane burned is 100 gal/hr
- the nitrogen dioxide (NO_2) EF for burning the waste (Table 3-6) is 7.5E-02 g of NO_2 per g of waste burned
- the NO_2 EF for propane is 1.4E-01 lb NO_2/1000 gal of propane burned

The impacts from burning the waste are:

$$\frac{7.5\text{E-02 g } NO_2}{\text{g waste}} \times \frac{454 \text{ g waste}}{\text{lb waste}} \times \frac{250 \text{ lb waste}}{\text{hr}} \times \frac{1 \text{ hr}}{3600 \text{ s}} \times \frac{10 \ \mu g\ NO_2/m^3}{\text{g pollutant/s}} = 24\ \mu g\ NO_2/m^3$$

The impacts from burning propane are:

$$\frac{1.4\text{E+01 lb } NO_2}{1000 \text{ gal propane}} \times \frac{454 \text{ g } NO_2}{\text{lb } NO_2} \times \frac{100 \text{ gal propane}}{\text{hr}} \times \frac{1 \text{ hr}}{3600 \text{ sec}} \times \frac{10\ \mu g\ NO_2/m^3}{\text{g pollutant/sec}} = 2\ \mu g\ NO_2/m^3$$

The total nitrogen dioxide impact = 24 +2 = 26 μg NO_2/m^3. This is compared to the 1-hr AAQS for NO_2 (149 μg NO_2/m^3). The ambient air quality impacts would be well below the standard in this fictional analysis. This same type of analysis will be repeated for every contaminant for every averaging period of interest.

5.2 Deposition Impacts Analysis

CALPUFF will be used to derive annual deposition levels in milligrams of pollutant deposited per kilogram of soil (mg/kg) per g/s of pollutant release rate at the highest impact receptor for the annual averaging period. The impacts calculation is similar to that shown in Section 5.1 for air quality impacts.

The annual impacts will be multiplied by 10 to estimate a 10-year impact, which will provide an incremental change over the lifetime of the permit. The 10-year impact will be compared to the deposition screening levels described in Section 2.3.

The deposition calculations will use an upper estimated limit of 20,000 lb of burnable wastes (this does not include non-combustibles associated with the waste, such as scrap metal or soil) to be treated annually and 15,000 gal of propane used as supplemental fuel annually. Both of these activity limits are considerably higher than current or anticipated open burn activity levels. Waste emissions will be calculated using Table 3-6 worst-case EFs and propane impacts will be calculated using Table 3-5 EFs. To obtain the final impacts, the waste and propane impacts will be added and compared to the deposition screening levels.

5.3 Regulated Solvent Impacts Analysis

Specific individual solvents burned at the TA-16 Burn Ground cannot be modeled in the same general manner described above. Solvents treated at TA-16 are produced mainly from constantly-changing research and development processes. Therefore, the types and amounts of solvents cannot be anticipated. Solvent emissions calculated in the past were snapshots of a single year's activities and cannot be extrapolated to other years with any certainty. To help put into perspective the acceptable releases of individual regulated solvents that can be treated at the TA-16 Burn Ground, LANL will use the acute air quality screening levels described in Section 2.2 of this document for the solvents listed in the most recent version of the LANL General Part A Permit Application (LANL, 2006) to back-calculate acceptable releases. The acute screening level for a pollutant and a CF (as calculated by the model) will be used to estimate the amount of a pollutant that could be released from the TA-16 Burn Ground operations before the screening level is reached. Below is an example using benzene as the pollutant (1300 $\mu g/m^3$) and a fictional CF of 10 $\mu g/m3$ per g/s:

$$\frac{1300\ \mu g/m^3}{} \times \frac{g\ pollutant/sec}{10\ \mu g/m3} \times \frac{3600\ sec}{hr} \times \frac{lb\ pollutant}{454\ g\ pollutant} = 1031\ lb\ of\ benzene\ released/hr$$

The TA-16-388 Flash Pad is limited to 250 lb of material treated per burn; therefore, the calculated limit (1031 lb of benzene) released would never be reached even if it was assumed (incorrectly) that none of the benzene was burned. If one assumes that 95% of benzene burns, only 5% would be emitted. Using these assumptions, more than 20,000 lb (1031/0.05) of benzene could be burned in an hour before the limit was approached.

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