'ANL Report 1/28/02

Los Alamos
NATIONAL LABORATORY

Environment, Safety, and Health Division
ESH-17, Air Quality Group
P.O. Box 1663, MS J978
Los Alamos, New Mexico 87545
(505) 665-8855/Fax: (505) 665-8858

Received
JAN 2002
Air Quality Bureau

Date: January 22, 2002
Refer to: ESH-17:02-021

Mr. John Volkerding
New Mexico Environment Department
Air Quality Bureau
2048 Galisteo Street
Santa Fe, NM 87505

Dear Mr. Volkerding:

Enclosed is the Los Alamos National Laboratory's (LANL) Annual Fire Activity Report for calendar year 2001. This notification is provided at your request and reports all open burn activities conducted at the LANL facility and approved in the Open Burn Permit AQB.97.214, effective August 18, 1997 through December 31, 2002.

Although three Air Curtain Destructors (ACDs) were started up during 2001, emissions from these ACDs will not be included in this report. Instead, these emissions will be reported in the annual 20 NMAC 2.73 emissions inventory due to NMED on April 1, 2002.

All operational burns for 2001 were conducted within the terms specified in the permit and the email correspondence dated 4/13/01 between Leland Maez of LANL and yourself.

If you have any questions concerning this report, please contact me at (505) 665-8863.

Sincerely,

Harold A Martinez

Harold Martinez

HM:db

Cy:
M. Montoya, DX-DO, P915
D. Stavert, ESH-DO, J978
K. Uher, DX-2, C920
L. Hatler, ESA-WMM, C930
F. Sisneros, DX-DO, P915
D. Hemphill, ESA-WMM, C930
P. Smith, ESA-MT, C931
D. Montoya, ESA-MT, C931
D. Macdonell, ESA-FM-ESH, C928
B. Olinger, ESA-WMM, C930
A. Sherrard, ESA-FM-ESH, C924
D. Woitte, LC/GL, A187
M. Stockton, ESH-17, J978
S. Fong, DOE/LAAO, A316
ESH-17 File

8204

FIRE ACTIVITY OPEN BURN LOG FOR CALENDAR YEAR 2001

ALL OPERATIONS UNDER PERMIT NO. AQB.97.214

TECH. AREA	OPERATION	DATE/WEEK BURN EVENT	ACCUMULATIVE BURN DURATION	FUEL TYPE	FUEL QUANTITY	FIRE STARTER
TA-11	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
TA-14	*HE Contaminated Waste*	*2/19/01*	*1 Hour*	*Kimwipes,Paper, Rags, etc.*	*20 lbs*	*½ gal Kerosene*
		5/14/01	"	"	*20 lbs*	"
		9/17/01	"	"	*45 lbs*	"
		11/5/01	"	"	*45 lbs*	"
		12/10/01	"	"	*45 lbs*	"
TA-16	*HE Contaminated Combustible Waste*	*3/5/01*	*1 Hour*	*HE Contaminated Rags, Paper, etc.*	*50 lbs*	*Propane*
		3/5/01	"	"	*35 lbs*	"
		3/30/01	"	"	*50 lbs*	"
		5/16/01	*2 Hours*	*HE Contaminated Rags, Paper, and Scrap Metal*	*30 lbs*	"
		5/17/01	*1 Hour*	*HE Contaminated Rags, Paper, etc.*	*50 lbs*	"
		8/1/01	"	"	*50 lbs*	"
		8/1/01	"	"	*50 lbs*	"
		8/2/01	"	"	*50 lbs*	"
		8/2/01	"	"	*50 lbs*	"
		8/20/01	"	"	*50 lbs*	"
		8/21/01	"	"	*50 lbs*	"
		8/21/01	"	"	*50 lbs*	"
		8/22/01	"	"	*50 lbs*	"
		8/22/01	"	"	*50 lbs*	"
		8/27/01	"	"	*40 lbs*	"
		8/28/01	"	"	*30 lbs*	"
		8/30/01	"	"	*35 lbs*	"
		9/4/01	"	"	*48 lbs*	"
		9/5/01	"	"	*45 lbs*	"
		9/6/01	"	"	*45 lbs*	"
		9/24/01	"	"	*50 lbs*	"
		11/29/01	"	"	*50 lbs*	"
	HE Contaminated	*12/5/01*	"	"	*20 lbs*	"
TA-16	*Combustible*	*12/19/01*	"	"	*50 lbs*	"
	Waste					
		3/19thru3/21	*3 Hours*	*Scrap Metal*	*N/A*	"

TECH. AREA	OPERATION	DATE/WEEK BURN EVENT	ACCUMULATIVE BURN DURATION	FUEL TYPE	FUEL QUANTITY	FIRE STARTER
		3/22thru3/23	*2 Hours*	"		"
		3/27thru3/28	*2 Hours*	"		"
		4/03thru4/05	*3 Hours*	"		"
		5/08thru5/09	*2 Hours*	"		"
		5/23thru5/24	*2 Hours*	"		"
		6/06/01	*1 Hour*	"		"
		6/11thru6/12	*2 Hours*	"		"
		6/27/01	*1 Hour*	"		"
		10/01thru10/02	*2 Hours*	"		"
		10/16thru10/18	*3 Hours*	"		"
		10/29thru10/30	*2 Hours*	"		"
	HE Contaminated Liquid	*1/10/01*	*1 Hour*	*Solvents*	*18.25 gals*	"
		2/26/01	*1 Hour*	"	*5 gals*	"
		2/27/01	*1 Hour*	"	*13 gals*	"
		2/28/01	*1 Hour*	"	*10 gals*	"
		3/13/01	*1 Hour*	"	*8 gals*	"
		3/29/01	*1 Hour*	"	*9 gals*	"
		5/29/01	*1 Hour*	"	*12 gals*	"
		5/30/01	*1 Hour*	"	*15 gals*	"
		6/07/01	*1 Hour*	"	*10 gals*	"
		7/30/01	*1 Hour*	"	*20 gals*	"
		7/31/01	*1 Hour*	"	*10 gals*	"
		8/09/01	*1 Hour*	"	*5 gals*	"
		8/16/01	*1 Hour*	"	*11 gals*	"
		9/19/01	*1 Hour*	"	*9 gals*	"
		9/20/01	*1 Hour*	"	*10 gals*	"
		9/24/01	*1 Hour*	"	*10 gals*	"
		11/6/01	*1 Hour*	"	*12.3 gals*	"
		11/28/01	*1 Hour*	"	*18 gals*	"
						1275 gals Total/2001
TA-36	*HE Wood Waste*	*3/19/01*	*8 Hour Min.*	*Work Lexan and/or Plexiglass, Packing Mat'l etc.*	*260m^3 Wood 190 lbs Lexan, Plexiglass*	*Kerosene 10 gals*
		10/15/01	"	"	*235m^3 Wood 200 lbs Lexan, Plexiglass*	*Kerosene 10 gals*

Department of Energy
Albuquerque Operations Office
Los Alamos Area Office
Los Alamos, New Mexico 87544

MAR 4 1997

Mr. Filiberto Dominguez
Air Pollution Control Bureau
New Mexico Environment Department
2048 Galisteo Street
Santa Fe, NM 87505

Dear Mr. Dominguez:

Enclosed for your approval is an application for open burning at Technical Area (TA) 14. Open burning is conducted at this area of the Los Alamos National Laboratory in order to diminish the safety risks associated with high explosives contaminated waste generated.

The application request is for a single burn scheduled for early March. Approval to conduct open burns at TA-14 is included in the five (5) year permit application being prepared for submittal to your office. As you are aware, open burning is allowed only when approved by the State of New Mexico as specified under Title 20, Chapter 2, Part 60 of the New Mexico Administrative Code. The enclosed application was prepared to satisfy the information requirements specified under this regulation.

If you have any questions concerning this permit application, please contact Steve Fong of my staff at (505) 665-5534.

Sincerely,

Mathew P. Johansen

Mathew P. Johansen, P.E.
Acting Assistant Area Manager
Office of Environment and Projects

LAAMEP:9SF-094

Enclosure

cc w/enclosure:
S. Fong, LAAMEP, LAAO
E. Christie, LAAMEP, LAAO
L. Maez, ESH-17, LANL, MS-J978

STATE OF NEW MEXICO
Environment
Department

PERMIT NO. AOB 97 126
(AQB assigned)

NEW MEXICO ENVIRONMENT DEPARTMENT/AIR QUALITY BUREAU
PERMIT APPLICATION AND REPORTING OF OPEN BURNING FOR PRESCRIBED/PRESCRIBED NATURAL FIRE AREAS

PERMITTEE: USDA___ USDI___ BLM___ MILITARY___ DOE X PRIVATE___ OTHER___

ADMINISTRATIVE UNIT: Technical Area 14 COUNTY: Los Alamos

CONTACT: Steve Fono/Leland Maez PHONE: 665-5534/665-1240

NAME OF BURN: Burn Cage LOCATION: Los Alamos National Laboratory
(Township, Range, Section)

PROPOSED ACREAGE See Attach. FUEL LOADING DETERMINATION METHOD See attachment

TYPE OF FUEL See attachment TONS/ACRE See attachment

Is burn likely to impact a smoke sensitive area? Yes___ No X
If yes, please attach a map of smoke sensitive areas (Include distance and direction).

Smoke sensitive areas include: Class I areas as well as other scenic and important views, urban and rural population centers, hospitals, nursing homes, schools, transportation facilities such as roads, highways, and airports, recreational areas, and other locations that may be sensitive to smoke impacts for health, safety, and/or aesthetic reasons.

Signed [signature] Date 3/4/97
Name and Title
Joseph Vozella, Asst. Area Manager, Office of Environment & Projects

Submit to: New Mexico Environment Department, Air Quality Bureau
2048 Galisteo
Santa Fe, NM 87505

This application has been received by the New Mexico Environment Department and is
APPROVED X **DENIED** ___ **for the following reasons:**

AS PER 20 NMAC 2.60, SUBSECTION 113

This permit is approved for the following dates: 3/5/97 - 12/31/97
and is subject to the conditions set forth in 20 NMAC 2.60 and the following conditions:

RESTRICT IGNITION TO DAYS W/ GOOD DISPERSION TO BETTER DILUTE SMOKE

The Department reserves the right to cancel this permit at any time if the public interest so warrants it. The holder of this permit is therefore cautioned and charged that he/she, and he/she alone, assumes full responsibility to exercise the utmost care and judgement before igniting any prescribed fires. The Environment Department hereby disclaims any and all liability of itself or it's agents that might be incurred by petitioner's acts.

Signed Filiberto Dominguez Env. Specialist Date 3/5/97
Name and Title

ATTACHMENT A

LOS ALAMOS NATIONAL LABORATORY
APPLICATION FOR OPEN-BURNING PERMIT
IN TECHNICAL AREA 14, BURN CAGE

DATES BURNING REQUESTED:

A single burn scheduled for either March 4th or 5th is requested in order to mitigate the safety hazards posed by high explosive (HE) contaminated burnable waste. This burn is required to keep the HE waste from accumulating to dangerous levels. Safety and storage requirements dictate that waste burning must occur every 90 days as needed.

EXACT LOCATION AND DIRECTION TO SITE:

The burn will be conducted within Los Alamos National Laboratory boundaries at Technical Area 14, in the burn cage located near mound 3, just south of the Control Building (Q-23), and south of the magazine storage building (Q-22) (Attachment B). The site known as Q-Site East can be accessed by properly cleared or escorted personnel via a paved road off R-Site Road. However, the road is not accessible to the public and is administratively controlled.

TYPE AND QUANTITY OF MATERIALS TO BE BURNED:

The burn contains a maximum of 50 pounds of HE contaminated combustible waste placed inside the bottom grill of the burn cage. Each burn requires approximately a 1/2 gallon of excelsior or non-metal and non-halogen containing volatile organic compound to be used as a starter fluid. The starter fluid is placed in the bottom section of the burn cage or sprinkled over the HE-contaminated waste to aid in ignition and combustion of the waste. The waste consists of small amounts of HE, rags, paper, sample containers, Kimwipes, toothpicks, and other processing and clean-up waste.

METHOD OF IGNITION AND HOW BURNING WILL BE MAINTAINED AND CONTROLLED:

The Standard Operating Procedure (SOP) that will be followed during the burn is attached (Attachment C). It covers the hazards involved and precautions to be taken during the burn setup, method of ignition, and the post burn observation period. The SOP also covers unburnable material inspection procedures, receiving and placement for the burn, and disposal of the flashed material. The ignition method is a remotely operated electric match.

WHY IS BURNING NECESSARY:

The burning is necessary to mitigate the hazards associated with HE contaminated material generated during testing and operations of new HE having unknown properties and characteristics. Open burning is very effective in eliminating HE contamination of burnable waste so the safety concerns associated with burial disposal can be minimized.

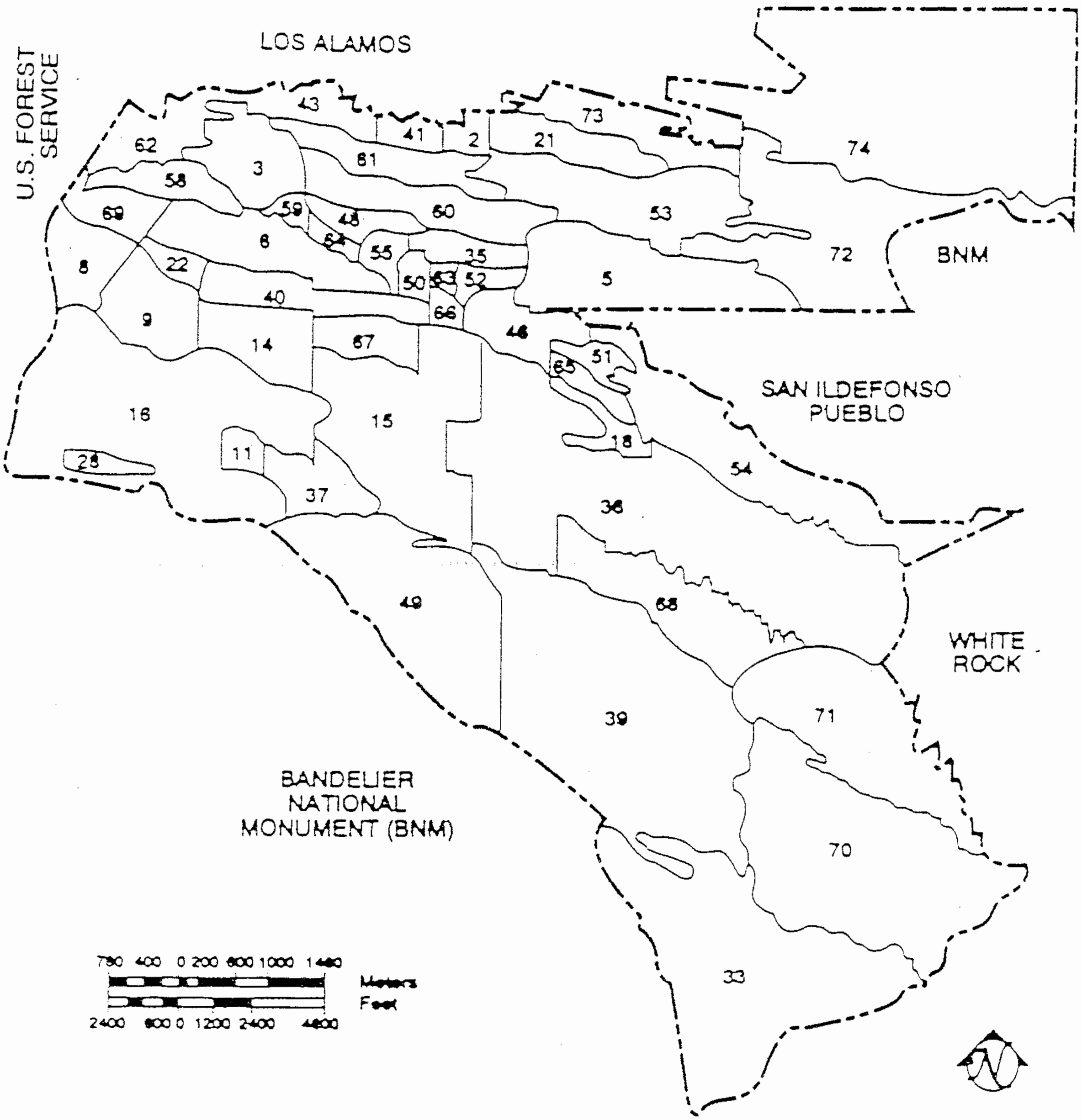
ALTERNATIVES TO BURNING AND REASONS WHY ALTERNATIVES ARE NOT FEASIBLE:

There are two alternatives to open burning. First, the direct burial of HE contaminated material is possible. However, this practice is contrary to the Laboratory's policy not to transport or move material resulting from any process associated with high explosives for safety reasons. For HE contaminated waste generated during testing and operations of new HE, this policy prevents accidents which might occur from the presence of HE residue remaining on the burnable materials. While this scenario is unlikely, there is a finite probability of its occurrence.

The second option would be to thermally treat the waste material in a thermal treatment oven or an incinerator. Due to the possibility of detonation at high temperatures occurring from contamination on the waste as well as some of the potentially explosive solvents, the treatment unit would have to be constructed of special materials.

Emission estimates and impacts are presented in attachment D.

ATTACHMENT B


LOS ALAMOS
U.S. FOREST SERVICE
SAN ILDEFONSO PUEBLO
WHITE ROCK
BNM
BANDELIER NATIONAL MONUMENT (BNM)
Meters
Feet
43
41
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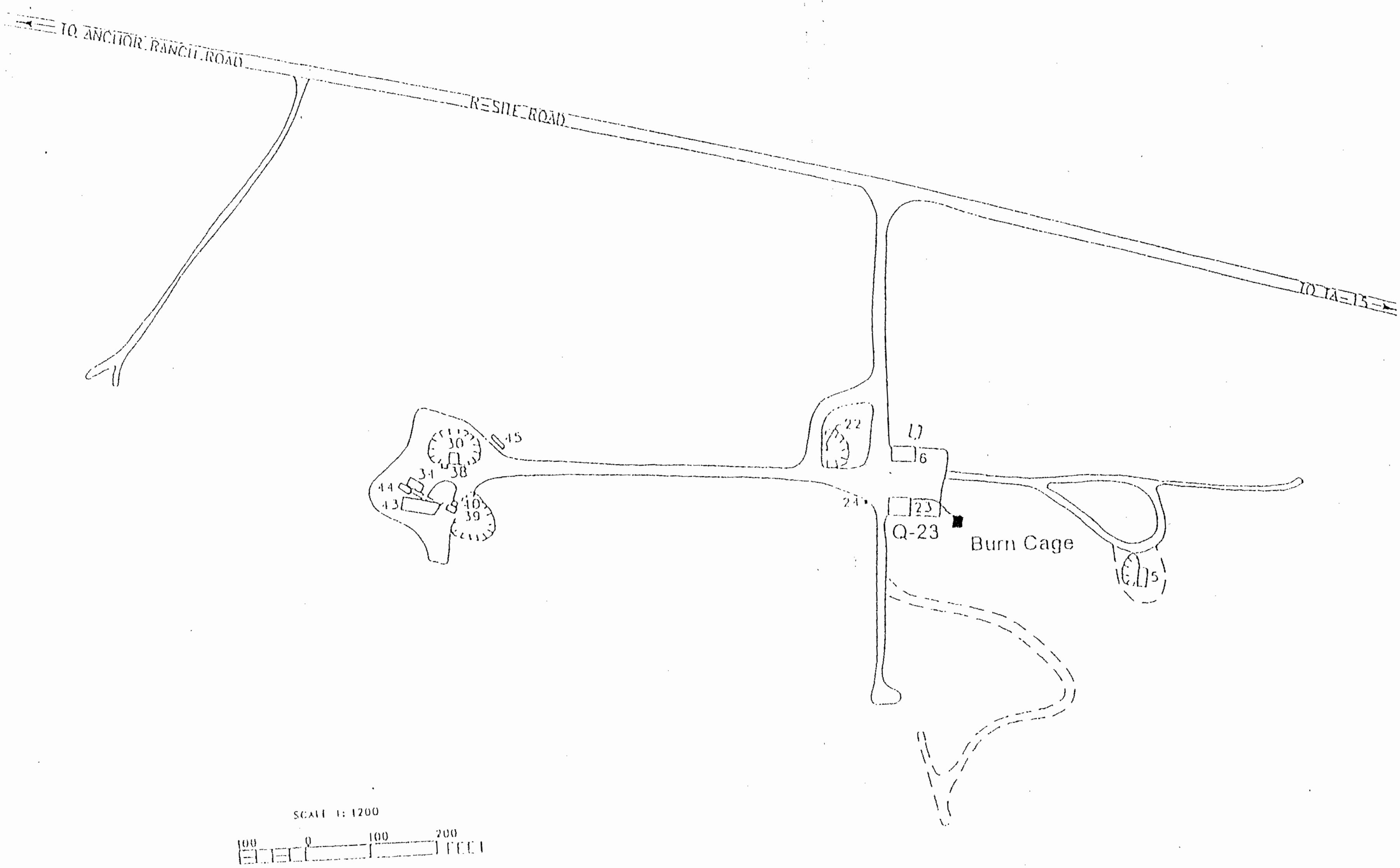
Technical Area 14



ATTACHMENT C

M-1

STANDARD OPERATING PROCEDURE

FOR

DESTRUCTION OF HE-CONTAMINATED WASTE AND HE WASTE

6.1.5

Prepared by: J. R. Stine, M-1 Date: 5/7/93

Approved by: John C. Dallman, M-1 Group Leader Date: 5/7/93

Approved by: M-DO Date:

Approved by: HS-5 Date:

Final Approval: C. B. Bieri, Group M-1 ES&H Officer Date:

This SOP has been approved by M-1 and M-DO. While we await final review from HS and other groups as determined by HS, we are using this SOP as written. If more than 30 days have elapsed without action by reviewing Groups outside M Division, this SOP will be regarded by the M-1 Group Office as having the full force of complete and unqualified endorsement.

Contents

1.0 INTRODUCTION

Group M-1 does tests and operations on new high-explosives that have unknown properties and characteristics. These operations generate waste that cannot be sent to WX-3 for disposal because of its uncharacterized nature or experimental history. These wastes are destroyed at Q-Site East by either burning or detonation.

2.0 PURPOSE

The purpose of this operation is to safely destroy HE waste and HE-contaminated waste originating in Group M-1. This SOP is closely tied to M-1:SOP 6.1.

3.0 SCOPE

This SOP applies to all M-1 personnel who perform the burning and detonation operations. These operations shall only be performed by Group M-1 personnel at Technical Area (TA) 14 (Q-site), Building 23 and the adjacent firing area.

4.0 DEFINITIONS

HE-Contaminated Waste: Materials such as rags; paper; sample containers; Kimwipes; toothpicks; other process and clean-up waste.

HE Waste: Damaged or suspect devices, explosives that have undergone severe testing, experimental explosives, explosives of temporary interest, newly synthesized compounds, new mixtures, and some salvage explosives.

5.0 RESPONSIBILITIES

5.1 Group Leader

- Ensures that the necessary policies, procedures, equipment, expertise (training), and manpower are available for this operation and delegates the responsibility for implementation of details to a Line Supervisor.

5.2 Line Supervisor

- Implements the details for safely performing these operations.
- Chooses, along with the Group Leader, the Firing Site Leader.

5.3 Firing Site Leader

- Has primary responsibility for safe operations.
- Supervises routine burning and detonation operations.
- Trains operators.

6.1.2 Detonation Operation

HE waste shall be destroyed by detonation on Mound 3.

6.1.3 Weight Limitations

Weight limitations are as follows.

Operation	Weight Limitation
Burning	50 lb of combustibles in each burn
Detonation	10 lb per shot

6.2 Personnel Limits

The personnel limits in M-1:SOP 6.1 shall be followed for this operation.

6.3 Transportation

The requirements for transporting HE-contaminated waste and small samples of HE waste for burning and detonation are listed below.

- Waste shall be transported to TA-14 (Q-Site) in accordance with M-1:SOP 1.9 for on-site transportation.
- No quantity greater than that which can be disposed of in a single day shall be transported to Q-Site.
- Operators will be told where HE waste is stored.

6.4 Storage

The following storage precautions shall be taken for materials to be burned and to be detonated:

- HE-contaminated wastes are stored in Magazine AE-208A at TA-9 while awaiting destruction at Q-Site. The waste will be labeled with its contents by the generator and labeled "Hazardous Waste" by the Waste Management Coordinator.
- At Q-Site, the explosive-contaminated waste will be kept in Room 104 of Building 23 while "in process."

7.2 Burning Operation

Follow the steps below for destroying HE-contaminated waste.

Step	Action
1	Short the end of the detonator cable.
2	Attach one or two ignitors in parallel to the firing cable and place them in the fuel space.
3	Sprinkle fuel on the HE-contaminated waste to enhance destruction of the waste and aid in ignition. Note: Use only volatile hydrocarbons, such as acetone, toluene, fuel oil, hexane, as a fuel. **CAUTION** DO NOT use any material that contains metals or halogens in its molecular composition. If in doubt, check with the experimenter in charge of Q-Site.
4	Cover the top of the burn cage with the wire mesh provided to minimize the escape of burning particles.
5	Fire the ignitors using the firing control unit in Room 101 of Building Q-23 (see M-1:SOP 6.1). Note: The siren will go through its normal sequence, but the Firing Supervisor may turn the siren off after determining that the burn is progressing satisfactorily.
6	• Wait for at least 10 minutes after visible flaming has stopped and • Then sound the "all-clear" signal. Note: If there is still a considerable amount of smoke, the Firing Site Leader must use his judgment about delaying the all-clear signal.
7	In the event of a misfire, do not approach the area until at least 10 minutes have elapsed without any evidence of flames or smoke in the burn cage.
8	DO NOT use the burn cage for another burn operation for 24 hours.
9	After 24 hours or more, remove the ashes and place in the satellite storage outside Building 23.
10	Cover the burn cage with a tarp.

7.4 Disposing of Waste

Waste generated from these operations shall be packaged and disposed of according to M-1:SOP 1.5. Waste minimization will be handled according to the M-Division Operations Manual.

7.5 Emergency Procedures

In the event of an emergency situation, the Building Emergency Plan (BEP)/ Site Emergency Plan (SEP) shall be followed. The BEP/SEP shall be available in Building Q-23 and the operators shall be familiar with its contents.

8.0 REQUIRED RECORDS

- M-1:SOP 6.1
- Completed and signed Shot Sheet (for detonation or burning)
- M-1 Q-Site Check List, Burning of HE-Contaminated Waste

9.0 REFERENCES

- DOE Explosives Safety Manual
- Los Alamos Environment, Safety, and Health Manual
- M-Division Operation Manual
- M-1:SOP 1.5, Disposal of Hazardous Materials
- M-1:SOP 1.9, Packaging and On-Site Transportation of Explosives
- M-1:SOP 6.1, Q-Site East (TA-14) Firing Operations

10.0 ATTACHMENTS

I. M-1 Q-Site Check List, Burning of HE-Contaminated Waste

II. Hazardous Waste Facility Permit

Attachment I

M-1 Q-Site Check List
Burning of HE-Contaminated Waste

Requester ____________________ Date Burned ____________________

Charge Code ____________________ Shot No. ____________________

This checklist is intended for use as a safety supplement to M-1:SOP 6.1.5 "Destruction of HE-Contaminated Waste and Waste HE." All Q-Site users must be familiar with Group M-1 SOPs 6.1 and 6.1.5. This checklist should be referred to by the Firing Supervisor subsequent to burning in the burn cage and prior to final arming. In the event of a misfire follow the checklist on the other side of this page.

OK	N/A	
☐	☐	1) Secure and clear area.
☐	☐	2) Ensure burn cage is clean.
☐	☐	3) Open all glass and plastic containers.
☐	☐	4) Place containers to be burned on grate.
☐	☐	5) Place fuel material in bottom of burn cage.
☐	☐	6) Short end of detonator cable.
☐	☐	7) Attach ignitors to detonator cable and place igniters in fuel material.
☐	☐	8) Sprinkle fuel on waste material.
☐	☐	9) Cover top of burn cage with wire mesh.
☐	☐	10) Connect detonator cable to CDU.
☐	☐	11) Start firing sequence.
☐	☐	12) Fire ignitors.
☐	☐	13) Observe burning.
☐	☐	14) Turn off siren (do NOT sound "all-clear").
☐	☐	15) Wait 10 min. after flame has stopped and sound "all-clear."
☐	☐	16) Another batch cannot be burned until 24 hours has elapsed.
☐	☐	17) Clean up ashes (after 24 hours) and place in satellite storage outside TA-23.
☐	☐	18) Cover burn cage with tarp.

Signature ______________________________ Date ______________
Firing Supervisor

FORM DATE 8/7/91 Approved By: ____________________ Date: __________

Attachment II

Hazardous Waste Facility Permit

PERMITTEE: U.S. Department of Energy
University of California Regents

ID NUMBER: NM0890010515

LOCATION: Los Alamos National Laboratory,
Los Alamos, NM 87545

PERMIT NUMBER:
NM 0890010515-1

Pursuant to the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6901, *et seq.*), and the New Mexico Hazardous Waste Act (§§ 74-4-1 *et seq.* NMSA 1978), a permit is issued to the U.S. Department of Energy's Los Alamos Area Office and the University of California Regents, doing business as Los Alamos National Laboratory, (hereafter called the Permittee) to operate a hazardous waste incinerator, container storage and tank treatment and storage facility at the location stated above.

The Permittee must comply with all the terms and conditions of this permit. This permit consists of the conditions contained herein including the attachments. Applicable provisions of regulations cited are those which are in effect on the effective date of this permit, New Mexico Hazardous Waste Management Regulations (HWMR-5, as amended 1989). This permit shall become effective in accordance with HWMR-5, Part IX, sections 902.F. and 902.G. and shall run for a period of ten years.

This permit is based on the provisions of HWMR-5. This permit is also based on the assumption that all information contained in the permit application is accurate and that the facility will be operated as specified in the application. The permit application consists of information submitted on March 27, 1986; revised on November 13, 1986 and November 25, 1987; and supplemented on November 8, 1988 and through numerous technical discussions.

Any inaccuracies found in the information may be grounds for the termination or modification of this permit and potential enforcement action.

Signed this 8th day of November 1989

by [signature]
Richard Mitzelfelt, Director, H.M.E.I.D.

New Mexico
Health and Environment Department
Environmental Improvement Division

ATTACHMENT D

TECHNICAL APPROACH TO ESTIMATING EMISSIONS AND THE AIR QUALITY IMPACTS FROM THE OPEN BURNING OF HIGH EXPLOSIVES CONTAMINATED WASTE CONDUCTED AT TECHNICAL AREA 14

Air emissions resulting from the combustion of high explosives (HE) contaminated waste consist primarily of carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter (PM), volatile organic compounds (VOC's), sulfur dioxide (SO_2), and heavy metals such as lead (Pb). Detailed emission estimates for wood, paper, and plastics were performed for this analysis using AP-42 emission factors developed by the Environmental Protection Agency (EPA) found in the July 1995, Version 4.0 of EPA's Air Chief; available on CD ROM. In addition, emission estimates for the combustion of solvents were performed using emission factors and equations presented in the document titled "Prediction of Fire Properties of Fuels," A. Tewarson, Factory Mutual Research Corporation, 1986 (Attachment E). Emission estimates for the combustion of HE were performed using emission factors compiled from data provided in the documents titled: "Emissions from the Open Burning or Detonation of High Explosives," R.V. Carter, U.S. Army Environmental Hygiene Agency, 1978; "Air Quality Impact Analysis, Open Burning of Explosives," Department of Energy, Pantex Plant, Amarillo, Texas, Radian Corp., 1990; "Lawrence Livermore National Laboratory (LLNL) Explosives Handbook Properties of Chemical Explosives and Explosive Simulants," B. M. Dobratz, 1981. Table 1 shows the typical profile of the constants of a burn as well as the emission factors from the sources described above.

TABLE 1. BURN CONSTITUENTS AND ASSOCIATED EMISSION FACTORS

Waste Type	Amount Burned	Emission Factors (lb/lb of material burned)							
		CO	NOx	VOC	PM	SO_2	HF	HCl	Pb
Wood/ Cardboard	10 lb	0.13	0.001	0.11	0.02	0.001	N/A	N/A	1E-07
Plastics/ Paper	30 lb	0.04	0.003	0.02	0.01	0.001	0.0001	0.004	N/A
HE	2 lb	0.05	0.13	0.005	0.27	N/A	0.050	0.028	N/A
Solvents	8 lb (≈ 1 gal)	0.01	N/A	0.02	0.04	0.05	N/A	N/A	1E-06
Emission Totals (lbs)	**50 lb**	**2.66**	**0.30**	**1.86**	**1.16**	**0.44**	**0.07**	**0.16**	**9E-06**

HE Contaminated Waste Solvent Mixtures

Approximately one gallon of HE contaminated dilute solvents generated during HE processing operations at LANL are included in the waste burn at TA-14. The average make-up of the dilute solvent solution is 30% methanol, 25% water, 20% acetonitrile, 20% tetrahydrofuran, 5% of any the solvents in Table 2. Combustion emissions were estimated using emission factors and equations from A. Tewarson, Prediction of Fire Properties of Fuels, Factory Mutual Research Corporation, 1985. Table 2 gives the chemical properties and assumptions required for the emission calculations. Emission estimates from solvent burning are shown above in Table 1.

TABLE 2. CHEMICAL PROPERTIES OF HE CONTAMINATED WASTE SOLVENTS

SOLVENT TYPE	MOLECULAR WEIGHT (g/mole)	DENSITY (g/ml)	NUMBER OF CARBONS	ASSUMPTIONS USED FOR CALCULATIONS
methanol	32	0.7914	1	experimental data available
acetonitrile	41	0.7868	2	C_2 linear alkanes
tetrahydrofuran	72	0.8888	4	C_3-C_6 linear ketones
methyl ethyl ketone	72	0.8054	4	C_3-C_6 linear ketones
butyl acetate	116	0.8825	6	C_5-C_{10} acetate
ethyl acetate	88	0.9003	4	C_4 acetate
toluene	92	0.8669	7	experimental data available
ethanol	46	0.7893	2	experimental data available
acetone	58	0.7899	3	experimental data available
cyclohexane	84	0.7785	6	C_5 -C_{10} cyclo alkane

High Explosives (HE) Waste

Waste HE, generated during HE processing, can consist of a number of different types of HE and associated binders. Table 3 gives a representative list of the HE waste composition found in process waste burned as well as amount of combustion products formed.

TABLE 3. EMISSIONS FROM THE OPEN BURNING OF HIGH EXPLOSIVES

High Explosives, Propellants, and Binders	Composition Fraction	Quantity Burned (lb/burn)	Combustion Products (lb)			
			CO	NOx	VOC	PM
TATB[1,2]	0.21	0.42	1.09E-02	2.92E-02	1.93E-04	8.17E-02
NTO[1,2]	0.18	0.36	1.01E-02	2.70E-02	1.80E-04	7.56E-02
Pyroxylin[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
Comp B[1,2]	0.04	0.08	2.00E-04	1.48E-03	N/A	N/A
LAX 112[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
RDX[1,2]	0.04	0.08	2.09E-04	1.50E-03	4.17E-03	N/A
DNT[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
Nitroguanidine[1,2]	0.04	0.08	2.22E-04	1.50E-03	N/A	2.34E-03
HMX[1,2]	0.04	0.08	2.22E-04	1.50E-03	N/A	2.34E-03
PETN[1,2]	0.04	0.08	2.00E-04	1.48E-03	N/A	N/A
TNT[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
HNS[1,2]	0.04	0.08	2.18E-04	1.15E-03	1.58E-04	6.48E-03
Barium nitrate[3,4]	0.01	0.02	N/A	7.00E-03	N/A	N/A
Cyanuric acid[3,4]	0.01	0.02	2.20E-03	1.76E-02	N/A	1.76E-02
Pentek[3,4]	0.01	0.02	2.20E-03	1.76E-02	N/A	1.76E-02
Exxon461[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
KFE[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
Polystyrene[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
Estane[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
Viton[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
BDNPA-F[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
DBP[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
DOP[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
CEF[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
TOTAL	**1**	**2**	**5.06E-02**	**1.31E-01**	**4.86E-03**	**2.71E-01**

1 Emission factors from Roy V. Carter (June 1978), Emissions from the Open Burning and Detonation of Explosives.

2 Emission factors from U.S. Environmental Protection Agency (June 1995), AP-42 Air Pollution Emission Factors.

3 Emission factors from Radian Corp. (July 1990), Air Quality Impact Analysis, Open Burning of Explosives, Department of Energy, Pantex Plant, Amarillo, Texas.

4 Emission factors based on chemical structures from B. M. Dobratz (March 1981), LLNL Explosives Handbook Properties of Chemical Explosives and Explosive Simulants.

Air Quality Impact Modeling

Air emissions from the open burning of HE contaminated waste at TA-14 are regulated under National and New Mexico Ambient Air Quality Standards. Air emissions from this operation include criteria pollutants such as carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter (PM), sulfur dioxide (SO_2), volatile organic compounds (VOC's), and lead (Pb). In addition, some hazardous air pollutants such as hydrogen chloride (HCl) and hydrogen fluoride (HF) are emitted as a result of combustion of some binders used to form HE. Impacts from operations of this type* must meet ambient air standards for all criteria pollutants. Compliance with the ambient air quality standards was determined using the SCREEN 3 air emissions dispersion model.

The SCREEN 3 model was developed and approved by the Environmental Protection Agency (EPA) as a screening procedure for estimating air quality impacts of stationary sources. SCREEN 3 is a conservative model which uses worst case meteorological data to determine emission impacts. Input parameters supplied for this analysis included: a heat release rate of 15,748 cal/sec; a one hour burn duration; a 2.5 m/sec wind speed; and a one meter source height using a flare source type. Emission impacts are shown in Table 4 for the maximum impact (61 meters) and for the two nearest off-site locations, Pajarito Road 2,042 meters to the north/northeast and State Road 4 bordering Bandelier National Monument 2,286 meters to the south/southeast. The impacts are shown to be will below the ambient standards at all affected locations.

TABLE 4. AIR QUALITY IMPACTS FROM HE PROCESS WASTE BURNING

CHEMICAL	MODELING PARAMETERS	AMBIENT AIR QUALITY STANDARD			AIR CONCENTRATION AT:		
					61 M (Max.)	2042 M (Pajarito Rd.)	2286 M (SR 4)
CO	D Stability	8-hour average 1-hour average	0.5 mg/m³ 2.0 mg/m³	(8.7 ppm) (13.1 ppm)	0.53 ppm 0.76 ppm	3.8E-03 ppm 5.5E-03 ppm	3.2E-03 ppm 4.6E-03 ppm
NOx		24-hour average Annual arithmetic average	5.0 μg/m³ 1.0 μg/m³	(0.1 ppm) (0.05 ppm)	1.4E-02 ppm 2.9E-03 ppm	1.0E-04 ppm 2.1E-05 ppm	8.6E-05 ppm 1.7E-05 ppm
PM	2.5 meters/sec. wind speed	24-hour average 7-day average 30-day average Annual geometric mean	150 μg/m³ 110 μg/m³ 90 μg/m³ 60 μg/m³		136.6 μg/m³ 19.5 μg/m³ 4.6 μg/m³ 27.3 μg/m³	1.0 μg/m³ 0.1 μg/m³ 3.3E-02 μg/m³ 0.2 μg/m³	0.8 μg/m³ 0.1 μg/m³ 2.8E-02 μg/m³ 0.2 μg/m³
SO_2	Heat Released 15,748 cal/sec.	24-hour average Annual arithmetic average	5.0 μg/m³ 1.0 μg/m³	(0.1 ppm) (0.02 ppm)	0.03 ppm 0.006 ppm	2.1E-04 ppm 4.3E-05 ppm	1.8E-04 ppm 3.6E-05 ppm
Lead		3-month average	0.03 μg/m³		8.9E-06 μg/m³	6.4E-08 μg/m³	5.4E-08 μg/m³
Photo Chemical Oxidant (VOC)		1-hour average		(0.06 ppm)	0.14 ppm	1.0E-03 ppm	8.0E-04 ppm

* HAP's emission standards are regulated under 20 NMAC 2.70 for the facility at 10 tons per year for any one HAP or 25 tons per year for any combination of HAP's. Subsequently, impacts for HCl and HF releases were not included in this modeling analysis.

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PREDICTION OF FIRE PROPERTIES OF FUELS

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1. INTRODUCTION

Fire properties are defined as the parameters which characterize the combustion and pyrolysis behavior of fuels in fires[1]. In conjunction with fire models, fire properties are used to assess hazards presented by various types of fires and protection needs. A fundamental understanding of diffusion flames has always been found to be very useful in the prediction of fires. In this paper, an attempt has thus been made to use the understanding of the soot formation in diffusion flames to develop relationships for the prediction of fire properties.

The soot formation in diffusion flames has been of great interest because of the relationship with flame radiation and heat transfer, combustion efficiency, and emission of particulates and other chemical compounds some of which may be toxic and corrosive in nature.

In this study, we have used the concept of the smoke point height, L_s, which has been used by many investigators to describe the sooting tendency of fuels. L_s is defined as the height of an overventilated diffusion flame at which soot just begins to be released at the flame tip. The smaller the value of L_s, the greater the tendency to soot. Extensive data for L_s are available in the literature for liquid and gaseous fuels[2-8]. Many investigators find that L_s depends on the nature of chemical bonds and flame turbulence. It has been shown that L_s is related to flame temperature (flame convection)[6] and to flame radiation[9].

In order to use the literature data for L_s to develop predictions for fire properties, it was necessary to perform experiments in our flammability apparatus. In the experiments, simultaneous measurements were made for L_s and fire properties of fuels of known chemical structures and L_s values. In addition to gaseous and liquid fuels, solid fuels were used in the experiments.

The radiative component of the combustion efficiency, χ_R, is defined as

$$\chi_R = \chi_A - \chi_C . \tag{7}$$

3. EXPERIMENTS

Experiments were performed in our apparatus, shown in Fig. 1[10]. For gaseous samples, a burner tube very similar to one in Ref. 9 was used. For liquid and solid samples, a 250 ml Pyrex Erlenmeyer flask with a 14/35 ground glass joint was used. The ground glass joint was attached to a 0.12-m long Pyrex glass tube with an internal diameter of 0.009 m to reduce the effects of temperature on L_s values. External heat flux was used for solid and low vapor pressure liquids; for high vapor pressure liquids, a heating mantle placed around the flask was used. The rate of generation of the fuel vapors and flame height were varied by varying either the external heat flux or the heating rate of the mantle.

L_s value was measured visually and for the measurement of fire properties, all the combustion products were captured along with air in the sampling duct of our apparatus. In the duct, measurements were made for the gas temperature, mass fractions of CO_2, CO, total gaseous hydrocarbons (CH), soot (S), and O_2, and $\dot{m}_T$. Measurements were also made for optical transmission through soot, but data have not been discussed in this paper. The generation rate of fuel vapors was measured by a load cell assembly.

In the experiments, data were recorded by a computer at a time interval of about one second. Data were averaged by the computer at the steady state, lasting for about 10 minutes. Each experiment was performed at least twice and the data were averaged. The accuracy of all the averaged experimental data is about ±2%.

All the experiments were performed under natural air flow conditions and thus represent overventilated fire conditions.

The relationship between f_{CO_2} and L_s is same as between χ_A and L_s as expected from Eq. (5) for overventilated fires.

Predictions of Fire Properties of Fuels

If it is assumed that the relationships given in Eqs. (8) to (13) are of general applicability, then it is possible to use the L_s values from the literature to predict χ_i and f_j values for many fuels. The literature values for L_s, however, cannot be used directly because of variations due to differences in the experimental conditions used by various investigators.[11] The following approach was thus taken in this study: 1) relationships between L_s values measured by us and reported in the literature, for selected fuels, were established separately for each investigator; 2) these relationships were then used to recalculate all other L values separately for each investigator; and 3) for fuels which were used by several investigators, the recalculated values of L_s were averaged. The recalculated values of L_s were then used in Eqs. (8) to (13) to predict the χ_i and f_j values. The predicted values of χ_i and f_j are listed in Table II. The detailed tabulation of the data is given in Ref. 12. Values of f_{others} in the table are calculated from the atom balance, i.e., $f_{others} = 1 - \Sigma f_j$.

5. DISCUSSION

Comparison Between the Predicted and Measured Values of Fire Properties

Table III lists the experimental and predicated data for some selected fire properties (f_{CO_2} or χ_A and f_S). A reasonable agreement can be noted between the predicted and measured values. Also our predictions for f_S and those of Pagni's[15], based on entirely different principles, are very similar, except for octane and polystyrene. The new measurements suggest that our older f_S value of 0.18 for polystyrene[17], referred in Ref. 15, appears to be somewhat higher.

and soot, in that order. Butadiene, which is at the top within the aliphatic fuels group, is expected to follow the above aromatic group of compounds.

Relationship Between the Generation Efficiencies of CO and CO_2

In combustion systems, the ratio of CO to CO_2 is used as an indicator of the burning efficiency of fuels. For fuels burning under overventilated conditions, the ratio will vary with the chemical structure of the fuels. For fuels with fixed chemical structure, the ratio will vary with ventilation.

For fuels with variable chemical structure, burning under overventilated conditions, the relationship between f_{CO} and f_{CO_2} can be predicted from Eqs. (10) and (11). The predicted relationship is shown by the solid line in Fig. 3. Experimental data obtained under variable ventilation conditions for wood cribs, heptane, and PMMA from Ref. (18) to (20) have also been included in Fig. 3. Data for enclosure fires of wood cribs with variable ventilation were averaged for similar f_{CO_2} values, and were restricted to the flaming fires only. Data in Fig. 3 indicate that as f_{CO_2} decreases, f_{CO} approaches an asymptotic limit, which is about 0.12 for wood, which is a char forming fuel, and about 0.08 for heptane and PMMA, which are non-char forming fuels.

The results in Fig. 3 indicate that, up to the asymptotic limit of f_{CO}, the relationship between f_{CO} and f_{CO_2} is expected to be the same for the combustion of fuels with: 1) fixed chemical structure and variable ventilation; and 2) variable chemical structure with overventilation. It may be possible to define the asymptotic limit for f_{CO} for underventilated fires of fuels based on their chemical structure.

Relationship Between the Generation Efficiencies of CO and Soot

Emissions of CO and soot from combustion systems are associated with reduced ventilation and/or involvement of fuels which burn inefficiently because of their chemical structures.

From Eqs. (3), (4), and (14),

$$\dot{E}''_j = (f_j \; k_j/[\int_0^{T_v} c_p \, dT + H_v]) \, (\dot{q}''_{fs} - \dot{q}''_{rr}) \; , \qquad (16)$$

where $\dot{E}''_j$ is the emission rate of a compound j per unit fuel surface area (kg/m^2s). In Eqs. (14), (15), and (16), $\int_0^{T_v} c_p \, dT + H_v$ is defined as heat of gasification of the fuel, L_g (kJ/kg). H_T values are known from the literature and k_j values can be calculated from the elemental composition of the fuel. L_g values can also be calculated from the literature values for c_p, T_v, and H_v[21], or can be measured. Within a generic group of fuels, L_g increases with the molecular weight of the fuel, primarily due to increase in T_v, and can be estimated for fuels of higher molecular weight. The measured value of L_g for PE is 1750 kJ/kg[17], and from the relationship between L_g and the molecular weight of alkenes, it can be estimated that the molecular weight of the oligomer produced by the vaporization of PE is about 0.601 kg/mole, which is reasonably close to a value of 0.692 kg/mole reported for the molecular weight of the PE oligomer in pyrolysis[22]. In a similar fashion, the molecular weight of PP oligomer is estimated to be 0.720 kg/mole.

From the values of L_g, H_T, k_j, and the data from Table II, emission rates can be calculated for the fuel vapors and the combustion products for defined values of $\dot{q}''_{fs} - \dot{q}''_{rr}$, for example, at the asymptotic limit of $\dot{q}''_{fs} - \dot{q}''_{rr}$, which is approximately constant for fuels with variable molecular weight within a generic group of fuels. Within the aliphatic fuels group, the asymptotic limit for $\dot{q}''_{fs} - \dot{q}''_{rr}$ is equal to 41 kW/m^2, with a variation of ± 15% (as derived from the data for polyoxymethylene, PMMA, heptane, polyethylene, and polypropylene[1,10,16,17]). The emission rates for heat, CO, and soot calculated in this fashion for alkanes and alkenes, as examples, are shown in Figs. 5 and 6, respectively. Experimental data for PE and PP are also included in Fig. 6. The emission rates decrease with increase in the molecular weight of the fuel, because of the increase of L_g due to increase of T_v.

NOMENCLATURE

C_p	specific heat (kJ/kg K)
$\dot{E}''$	emission rate per unit fuel surface area (kg/m^{2}s)
f_j	generation efficiency of compounds j or oxygen depletion efficiency (-)
$\dot{G}_f$	generation rate of fuel vapors (kg/s)
H_{CO}	heat of combustion of CO (kJ/kg)
H_T	net heat of complete combustion (kJ/kg)
H_v	heat of vaporization (kJ/kg)
k_j	maximum possible total (theoretical) yield of compound j or stoichiometric mass oxygen to fuel ratio (kg/kg)
L_g	heat of gasification of the fuel (kJ/kg)
L_s	smoke point height (m)
$\dot{m}_T$	total mass flow rate of combustion product-air mixture (kg/s)
$\dot{Q}_A$	actual heat release rate (kW)
$\dot{Q}_T$	total (theoretical) heat release rate (kW)
$\dot{q}''_{fs}$	flame heat to the surface of the fuel (kW/m^2)
$\dot{q}''_{rr}$	surface heat loss due to reradiation (kW/m^2)
ΔT	gas temperature above ambient (K)
T_v	vaporization temperature (K)
X_j	mass fraction of compound j (kg/kg)
Y_j	yield of compound j (kg/kg)
χ_A	combustion efficiency (-)
χ_C	convective component of combustion efficiency
χ_R	radiative component of combustion efficiency

Subscripts

f	fuel vapors
i	heat
j	chemical compound

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TABLE I

Experimental Data for Smoke Point Height and

Selected Fire Properties of Fuels

Fuel	L (m)	χ_A	χ_C	χ_R	f_{CO_2}	f_{CO}	f_{CH}	f_S
Methanol	N	0.97	0.83	0.14	0.97	0.001	0.001	N
Ethanol	0.225	0.97	0.74	0.23	0.97	0.001	0.001	0.021
Acetone	0.205	0.96	0.73	0.23	0.96	0.001	0.001	0.022
Pentane	0.155	0.94	0.65	0.29	0.94	0.002	0.001	N
Isopropanol	0.148	0.94	0.65	0.29	0.94	0.002	0.001	N
Hexane	0.125	0.93	0.63	0.30	0.93	0.004	0.002	N
Nylon	0.120	0.90	0.58	0.32	0.90	0.004	0.002	0.030
Ethylene	0.106	0.91	0.61	0.30	0.91	0.003	0.002	0.032
Heptane	0.110	0.93	0.61	0.32	0.93	0.004	0.003	0.032
PMMA	0.105	0.95	0.63	0.32	0.95	0.006	0.001	0.027
Cyclohexane	0.085	0.91	0.56	0.35	0.91	0.005	0.001	N
Isooctane	0.080	0.91	0.60	0.31	0.91	0.007	0.003	N
Polypropylene	0.050	0.89	0.52	0.37	0.89	0.015	0.003	0.050
Polyethylene	0.045	0.87	0.50	0.37	0.86	0.013	0.002	0.060
Propylene	0.029	0.81	0.41	0.40	0.81	0.011	0.006	0.064
Polystyrene	0.015	0.66	0.26	0.40	0.65	0.027	0.023	0.101
Toluene	0.005	0.68	0.28	0.40	0.68	0.030	0.023	0.190

N not measured

TABLE II

(continued)

Fuel	C atoms	x_A	x_C	x_R	f_{CO_2}	f_{CO} x100	f_{CH} x100	f_S x10	f_{others} x10
Butyrate	5 to 6	0.97	0.72	0.25	0.97	0.20	0.11	0.24	0.04
	7 to 8	0.93	0.63	0.30	0.93	0.31	0.15	0.30	0.35
Laurate, oxalate, malonate, lactate	4 to 14	0.97	0.71	0.26	0.97	0.22	0.11	0.24	0.03
<u>C-H-N Structure</u>									
Amines	4 to 12	0.90	0.57	0.33	0.90	0.43	0.21	0.36	0.58
<u>C-H-S Structure</u>									
Mercaptans and Sulfides	6 to 12	0.90	0.57	0.33	0.90	0.43	0.21	0.36	0.58
					<u>Aromatic Fuels</u>				
<u>C-H Structure</u>									
Arenes	6 to 21	0.71	0.30	0.41	0.70	3.80	1.58	1.32	1.14
Cyclic Arenes	10 to 12	0.76	0.36	0.40	0.75	1.96	0.85	0.89	1.32
PAH	9 to 12	0.68	0.27	0.41	0.68	5.20	2.13	1.59	0.88
polycyclic aromatic HCs → 3 or more rings									
<u>C-H-O Structure</u>									
Alcohols	7 to 8	0.71	0.30	0.41	0.71	3.49	1.46	1.25	1.16
Ketones	11	0.76	0.36	0.40	0.76	2.01	0.87	0.90	1.20
Aldehydes	7	0.75	0.35	0.40	0.75	2.26	0.97	0.97	1.21
Esters	9	0.76	0.36	0.40	0.76	1.96	0.85	0.89	1.22
<u>C-H-N Structure</u>									
Amines and Heterocylics	6 to 11	0.73	0.32	0.41	0.73	3.00	1.26	1.14	1.13
<u>C-H-S Structure</u>									
Mercaptans and Sulfides	6 to 8	0.67	0.26	0.41	0.67	6.18	2.50	1.76	0.67

N: not predicted

FIGURE CAPTIONS

Fig. 1 Flammability apparatus

Fig. 2 Combustion efficiency and its convective and radiative components as functions of smoke point height

Fig. 3 Relationship between the generation efficiencies of CO and CO_2. Solid line represents our predictions for fuels with variable chemical structures. Experimental data points connected by dashed lines are for variable ventilation conditions: O, enclosure fires of wood cribs, Ref. 18; ●, Heptane, Ref. 19; ■, wood cribs, Ref. 18; *, PMMA, Ref. 20.

Fig. 4 Relationship between the generation efficiencies of soot and CO. Solid line represents our predictions for fuels with variable chemical structures. Symbols connected by dashed lines represent experimental data for PMMA with variable ventilation conditions, Ref. 20.

Fig. 5 Estimated emission rates of heat, CO, and soot as functions of the molecular weight of alkanes for overventilated fires.

Fig. 6 Estimated emission rates of heat, CO, and soot as functions of molecular weight of alkenes for overventilated fires. Dark symbols represent experimental data for polyethylene and polypropylene.

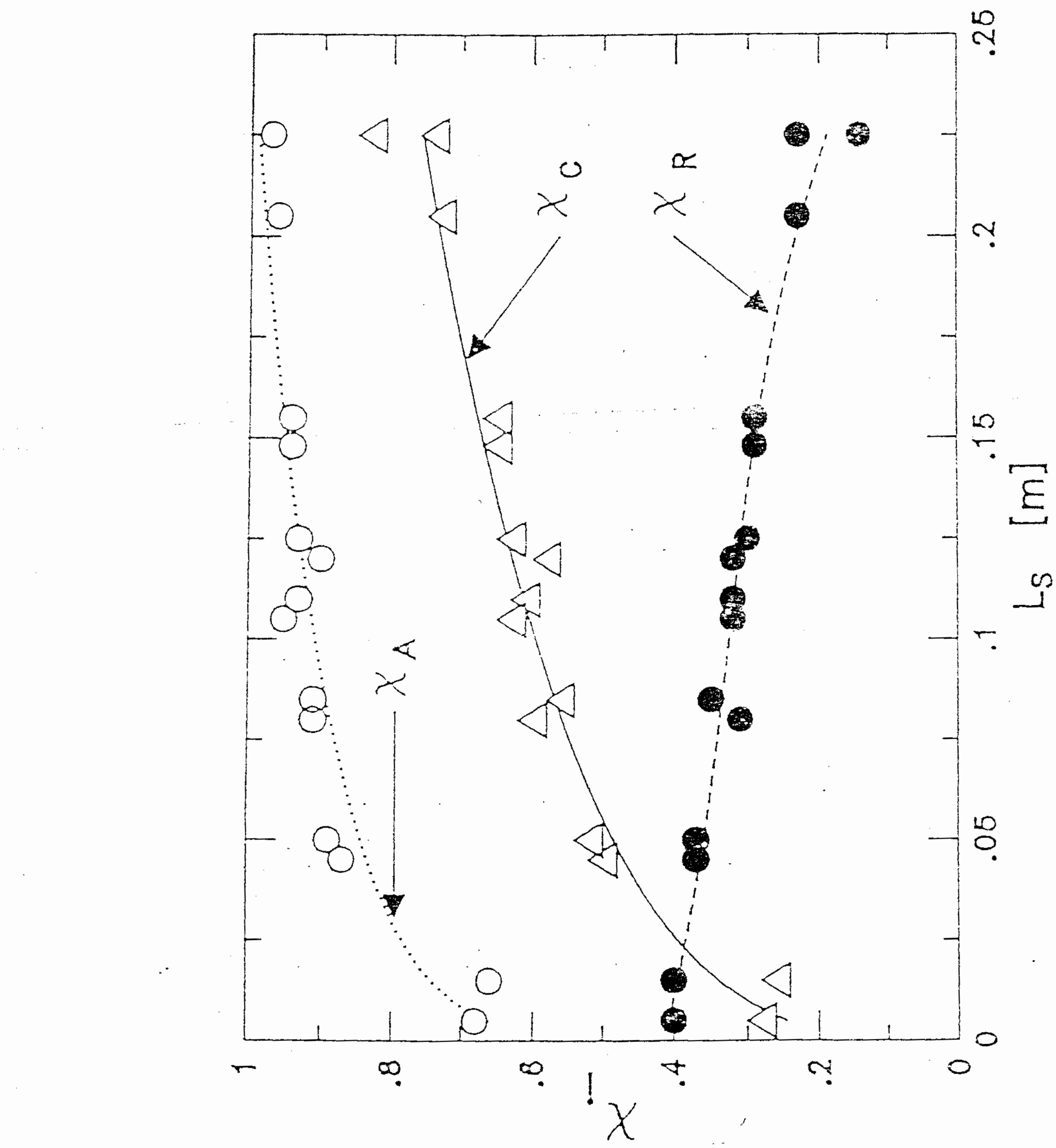


Fig. 2/ Tewarson

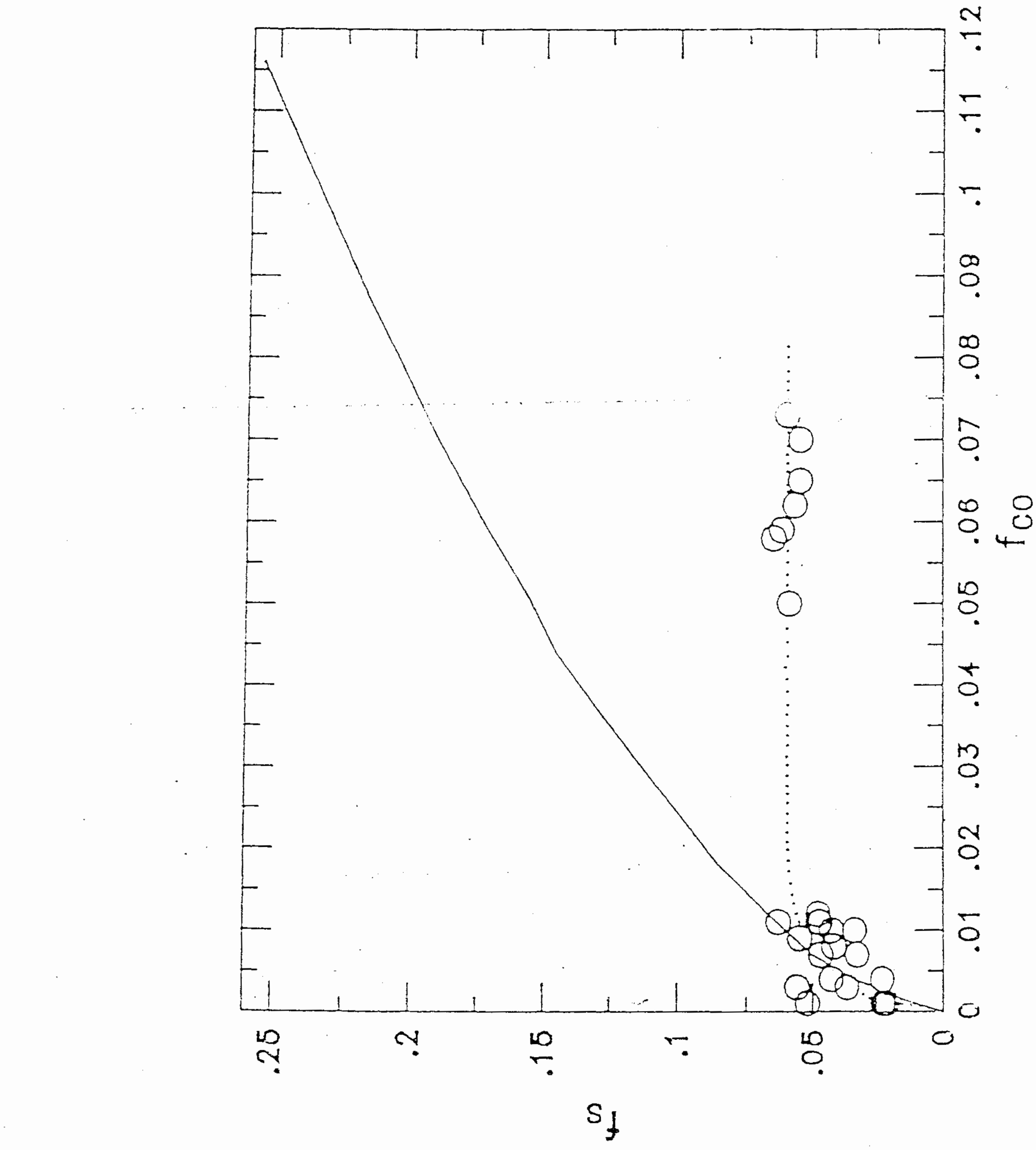


Fig. 4/ Tewarson

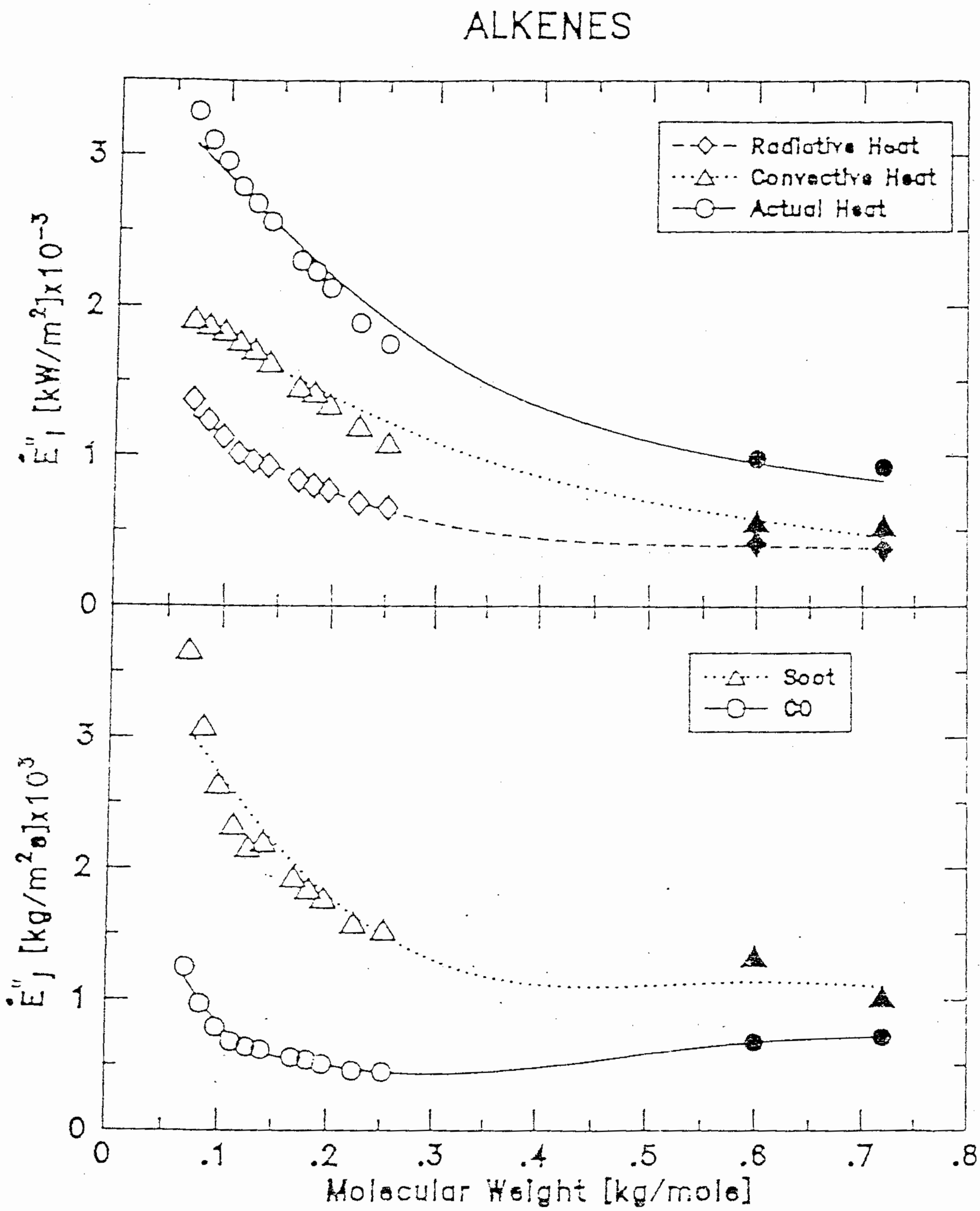


Fig. 6/ Tewarson

STATE OF NEW MEXICO
Environment Department

PERMIT NO. ____________
(AQB assigned)

**NEW MEXICO ENVIRONMENT DEPARTMENT/AIR QUALITY BUREAU
PERMIT APPLICATION AND REPORTING OF OPEN BURNING FOR
PRESCRIBED/PRESCRIBED NATURAL FIRE AREAS**

PERMITTEE: USDA___ USDI___ BLM___ MILITARY___ DOE X PRIVATE___ OTHER___

ADMINISTRATIVE UNIT: Technical Area 14 COUNTY: Los Alamos

CONTACT: Steve Fong/Leland Maez PHONE: 665-5534/665-1240

NAME OF BURN: Burn Cage LOCATION: Los Alamos National Laboratory
(Township, Range, Section)

PROPOSED ACREAGE See Attach. FUEL LOADING DETERMINATION METHOD See attachment

TYPE OF FUEL See attachment TONS/ACRE See attachment

Is burn likely to impact a smoke sensitive area? Yes___ No X
If yes, please attach a map of smoke sensitive areas (Include distance and direction).

Smoke sensitive areas include: Class I areas as well as other scenic and important views, urban and rural population centers, hospitals, nursing homes, schools, transportation facilities such as roads, highways, and airports, recreational areas, and other locations that may be sensitive to smoke impacts for health, safety, and/or aesthetic reasons.

Signed ______________________________ Date ____________
Name and Title
Joseph Vozella, Asst. Area Manager, Office of Environment & Projects

Submit to: New Mexico Environment Department, Air Quality Bureau
2048 Galisteo
Santa Fe, NM 87505

This application has been received by the New Mexico Environment Department and is
APPROVED ___ **DENIED** ___ **for the following reasons:** ______________________

This permit is approved for the following dates: ______________________
and is subject to the conditions set forth in 20 NMAC 2.60 and the following conditions:

The Department reserves the right to cancel this permit at any time if the public interest so warrants it. The holder of this permit is therefore cautioned and charged that he/she, and he/she alone, assumes full responsibility to exercise the utmost care and judgement before igniting any prescribed fires. The Environment Department hereby disclaims any and all liability of itself or it's agents that might be incurred by petitioner's acts.

Signed ______________________________ Date ____________
Name and Title

NMED 8/96 White - Applicant; Canary - Applicant Main Office; Pink - Air Quality Bureau;

ATTACHMENT A

LOS ALAMOS NATIONAL LABORATORY APPLICATION FOR OPEN-BURNING PERMIT IN TECHNICAL AREA 14, BURN CAGE

DATES BURNING REQUESTED:

A single burn scheduled for either March 4th or 5th is requested in order to mitigate the safety hazards posed by high explosive (HE) contaminated burnable waste. This burn is required to keep the HE waste from accumulating to dangerous levels. Safety and storage requirements dictate that waste burning must occur every 90 days as needed.

EXACT LOCATION AND DIRECTION TO SITE:

The burn will be conducted within Los Alamos National Laboratory boundaries at Technical Area 14, in the burn cage located near mound 3, just south of the Control Building (Q-23), and south of the magazine storage building (Q-22) (Attachment B). The site known as Q-Site East can be accessed by properly cleared or escorted personnel via a paved road off R-Site Road. However, the road is not accessible to the public and is administratively controlled.

TYPE AND QUANTITY OF MATERIALS TO BE BURNED:

The burn contains a maximum of 50 pounds of HE contaminated combustible waste placed inside the bottom grill of the burn cage. Each burn requires approximately a 1/2 gallon of excelsior or non-metal and non-halogen containing volatile organic compound to be used as a starter fluid. The starter fluid is placed in the bottom section of the burn cage or sprinkled over the HE-contaminated waste to aid in ignition and combustion of the waste. The waste consists of small amounts of HE, rags, paper, sample containers, Kimwipes, toothpicks, and other processing and clean-up waste.

METHOD OF IGNITION AND HOW BURNING WILL BE MAINTAINED AND CONTROLLED:

The Standard Operating Procedure (SOP) that will be followed during the burn is attached (Attachment C). It covers the hazards involved and precautions to be taken during the burn setup, method of ignition, and the post burn observation period. The SOP also covers unburnable material inspection procedures, receiving and placement for the burn, and disposal of the flashed material. The ignition method is a remotely operated electric match.

WHY IS BURNING NECESSARY:

The burning is necessary to mitigate the hazards associated with HE contaminated material generated during testing and operations of new HE having unknown properties and characteristics. Open burning is very effective in eliminating HE contamination of burnable waste so the safety concerns associated with burial disposal can be minimized.

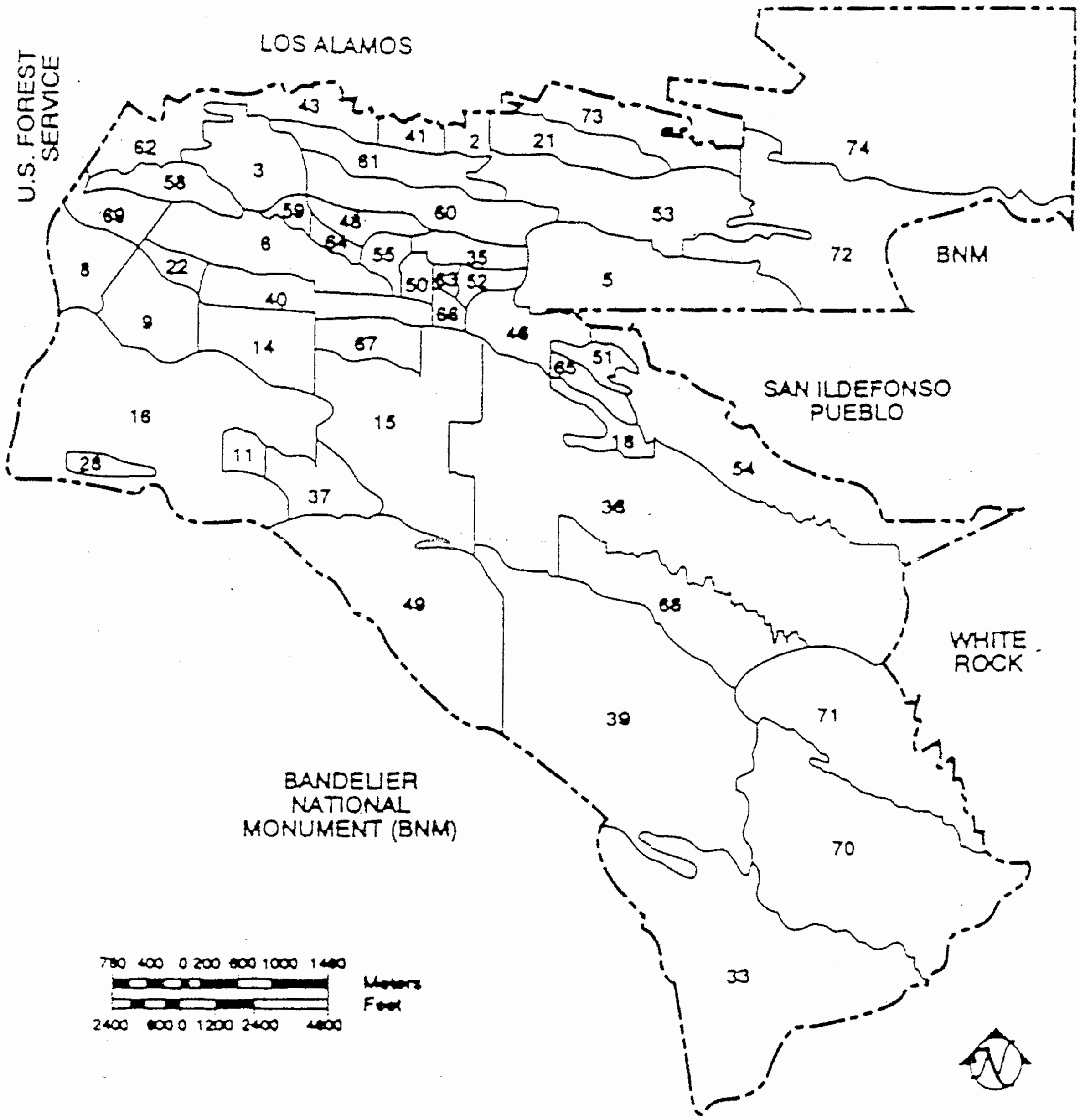
ALTERNATIVES TO BURNING AND REASONS WHY ALTERNATIVES ARE NOT FEASIBLE:

There are two alternatives to open burning. First, the direct burial of HE contaminated material is possible. However, this practice is contrary to the Laboratory's policy not to transport or move material resulting from any process associated with high explosives for safety reasons. For HE contaminated waste generated during testing and operations of new HE, this policy prevents accidents which might occur from the presence of HE residue remaining on the burnable materials. While this scenario is unlikely, there is a finite probability of its occurrence.

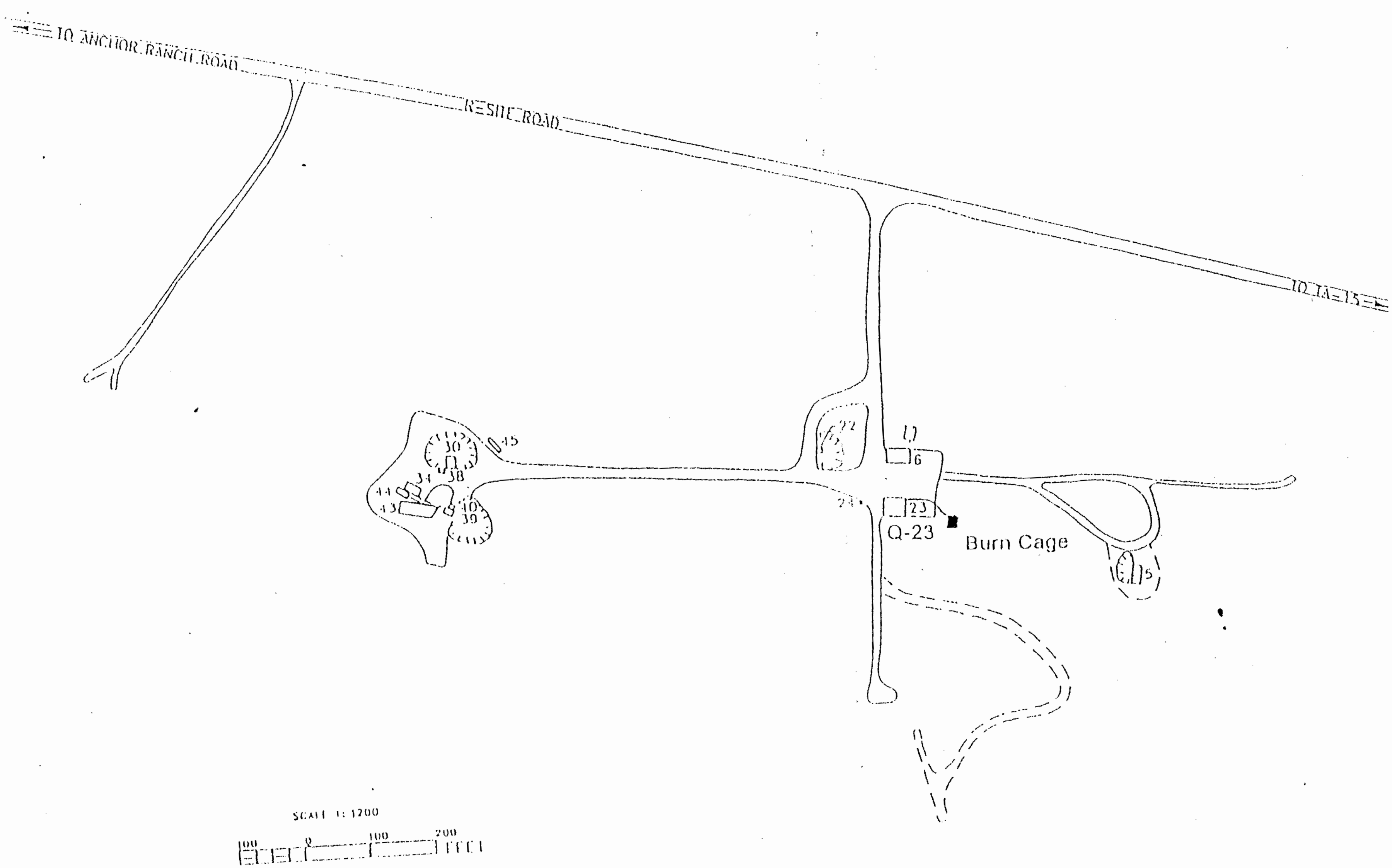
The second option would be to thermally treat the waste material in a thermal treatment oven or an incinerator. Due to the possibility of detonation at high temperatures occurring from contamination on the waste as well as some of the potentially explosive solvents, the treatment unit would have to be constructed of special materials.

Emission estimates and impacts are presented in attachment D.

ATTACHMENT B


LOS ALAMOS
U.S. FOREST SERVICE
SAN ILDEFONSO PUEBLO
WHITE ROCK
BNM
BANDELIER NATIONAL MONUMENT (BNM)
Meters
Feet

Technical Area 14



ATTACHMENT C

M-1

STANDARD OPERATING PROCEDURE

FOR

DESTRUCTION OF
HE-CONTAMINATED WASTE AND HE WASTE

6.1.5

Prepared by: [signature] Date: 5/7/93
J. R. Stine, M-1

Approved by: [signature] Date: 5/7/93
John C. Dallman, M-1 Group Leader

Approved by: ____________ Date: ________
M-DO

Approved by: ____________ Date: ________
HS-5

Final Approval: ____________ Date: ________
C. B. Bieri, Group M-1 ES&H Officer

This SOP has been approved by M-1 and M-DO. While we await final review from HS and other groups as determined by HS, we are using this SOP as written. If more than 30 days have elapsed without action by reviewing Groups outside M Division, this SOP will be regarded by the M-1 Group Office as having the full force of complete and unqualified endorsement.

Contents

1.0 INTRODUCTION

Group M-1 does tests and operations on new high-explosives that have unknown properties and characteristics. These operations generate waste that cannot be sent to WX-3 for disposal because of its uncharacterized nature or experimental history. These wastes are destroyed at Q-Site East by either burning or detonation.

2.0 PURPOSE

The purpose of this operation is to safely destroy HE waste and HE-contaminated waste originating in Group M-1. This SOP is closely tied to M-1:SOP 6.1.

3.0 SCOPE

This SOP applies to all M-1 personnel who perform the burning and detonation operations. These operations shall only be performed by Group M-1 personnel at Technical Area (TA) 14 (Q-site), Building 23 and the adjacent firing area.

4.0 DEFINITIONS

HE-Contaminated Waste:	Materials such as rags; paper; sample containers; Kimwipes; toothpicks; other process and clean-up waste.
HE Waste:	Damaged or suspect devices, explosives that have undergone severe testing, experimental explosives, explosives of temporary interest, newly synthesized compounds, new mixtures, and some salvage explosives.

5.0 RESPONSIBILITIES

5.1 Group Leader

- Ensures that the necessary policies, procedures, equipment, expertise (training), and manpower are available for this operation and delegates the responsibility for implementation of details to a Line Supervisor.

5.2 Line Supervisor

- Implements the details for safely performing these operations.
- Chooses, along with the Group Leader, the Firing Site Leader.

5.3 Firing Site Leader

- Has primary responsibility for safe operations.
- Supervises routine burning and detonation operations.
- Trains operators.

6.1.2 Detonation Operation

HE waste shall be destroyed by detonation on Mound 3.

6.1.3 Weight Limitations

Weight limitations are as follows.

Operation	Weight Limitation
Burning	50 lb of combustibles in each burn
Detonation	10 lb per shot

6.2 Personnel Limits

The personnel limits in M-1:SOP 6.1 shall be followed for this operation.

6.3 Transportation

The requirements for transporting HE-contaminated waste and small samples of HE waste for burning and detonation are listed below.

- Waste shall be transported to TA-14 (Q-Site) in accordance with M-1:SOP 1.9 for on-site transportation.
- No quantity greater than that which can be disposed of in a single day shall be transported to Q-Site.
- Operators will be told where HE waste is stored.

6.4 Storage

The following storage precautions shall be taken for materials to be burned and to be detonated:

- HE-contaminated wastes are stored in Magazine AE-208A at TA-9 while awaiting destruction at Q-Site. The waste will be labeled with its contents by the generator and labeled "Hazardous Waste" by the Waste Management Coordinator.
- At Q-Site, the explosive-contaminated waste will be kept in Room 104 of Building 23 while "in process."

7.2 Burning Operation

Follow the steps below for destroying HE-contaminated waste.

Step	Action
1	Short the end of the detonator cable.
2	Attach one or two ignitors in parallel to the firing cable and place them in the fuel space.
3	Sprinkle fuel on the HE-contaminated waste to enhance destruction of the waste and aid in ignition. Note: Use only volatile hydrocarbons, such as acetone, toluene, fuel oil, hexane, as a fuel. **CAUTION** DO NOT use any material that contains metals or halogens in its molecular composition. If in doubt, check with the experimenter in charge of Q-Site.
4	Cover the top of the burn cage with the wire mesh provided to minimize the escape of burning particles.
5	Fire the ignitors using the firing control unit in Room 101 of Building Q-23 (see M-1:SOP 6.1). Note: The siren will go through its normal sequence, but the Firing Supervisor may turn the siren off after determining that the burn is progressing satisfactorily.
6	• Wait for at least 10 minutes after visible flaming has stopped and • Then sound the "all-clear" signal. Note: If there is still a considerable amount of smoke, the Firing Site Leader must use his judgment about delaying the all-clear signal.
7	In the event of a misfire, do not approach the area until at least 10 minutes have elapsed without any evidence of flames or smoke in the burn cage.
8	DO NOT use the burn cage for another burn operation for 24 hours.
9	After 24 hours or more, remove the ashes and place in the satellite storage outside Building 23.
10	Cover the burn cage with a tarp.

7.4 Disposing of Waste

Waste generated from these operations shall be packaged and disposed of according to M-1:SOP 1.5. Waste minimization will be handled according to the M-Division Operations Manual.

7.5 Emergency Procedures

In the event of an emergency situation, the Building Emergency Plan (BEP)/ Site Emergency Plan (SEP) shall be followed. The BEP/SEP shall be available in Building Q-23 and the operators shall be familiar with its contents.

8.0 REQUIRED RECORDS

- M-1:SOP 6.1
- Completed and signed Shot Sheet (for detonation or burning)
- M-1 Q-Site Check List, Burning of HE-Contaminated Waste

9.0 REFERENCES

- DOE Explosives Safety Manual
- Los Alamos Environment, Safety, and Health Manual
- M-Division Operation Manual
- M-1:SOP 1.5, Disposal of Hazardous Materials
- M-1:SOP 1.9, Packaging and On-Site Transportation of Explosives
- M-1:SOP 6.1, Q-Site East (TA-14) Firing Operations

10.0 ATTACHMENTS

I. M-1 Q-Site Check List, Burning of HE-Contaminated Waste

II. Hazardous Waste Facility Permit

Attachment I

M-1 Q-Site Check List
Burning of HE-Contaminated Waste

Requester ____________________ Date Burned ____________________

Charge Code ____________________ Shot No. ____________________

This checklist is intended for use as a safety supplement to M-1:SOP 6.1.5 "Destruction of HE-Contaminated Waste and Waste HE." All Q-Site users must be familiar with Group M-1 SOPs 6.1 and 6.1.5. This checklist should be referred to by the Firing Supervisor subsequent to burning in the burn cage and prior to final arming. In the event of a misfire follow the checklist on the other side of this page.

OK	N/A	
☐	☐	1) Secure and clear area.
☐	☐	2) Ensure burn cage is clean.
☐	☐	3) Open all glass and plastic containers.
☐	☐	4) Place containers to be burned on grate.
☐	☐	5) Place fuel material in bottom of burn cage.
☐	☐	6) Short end of detonator cable..
☐	☐	7) Attach ignitors to detonator cable and place igniters in fuel material.
☐	☐	8) Sprinkle fuel on waste material.
☐	☐	9) Cover top of burn cage with wire mesh.
☐	☐	10) Connect detonator cable to CDU.
☐	☐	11) Start firing sequence.
☐	☐	12) Fire ignitors.
☐	☐	13) Observe burning.
☐	☐	14) Turn off siren (do NOT sound "all-clear").
☐	☐	15) Wait 10 min. after flame has stopped and sound "all-clear."
☐	☐	16) Another batch cannot be burned until 24 hours has elapsed.
☐	☐	17) Clean up ashes (after 24 hours) and place in satellite storage outside TA-23.
☐	☐	18) Cover burn cage with tarp.

Signature ______________________________ Date ____________
Firing Supervisor

FORM DATE 8/7/91 Approved By: ____________________ Date:__________

Attachment II

Hazardous Waste Facility Permit

PERMITTEE: U.S. Department of Energy
University of California Regents

ID NUMBER: NM0890010515

LOCATION: Los Alamos National Laboratory,
Los Alamos, NM 87545

PERMIT NUMBER:
NM 0890010515-1

Pursuant to the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6901, et seq.), and the New Mexico Hazardous Waste Act (§§ 74-4-1 et seq. NMSA 1978), a permit is issued to the U.S. Department of Energy's Los Alamos Area Office and the University of California Regents, doing business as Los Alamos National Laboratory, (hereafter called the Permittee) to operate a hazardous waste incinerator, container storage and tank treatment and storage facility at the location stated above.

The Permittee must comply with all the terms and conditions of this permit. This permit consists of the conditions contained herein including the attachments. Applicable provisions of regulations cited are those which are in effect on the effective date of this permit, New Mexico Hazardous Waste Management Regulations (HWMR-5, as amended 1989). This permit shall become effective in accordance with HWMR-5, Part IX, sections 902.F. and 902.G. and shall run for a period of ten years.

This permit is based on the provisions of HWMR-5. This permit is also based on the assumption that all information contained in the permit application is accurate and that the facility will be operated as specified in the application. The permit application consists of information submitted on March 27, 1986; revised on November 13, 1986 and November 25, 1987; and supplemented on November 8, 1988 and through numerous technical discussions.

Any inaccuracies found in the information may be grounds for the termination or modification of this permit and potential enforcement action.

Signed this 8th day of November 1989

by [signature]
Richard Mitzelfelt, Director, H.M.E.I.D.

New Mexico
Health and Environment Department
Environmental Improvement Division

ATTACHMENT D

TECHNICAL APPROACH TO ESTIMATING EMISSIONS AND THE AIR QUALITY IMPACTS FROM THE OPEN BURNING OF HIGH EXPLOSIVES CONTAMINATED WASTE CONDUCTED AT TECHNICAL AREA 14

Air emissions resulting from the combustion of high explosives (HE) contaminated waste consist primarily of carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter (PM), volatile organic compounds (VOC's), sulfur dioxide (SO_2), and heavy metals such as lead (Pb). Detailed emission estimates for wood, paper, and plastics were performed for this analysis using AP-42 emission factors developed by the Environmental Protection Agency (EPA) found in the July 1995, Version 4.0 of EPA's Air Chief; available on CD ROM. In addition, emission estimates for the combustion of solvents were performed using emission factors and equations presented in the document titled "Prediction of Fire Properties of Fuels," A. Tewarson, Factory Mutual Research Corporation, 1986 (Attachment E). Emission estimates for the combustion of HE were performed using emission factors compiled from data provided in the documents titled: "Emissions from the Open Burning or Detonation of High Explosives," R.V. Carter, U.S. Army Environmental Hygiene Agency, 1978; "Air Quality Impact Analysis, Open Burning of Explosives," Department of Energy, Pantex Plant, Amarillo, Texas, Radian Corp., 1990; "Lawrence Livermore National Laboratory (LLNL) Explosives Handbook Properties of Chemical Explosives and Explosive Simulants," B. M. Dobratz, 1981. Table 1 shows the typical profile of the constants of a burn as well as the emission factors from the sources described above.

TABLE 1. BURN CONSTITUENTS AND ASSOCIATED EMISSION FACTORS

Waste Type	Amount Burned	Emission Factors (lb/lb of material burned)							
		CO	NOx	VOC	PM	SO_2	HF	HCl	Pb
Wood/ Cardboard	10 lb	0.13	0.001	0.11	0.02	0.001	N/A	N/A	1E-07
Plastics/ Paper	30 lb	0.04	0.003	0.02	0.01	0.001	0.0001	0.004	N/A
HE	2 lb	0.05	0.13	0.005	0.27	N/A	0.050	0.028	N/A
Solvents	8 lb (≈ 1 gal)	0.01	N/A	0.02	0.04	0.05	N/A	N/A	1E-06
Emission Totals (lbs)	**50 lb**	**2.66**	**0.30**	**1.86**	**1.16**	**0.44**	**0.07**	**0.16**	**9E-06**

HE Contaminated Waste Solvent Mixtures

Approximately one gallon of HE contaminated dilute solvents generated during HE processing operations at LANL are included in the waste burn at TA-14. The average make-up of the dilute solvent solution is 30% methanol, 25% water, 20% acetonitrile, 20% tetrahydrofuran, 5% of any the solvents in Table 2. Combustion emissions were estimated using emission factors and equations from A. Tewarson, Prediction of Fire Properties of Fuels, Factory Mutual Research Corporation, 1985. Table 2 gives the chemical properties and assumptions required for the emission calculations. Emission estimates from solvent burning are shown above in Table 1.

TABLE 2. CHEMICAL PROPERTIES OF HE CONTAMINATED WASTE SOLVENTS

SOLVENT TYPE	MOLECULAR WEIGHT (g/mole)	DENSITY (g/ml)	NUMBER OF CARBONS	ASSUMPTIONS USED FOR CALCULATIONS
methanol	32	0.7914	1	experimental data available
acetonitrile	41	0.7868	2	C_2 linear alkanes
tetrahydrofuran	72	0.8888	4	C_3-C_6 linear ketones
methyl ethyl ketone	72	0.8054	4	C_3-C_6 linear ketones
butyl acetate	116	0.8825	6	C_5-C_{10} acetate
ethyl acetate	88	0.9003	4	C_4 acetate
toluene	92	0.8669	7	experimental data available
ethanol	46	0.7893	2	experimental data available
acetone	58	0.7899	3	experimental data available
cyclohexane	84	0.7785	6	C_5 -C_{10} cyclo alkane

High Explosives (HE) Waste

Waste HE, generated during HE processing, can consist of a number of different types of HE and associated binders. Table 3 gives a representative list of the HE waste composition found in process waste burned as well as amount of combustion products formed.

TABLE 3. EMISSIONS FROM THE OPEN BURNING OF HIGH EXPLOSIVES

High Explosives, Propellants, and Binders	Composition Fraction	Quantity Burned (lb/burn)	Combustion Products (lb)			
			CO	NOx	VOC	PM
TATB[1,2]	0.21	0.42	1.09E-02	2.92E-02	1.93E-04	8.17E-02
NTO[1,2]	0.18	0.36	1.01E-02	2.70E-02	1.80E-04	7.56E-02
Pyroxylin[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
Comp B[1,2]	0.04	0.08	2.00E-04	1.48E-03	N/A	N/A
LAX 112[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
RDX[1,2]	0.04	0.08	2.09E-04	1.50E-03	4.17E-03	N/A
DNT[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
Nitroguanidine[1,2]	0.04	0.08	2.22E-04	1.50E-03	N/A	2.34E-03
HMX[1,2]	0.04	0.08	2.22E-04	1.50E-03	N/A	2.34E-03
PETN[1,2]	0.04	0.08	2.00E-04	1.48E-03	N/A	N/A
TNT[1,2]	0.04	0.08	2.24E-03	6.00E-03	4.00E-05	1.68E-02
HNS[1,2]	0.04	0.08	2.18E-04	1.15E-03	1.58E-04	6.48E-03
Barium nitrate[3,4]	0.01	0.02	N/A	7.00E-03	N/A	N/A
Cyanuric acid[3,4]	0.01	0.02	2.20E-03	1.76E-02	N/A	1.76E-02
Pentek[3,4]	0.01	0.02	2.20E-03	1.76E-02	N/A	1.76E-02
Exxon461[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
KFE[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
Polystyrene[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
Estane[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
Viton[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
BDNPA-F[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
DBP[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
DOP[3,4]	0.02	0.04	2.20E-03	N/A	N/A	N/A
CEF[3,4]	0.02	0.04	1.00E-03	N/A	N/A	N/A
TOTAL	**1**	**2**	**5.06E-02**	**1.31E-01**	**4.86E-03**	**2.71E-01**

1 Emission factors from Roy V. Carter (June 1978), Emissions from the Open Burning and Detonation of Explosives.

2 Emission factors from U.S. Environmental Protection Agency (June 1995), AP-42 Air Pollution Emission Factors.

3 Emission factors from Radian Corp. (July 1990), Air Quality Impact Analysis, Open Burning of Explosives, Department of Energy, Pantex Plant, Amarillo, Texas.

4 Emission factors based on chemical structures from B. M. Dobratz (March 1981), LLNL Explosives Handbook Properties of Chemical Explosives and Explosive Simulants.

Air Quality Impact Modeling

Air emissions from the open burning of HE contaminated waste at TA-14 are regulated under National and New Mexico Ambient Air Quality Standards. Air emissions from this operation include criteria pollutants such as carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter (PM), sulfur dioxide (SO_2), volatile organic compounds (VOC's), and lead (Pb). In addition, some hazardous air pollutants such as hydrogen chloride (HCl) and hydrogen fluoride (HF) are emitted as a result of combustion of some binders used to form HE. Impacts from operations of this type* must meet ambient air standards for all criteria pollutants. Compliance with the ambient air quality standards was determined using the SCREEN 3 air emissions dispersion model.

The SCREEN 3 model was developed and approved by the Environmental Protection Agency (EPA) as a screening procedure for estimating air quality impacts of stationary sources. SCREEN 3 is a conservative model which uses worst case meteorological data to determine emission impacts. Input parameters supplied for this analysis included: a heat release rate of 15,748 cal/sec; a one hour burn duration; a 2.5 m/sec wind speed; and a one meter source height using a flare source type. Emission impacts are shown in Table 4 for the maximum impact (61 meters) and for the two nearest off-site locations, Pajarito Road 2,042 meters to the north/northeast and State Road 4 bordering Bandelier National Monument 2,286 meters to the south/southeast. The impacts are shown to be will below the ambient standards at all affected locations.

TABLE 4. AIR QUALITY IMPACTS FROM HE PROCESS WASTE BURNING

CHEMICAL	MODELING PARAMETERS	AMBIENT AIR QUALITY STANDARD			AIR CONCENTRATION AT:		
					61 M (Max.)	2042 M (Pajarito Rd.)	2286 M (SR 4)
CO	D Stability	8-hour average 1-hour average	0.5 mg/m³ 2.0 mg/m³	(8.7 ppm) (13.1 ppm)	0.53 ppm 0.76 ppm	3.8E-03 ppm 5.5E-03 ppm	3.2E-03 ppm 4.6E-03 ppm
NOx		24-hour average Annual arithmetic average	5.0 µg/m³ 1.0 µg/m³	(0.1 ppm) (0.05 ppm)	1.4E-02 ppm 2.9E-03 ppm	1.0E-04 ppm 2.1E-05 ppm	8.6E-05 ppm 1.7E-05 ppm
PM	2.5 meters/sec. wind speed	24-hour average 7-day average 30-day average Annual geometric mean	150 µg/m³ 110 µg/m³ 90 µg/m³ 60 µg/m³		136.6 µg/m³ 19.5 µg/m³ 4.6 µg/m³ 27.3 µg/m³	1.0 µg/m³ 0.1 µg/m³ 3.3E-02 µg/m³ 0.2 µg/m³	0.8 µg/m³ 0.1 µg/m³ 2.8E-02 µg/m³ 0.2 µg/m³
SO_2	Heat Released 15,748 cal/sec.	24-hour average Annual arithmetic average	5.0 µg/m³ 1.0 µg/m³	(0.1 ppm) (0.02 ppm)	0.03 ppm 0.006 ppm	2.1E-04 ppm 4.3E-05 ppm	1.8E-04 ppm 3.6E-05 ppm
Lead		3-month average	0.03 µg/m³		8.9E-06 µg/m³	6.4E-08 µg/m³	5.4E-08 µg/m³
Photo Chemical Oxidant (VOC)		1-hour average		(0.06 ppm)	0.14 ppm	1.0E-03 ppm	8.0E-04 ppm

* HAP's emission standards are regulated under 20 NMAC 2.70 for the facility at 10 tons per year for any one HAP or 25 tons per year for any combination of HAP's. Subsequently, impacts for HCl and HF releases were not included in this modeling analysis.

ATTACHMENT E

Tamura, G. T.

Klote, J. H. and Tamura, G. T.
Smoke Control and Fire Evacuation by Elevators.
American Society of Heating, Refrigerating and Air-Conditioning Engineers Transactions, Winter Meeting, Vol. 92, No. 1A, 231-245, 1986.

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PREDICTION OF FIRE PROPERTIES OF FUELS

by

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Subject Categories

(3) Combustion and Practical Systems

(9) Fire

(18) Modeling and Scaling

For presentation at the Twenty-First International Symposium on Combustion, Technical University of Munich, West Germany, August 3-8, 1986

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1151 Boston-Providence Turnpike
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1. INTRODUCTION

Fire properties are defined as the parameters which characterize the combustion and pyrolysis behavior of fuels in fires[1]. In conjunction with fire models, fire properties are used to assess hazards presented by various types of fires and protection needs. A fundamental understanding of diffusion flames has always been found to be very useful in the prediction of fires. In this paper, an attempt has thus been made to use the understanding of the soot formation in diffusion flames to develop relationships for the prediction of fire properties.

The soot formation in diffusion flames has been of great interest because of the relationship with flame radiation and heat transfer, combustion efficiency, and emission of particulates and other chemical compounds some of which may be toxic and corrosive in nature.

In this study, we have used the concept of the smoke point height, L_s, which has been used by many investigators to describe the sooting tendency of fuels. L_s is defined as the height of an overventilated diffusion flame at which soot just begins to be released at the flame tip. The smaller the value of L_s, the greater the tendency to soot. Extensive data for L_s are available in the literature for liquid and gaseous fuels[2-8]. Many investigators find that L_s depends on the nature of chemical bonds and flame turbulence. It has been shown that L_s is related to flame temperature (flame convection)[6] and to flame radiation[9].

In order to use the literature data for L_s to develop predictions for fire properties, it was necessary to perform experiments in our flammability apparatus. In the experiments, simultaneous measurements were made for L_s and fire properties of fuels of known chemical structures and L_s values. In addition to gaseous and liquid fuels, solid fuels were used in the experiments.

The radiative component of the combustion efficiency, χ_R, is defined as

$$\chi_R = \chi_A - \chi_C \, . \qquad (7)$$

3. EXPERIMENTS

Experiments were performed in our apparatus, shown in Fig. 1[10]. For gaseous samples, a burner tube very similar to one in Ref. 9 was used. For liquid and solid samples, a 250 ml Pyrex Erlenmeyer flask with a 14/35 ground glass joint was used. The ground glass joint was attached to a 0.12-m long Pyrex glass tube with an internal diameter of 0.009 m to reduce the effects of temperature on L_s values. External heat flux was used for solid and low vapor pressure liquids; for high vapor pressure liquids, a heating mantle placed around the flask was used. The rate of generation of the fuel vapors and flame height were varied by varying either the external heat flux or the heating rate of the mantle.

L_s value was measured visually and for the measurement of fire properties, all the combustion products were captured along with air in the sampling duct of our apparatus. In the duct, measurements were made for the gas temperature, mass fractions of CO_2, CO, total gaseous hydrocarbons (CH), soot (S), and O_2, and $\dot{m}_T$. Measurements were also made for optical transmission through soot, but data have not been discussed in this paper. The generation rate of fuel vapors was measured by a load cell assembly.

In the experiments, data were recorded by a computer at a time interval of about one second. Data were averaged by the computer at the steady state, lasting for about 10 minutes. Each experiment was performed at least twice and the data were averaged. The accuracy of all the averaged experimental data is about ±2%.

All the experiments were performed under natural air flow conditions and thus represent overventilated fire conditions.

The relationship between f_{CO_2} and L_s is same as between χ_A and L_s as expected from Eq. (5) for overventilated fires.

Predictions of Fire Properties of Fuels

If it is assumed that the relationships given in Eqs. (8) to (13) are of general applicability, then it is possible to use the L_s values from the literature to predict χ_i and f_j values for many fuels. The literature values for L_s, however, cannot be used directly because of variations due to differences in the experimental conditions used by various investigators.[11] The following approach was thus taken in this study: 1) relationships between L_s values measured by us and reported in the literature, for selected fuels, were established separately for each investigator; 2) these relationships were then used to recalculate all other L values separately for each investigator; and 3) for fuels which were used by several investigators, the recalculated values of L_s were averaged. The recalculated values of L_s were then used in Eqs. (8) to (13) to predict the χ_i and f_j values. The predicted values of χ_i and f_j are listed in Table II. The detailed tabulation of the data is given in Ref. 12. Values of f_{others} in the table are calculated from the atom balance, i.e., $f_{others} = 1 - \Sigma f_j$.

5. DISCUSSION

Comparison Between the Predicted and Measured Values of Fire Properties

Table III lists the experimental and predicated data for some selected fire properties (f_{CO_2} or χ_A and f_S). A reasonable agreement can be noted between the predicted and measured values. Also our predictions for f_S and those of Pagni's[15], based on entirely different principles, are very similar, except for octane and polystyrene. The new measurements suggest that our older f_S value of 0.18 for polystyrene[17], referred in Ref. 15, appears to be somewhat higher.

and soot, in that order. Butadiene, which is at the top within the aliphatic fuels group, is expected to follow the above aromatic group of compounds.

Relationship Between the Generation Efficiencies of CO and CO_2

In combustion systems, the ratio of CO to CO_2 is used as an indicator of the burning efficiency of fuels. For fuels burning under overventilated conditions, the ratio will vary with the chemical structure of the fuels. For fuels with fixed chemical structure, the ratio will vary with ventilation.

For fuels with variable chemical structure, burning under overventilated conditions, the relationship between f_{CO} and f_{CO_2} can be predicted from Eqs. (10) and (11). The predicted relationship is shown by the solid line in Fig. 3. Experimental data obtained under variable ventilation conditions for wood cribs, heptane, and PMMA from Ref. (18) to (20) have also been included in Fig. 3. Data for enclosure fires of wood cribs with variable ventilation were averaged for similar f_{CO_2} values, and were restricted to the flaming fires only. Data in Fig. 3 indicate that as f_{CO_2} decreases, f_{CO} approaches an asymptotic limit, which is about 0.12 for wood, which is a char forming fuel, and about 0.08 for heptane and PMMA, which are non-char forming fuels.

The results in Fig. 3 indicate that, up to the asymptotic limit of f_{CO}, the relationship between f_{CO} and f_{CO_2} is expected to be the same for the combustion of fuels with: 1) fixed chemical structure and variable ventilation; and 2) variable chemical structure with overventilation. It may be possible to define the asymptotic limit for f_{CO} for underventilated fires of fuels based on their chemical structure.

Relationship Between the Generation Efficiencies of CO and Soot

Emissions of CO and soot from combustion systems are associated with reduced ventilation and/or involvement of fuels which burn inefficiently because of their chemical structures.

From Eqs. (3), (4), and (14),

$$\dot{E}''_j = (f_j\ k_j/[\int_0^{T_v} c_p\ dT + H_v])\ (\dot{q}''_{fs} - \dot{q}''_{rr}) \ , \qquad (16)$$

where $\dot{E}''_j$ is the emission rate of a compound j per unit fuel surface area (kg/m^2s). In Eqs. (14), (15), and (16), $\int_0^{T_v} c_p\ dT + H_v$ is defined as heat of gasification of the fuel, L_g (kJ/kg). H_T values are known from the literature and k_j values can be calculated from the elemental composition of the fuel. L_g values can also be calculated from the literature values for c_p, T_v, and H_v[21], or can be measured. Within a generic group of fuels, L_g increases with the molecular weight of the fuel, primarily due to increase in T_v, and can be estimated for fuels of higher molecular weight. The measured value of L_g for PE is 1750 kJ/kg[17], and from the relationship between L_g and the molecular weight of alkenes, it can be estimated that the molecular weight of the oligomer produced by the vaporization of PE is about 0.601 kg/mole, which is reasonably close to a value of 0.692 kg/mole reported for the molecular weight of the PE oligomer in pyrolysis[22]. In a similar fashion, the molecular weight of PP oligomer is estimated to be 0.720 kg/mole.

From the values of L_g, H_T, k_j, and the data from Table II, emission rates can be calculated for the fuel vapors and the combustion products for defined values of $\dot{q}''_{fs} - \dot{q}''_{rr}$, for example, at the asymptotic limit of $\dot{q}''_{fs} - \dot{q}''_{rr}$, which is approximately constant for fuels with variable molecular weight within a generic group of fuels. Within the aliphatic fuels group, the asymptotic limit for $\dot{q}''_{fs} - \dot{q}''_{rr}$ is equal to 41 kW/m^2, with a variation of ± 15% (as derived from the data for polyoxymethylene, PMMA, heptane, polyethylene, and polypropylene[1,10,16,17]). The emission rates for heat, CO, and soot calculated in this fashion for alkanes and alkenes, as examples, are shown in Figs. 5 and 6, respectively. Experimental data for PE and PP are also included in Fig. 6. The emission rates decrease with increase in the molecular weight of the fuel, because of the increase of Lg due to increase of Tv.

NOMENCLATURE

C_p	specific heat (kJ/kg K)
$\dot{E}''$	emission rate per unit fuel surface area (kg/m^{2}s)
f_j	generation efficiency of compounds j or oxygen depletion efficiency (-)
$\dot{G}_f$	generation rate of fuel vapors (kg/s)
H_{CO}	heat of combustion of CO (kJ/kg)
H_T	net heat of complete combustion (kJ/kg)
H_v	heat of vaporization (kJ/kg)
k_j	maximum possible total (theoretical) yield of compound j or stoichiometric mass oxygen to fuel ratio (kg/kg)
L_g	heat of gasification of the fuel (kJ/kg)
L_s	smoke point height (m)
$\dot{m}_T$	total mass flow rate of combustion product-air mixture (kg/s)
$\dot{Q}_A$	actual heat release rate (kW)
$\dot{Q}_T$	total (theoretical) heat release rate (kW)
$\dot{q}''_{fs}$	flame heat to the surface of the fuel (kW/m^2)
$\dot{q}''_{rr}$	surface heat loss due to reradiation (kW/m^2)
ΔT	gas temperature above ambient (K)
T_v	vaporization temperature (K)
X_j	mass fraction of compound j (kg/kg)
Y_j	yield of compound j (kg/kg)
χ_A	combustion efficiency (-)
χ_C	convective component of combustion efficiency
χ_R	radiative component of combustion efficiency

Subscripts

f	fuel vapors
i	heat
j	chemical compound

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TABLE I

Experimental Data for Smoke Point Height and

Selected Fire Properties of Fuels

Fuel	L (m)	χ_A	χ_C	χ_R	f_{CO_2}	f_{CO}	f_{CH}	f_S
Methanol	N	0.97	0.83	0.14	0.97	0.001	0.001	N
Ethanol	0.225	0.97	0.74	0.23	0.97	0.001	0.001	0.021
Acetone	0.205	0.96	0.73	0.23	0.96	0.001	0.001	0.022
Pentane	0.155	0.94	0.65	0.29	0.94	0.002	0.001	N
Isopropanol	0.148	0.94	0.65	0.29	0.94	0.002	0.001	N
Hexane	0.125	0.93	0.63	0.30	0.93	0.004	0.002	N
Nylon	0.120	0.90	0.58	0.32	0.90	0.004	0.002	0.030
Ethylene	0.106	0.91	0.61	0.30	0.91	0.003	0.002	0.032
Heptane	0.110	0.93	0.61	0.32	0.93	0.004	0.003	0.032
PMMA	0.105	0.95	0.63	0.32	0.95	0.006	0.001	0.027
Cyclohexane	0.085	0.91	0.56	0.35	0.91	0.005	0.001	N
Isooctane	0.080	0.91	0.60	0.31	0.91	0.007	0.003	N
Polypropylene	0.050	0.89	0.52	0.37	0.89	0.015	0.003	0.050
Polyethylene	0.045	0.87	0.50	0.37	0.86	0.013	0.002	0.060
Propylene	0.029	0.81	0.41	0.40	0.81	0.011	0.006	0.064
Polystyrene	0.015	0.66	0.26	0.40	0.65	0.027	0.023	0.101
Toluene	0.005	0.68	0.28	0.40	0.68	0.030	0.023	0.190

N not measured

TABLE II

(continued)

Fuel	C atoms	x_A	x_C	x_R	f_{CO_2}	f_{CO} x100	f_{CH} x100	f_S x10	f_{others} x10
Butyrate	5 to 6	0.97	0.72	0.25	0.97	0.20	0.11	0.24	0.04
	7 to 8	0.93	0.63	0.30	0.93	0.31	0.15	0.30	0.35
Laurate, oxalate, malonate, lactate	4 to 14	0.97	0.71	0.26	0.97	0.22	0.11	0.24	0.03
<u>C-H-N Structure</u>									
Amines	4 to 12	0.90	0.57	0.33	0.90	0.43	0.21	0.36	0.58
<u>C-H-S Structure</u>									
Mercaptans and Sulfides	6 to 12	0.90	0.57	0.33	0.90	0.43	0.21	0.36	0.58
				<u>Aromatic Fuels</u>					
<u>C-H Structure</u>									
Arenes	6 to 21	0.71	0.30	0.41	0.70	3.80	1.58	1.32	1.14
Cyclic Arenes	10 to 12	0.76	0.36	0.40	0.75	1.96	0.85	0.89	1.32
PAH	9 to 12	0.68	0.27	0.41	0.68	5.20	2.13	1.59	0.88
[illegible] → 30% more [illegible]									
<u>C-H-O Structure</u>									
Alcohols	7 to 8	0.71	0.30	0.41	0.71	3.49	1.46	1.25	1.16
Ketones	11	0.76	0.36	0.40	0.76	2.01	0.87	0.90	1.20
Aldehydes	7	0.75	0.35	0.40	0.75	2.26	0.97	0.97	1.21
Esters	9	0.76	0.36	0.40	0.76	1.96	0.85	0.89	1.22
<u>C-H-N Structure</u>									
Amines and Heterocylics	6 to 11	0.73	0.32	0.41	0.73	3.00	1.26	1.14	1.13
<u>C-H-S Structure</u>									
Mercaptans and Sulfides	6 to 8	0.67	0.26	0.41	0.67	6.18	2.50	1.76	0.67

N: not predicted

FIGURE CAPTIONS

Fig. 1 Flammability apparatus

Fig. 2 Combustion efficiency and its convective and radiative components as functions of smoke point height

Fig. 3 Relationship between the generation efficiencies of CO and CO_2. Solid line represents our predictions for fuels with variable chemical structures. Experimental data points connected by dashed lines are for variable ventilation conditions: O, enclosure fires of wood cribs, Ref. 18; ●, Heptane, Ref. 19; ■, wood cribs, Ref. 18; *, PMMA, Ref. 20.

Fig. 4 Relationship between the generation efficiencies of soot and CO. Solid line represents our predictions for fuels with variable chemical structures. Symbols connected by dashed lines represent experimental data for PMMA with variable ventilation conditions, Ref. 20.

Fig. 5 Estimated emission rates of heat, CO, and soot as functions of the molecular weight of alkanes for overventilated fires.

Fig. 6 Estimated emission rates of heat, CO, and soot as functions of molecular weight of alkenes for overventilated fires. Dark symbols represent experimental data for polyethylene and polypropylene.

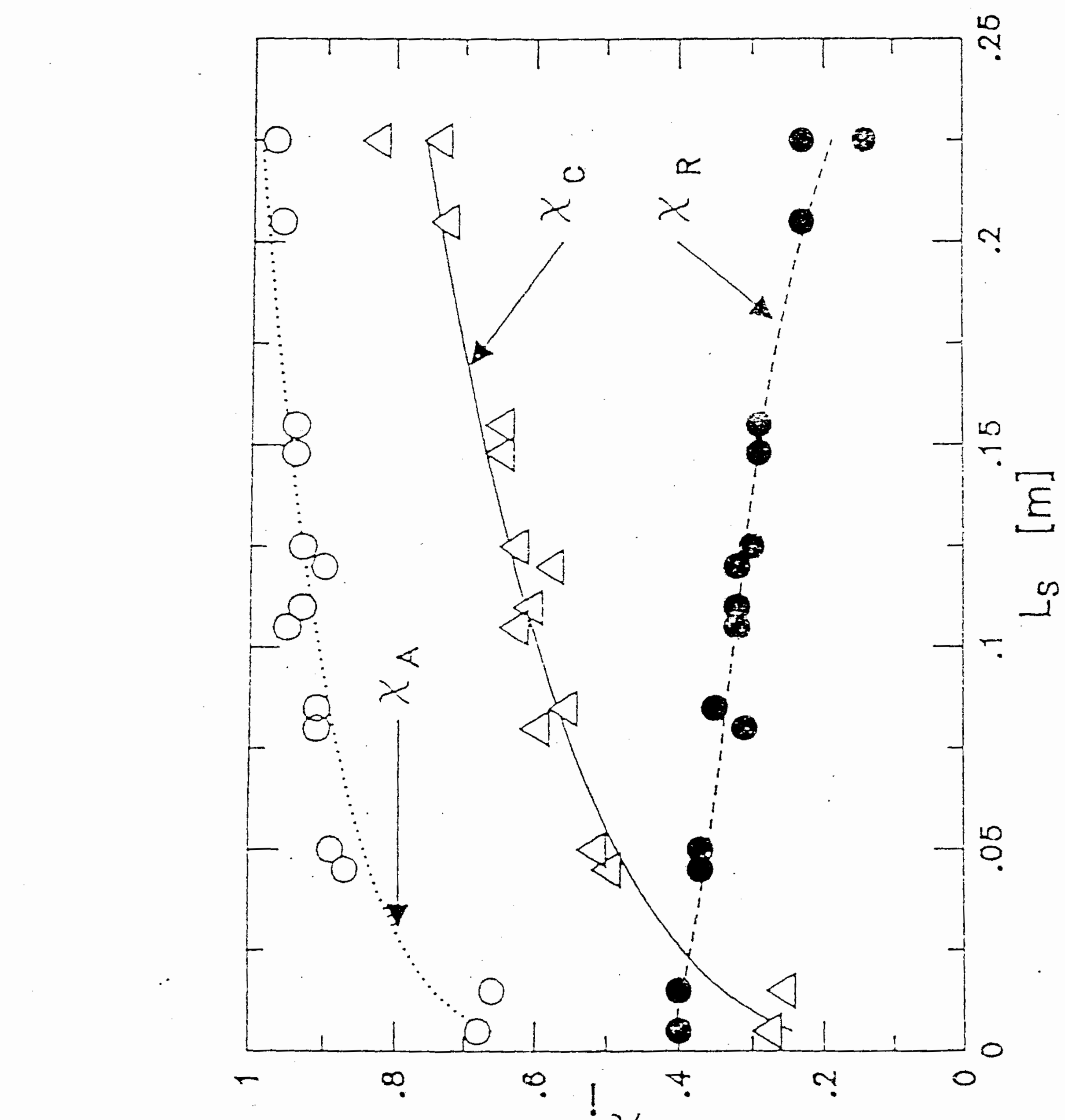

Fig. 2/ Tewarson

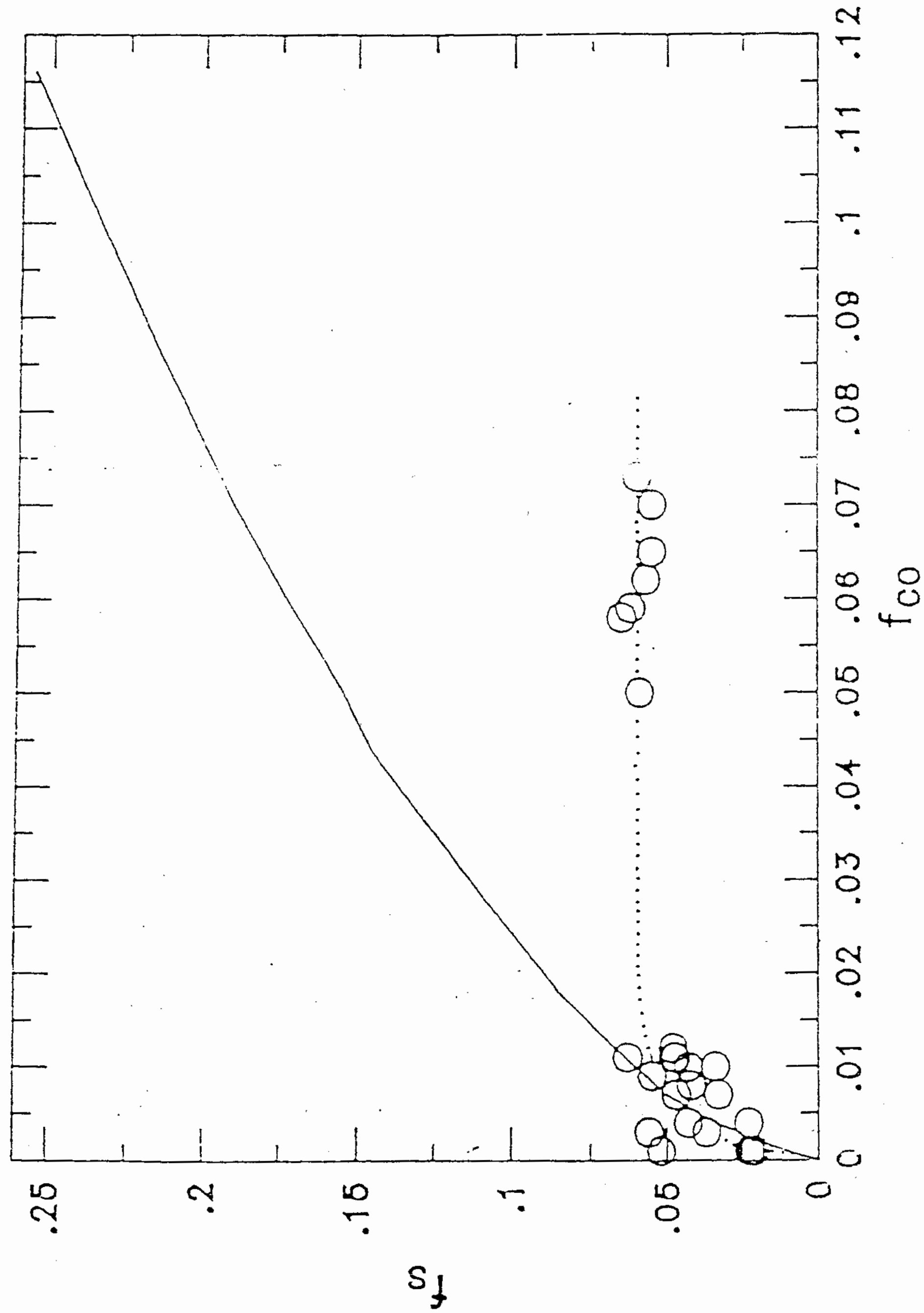

Fig. 4/ Tewarson

ALKENES

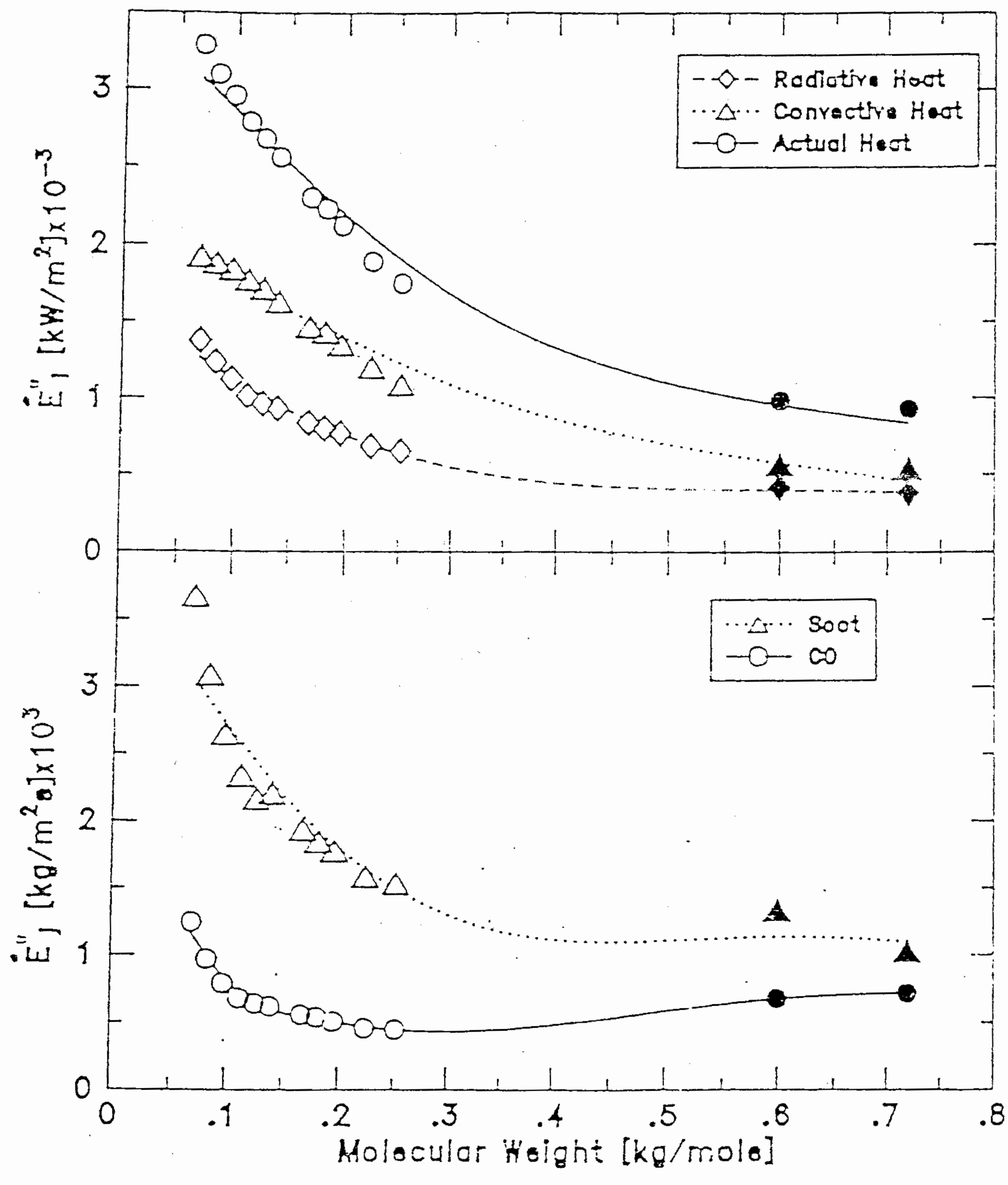

Fig. 6/ Tewarson

Los Alamos National Laboratory
ESH-17
Air Quality Group

P.O. Box 1663, Mail Stop J978
Los Alamos National Laboratory
Los Alamos, NM 87545

Phone: (505) 665-8855
Fax: (505) 665-8858

Memorandum

DATE: NOV. 6, 2001

TO: New Mexico Environment Department
Air Quality Bureau
Phone Number: (505) 827-1494
Fax Number: (505) 827-1523

Attention: John Volkerding, Enforcement

Subject: OPEN BURN NOTIFICATION

FROM: HAROLD A. MARTINEZ

Technical Area: 14 **Operation:** BURN AT Q-SITE (30 gal BARREL)

Proposed Burn Date: WEEK OF NOV 5th 2001

Comments:

For further information, please call Harold Martinez at (505) 665-8863.

Los Alamos National Laboratory
ESH-17
Air Quality Group

P.O. Box 1663, Mail Stop J978
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Phone: (505) 665-8855
Fax: (505) 665-8858

Memorandum

DATE: DEC. 10, 2001

TO: New Mexico Environment Department
Air Quality Bureau
Phone Number: (505) 827-1494
Fax Number: (505) 827-1523

Attention: John Volkerding, Enforcement

Subject: OPEN BURN NOTIFICATION

FROM: HAROLD A. MARTINEZ

Technical Area: 14 Operation: BURN AT Q-SITE (30 gal. BARREL

Proposed Burn Date: WEEK OF DECEMBER 10th 2001

Comments:

For further information, please call Harold Martinez at (505) 665-8863.

Los Alamos National Laboratory
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P.O. Box 1663, Mail Stop J978
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Phone: (505) 665-8855
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Memorandum

DATE: FEB. 1, 2002

TO: **New Mexico Environment Department**
Air Quality Bureau
Phone Number: (505) 827-1494
Fax Number: (505) 827-1523

Attention: John Volkerding, Enforcement

Subject: OPEN BURN NOTIFICATION

FROM: HAROLD A MARTINEZ

Technical Area: 14 **Operation:** BURN AT Q-SITE 30 gal. BARREL

Proposed Burn Date: WEEK OF FEB. 4, 2002

Comments:

For further information, please call Harold Martinez at (505) 665-8863.

State of New Mexico
ENVIRONMENT DEPARTMENT
AIR QUALITY BUREAU
2048 Galisteo
Santa Fe, New Mexico 87505
Telephone (505) 827-1494
Fax (505) 827-1523

GARY E. JOHNSON
GOVERNOR

PETER MAGGORIE
SECRETARY

12 August, 1999

Leland Maez
ESH-17
LANL
Los Alamos, NM

RE: TA-16 Open Burn Application

Dear Mr. Maez;

I have reviewed the open burn application dated July 29, 1999 and referred to as ESH-DO:99-163. Attached please find the signed approved open burn application.

I appreciate the invitation to observe the burn and do look forward to that opportunity. If you have any further questions or comments please feel free to contact me at the address below or at 505-827-1494 x1496.

Sincerely;

John M. Volkerding
Environmental Specialist
Enforcement

Los Alamos National Laboratory

Environment, Safety and Health Division
P.O. Box 1663, Mail Stop K491
Los Alamos, New Mexico 87545
(505) 667-4218 / FAX: (505) 665-3811

Date: July 29, 1999
Refer to: ESH-DO:99-163

Mr. John Volkerding
Air Quality Bureau
New Mexico Environment Department
2048 Galisteo
Santa Fe, NM 87505

Dear Mr. Volkerding:

Enclosed is an open burning permit application for the prescribed burn of a wood pile at TA-16. Prescribed burning is requested for this pile in order to eliminate the contaminated wood pile and to reduce the volume of contaminated waste.

This application request is for a one-day burn scheduled sometime in the summer or fall of 1999 or the spring of 2000. When the burn is scheduled, you will be notified and invited to view the burn.

Additional information for the proposed burn plan, emissions estimates, and impact analyses are included along with the permit application. The application and attachments satisfy the information requirements specified under Title 20, Chapter 2.60 of the New Mexico Administrative Code for Open Burning.

If you have any questions concerning this permit application for the prescribed burning of the wood pile at TA-16, please contact Leland Maez from the Laboratory's Air Quality Group at 665-1240.

Sincerely,

Dennis Erickson
Division Director

Sincerely,

James Gourdoux
Fire Marshal

Enc: a/s

Cy: R. Valdez, DOE-LAAO, MS A316
S. Fong, DOE-LAAO, MS A316
D. Tucker, LAFD, Los Alamos
D. Webb, ESH-20, MS M887
D. Woitte, LC/GL, MS A187
D. Stavert, ESH-17, MS J978
L. Maez, ESH-17, MS J978
ESH-17 File, J978
ESH-DO File

ATTACHMENT A

ADDITIONAL INFORMATION

Objectives: The proposed burn event must accomplish the following:

- Eliminate contaminated wood pile; and

- Reduce the amount of contaminated waste.

Purpose: Mitigate the hazard associated with a wood pile, potentially contaminated with depleted uranium (DU), that was collected as a result of wild fire prevention measures. Contamination is suspect due to the nature of activities historically performed at the site from which the wood was removed.

Date Burning Requested: One burn event to take place in the summer or fall of 1999 or the spring of 2000 and to be completed on a single day.

Alternatives to Burning and Why Alternatives are Not Feasible: 20 NMAC 2.60 – *Open Burning* requires that alternatives to open burning be used when appropriate. However, for the following reasons, burning the wood pile is the method of choice to achieve the objectives:

- Varying amounts or rock, concrete, and rebar mixed in with the wood make chipping impractical; and

- DU shrapnel imbedded in the wood could contaminate and damage the chipper.

Burn Organization:

Fire Coordinator - Los Alamos Fire Department

Burn Personnel - Los Alamos Fire Department

Emergency Response Coordinator - Gene Darling
Emergency Management and Response
Los Alamos National Laboratory

Air Emissions Coordinator - Leland Maez
ESH-17 Air Quality
Los Alamos National Laboratory

Smoke Management: A number of procedures will be performed prior to and during burning in order to reduce emission impacts. These include the following:

- Assessing atmospheric conditions (wind speed, direction, and stability)
  - Continuous monitoring through the use of meteorological data taken from the main meteorological tower located 3 km from the burn site
  - Burn only when meteorological conditions are within those used in the SASEM impact modeling studies shown in Attachment B of this document
  - Begin burn in late morning when down slope drainage winds have ceased and prevailing winds are out of the South/Southeast
  - End burns in early afternoon to allow adequate time for smoldering and smoke abatement to occur before down-slope draining begins (late afternoon/early evening)
  - Burn only when meteorological conditions are such that impairment of visibility across highway 501, highway 4, and the air strip East of town is not impacted

- Appropriate fuel conditions

- Ambient temperature:	50-80 °F	
- Relative humidity:	15-30%	
- Fuel moisture:	1 hr	15%
	10 hr (spring)	16%
	10 hr (fall)	20%
	100 hr	11-18%

Particulate Monitoring Location: Continuous PM_{10} emissions data will be collected for the duration of the burn. The monitor will be placed at a location sighted to receive maximum smoke impacts from South/Southeasterly winds. Filters from the monitor will be analyzed by the New Mexico Environment Department.

Firing Plan: The fire will be started with a torch to set off diesel fuel poured on the wood pile. Compressed air foam will be used as a holding method.

Contingency Plan: Should the burn escape the allowable area and grow beyond the capabilities of the holding forces, the escape will be declared a wild fire. The burn boss will notify the Santa Fe Zone Dispatch, Los Alamos Fire Department, the Department of Energy, and the District Ranger thereby implementing an Escape Fire Situation Analysis.

Air Emissions: The following table indicates the amount of pollutants estimated to be released from the proposed burn event.

Pollutant	Emission Factors* (lb/ton of wood burned)	Emissions (lb)
CO_2	252	52,164
NO_x	2.6	538
PM_{total}	40	8,280
SO_x	0.4	83
VOC	19.8	4,099
DU	0.05% of the uranium mass burned**	2.84E-04

*Unless otherwise noted: Air Chief, EFIG/EMAD/OAQPS/EPA, Version 4.0, July 1995
**Pacific Northwest Laboratory study

Air emission estimates for open burning are based on a wood pile of 1500 m^3. The quantity of wood available for burning was estimated assuming that loosely piled mound consisted of 25% by volume wood with a density of 0.5 g/cm^3 (from CRC Handbook of Chemistry and Physics, 62nd edition, p. F-1).

The DU air emissions result from the particles and shrapnel that are potentially lodged in the wood from historical projectile firing activities. Monitoring studies confirm that volumes of 20 cords have contained as much as 50 grams of DU lodged as shrapnel. Through extrapolation it is estimated that the woodpile (103 cords) potentially contains 259 g of DU. A study conducted by Pacific Northwest Laboratory found the fractional airborne release of uranium during controlled burning to be between 0.05 and 0.003 percent of the uranium mass burned. Assuming the conservative release fraction, the potential release is 0.129 g or 5.66E-08 Ci of DU (Specific Activity is 4.38E-07 Ci/g).

Impacts: The impacts from this burn event were estimated using SASEM for the particulate matter impact (Attachment B) and HOTSPOT for the radiological impact (Attachment C). DU was modeled as the following:

Radionuclide	Fraction of Parent Activity
U-238	75%
Th-234	75%
Pa-235	75%
U-234	25%

ATTACHMENT B

SASEM Impact Modeling

```
Your input values from SASEM are:
  1. Fire/site name ......................  TA-16 WOOD PILE
  2. Date of the burn ....................  No date
  3. Burn type of the fire ...............  PILED
  4. Fuel type of the fire ...............  WOOD
  5. Size of the fire ....................          1 piles
  6. Fuel loading of the fire site ........     13250. cu ft
  7. Fireline intensity ..................     1450.0 Btu/ft/sec
  8. Burn duration .......................       4.00 hours
  9. Meteorology type ....................  PRESCRIBED
 10. Prescribed wind speed, minimum .......        2.0 mi/hr
     Prescribed wind speed, maximum .......       10.0 mi/hr
 11. Prescribed wind direction, minimum ...  E
     Prescribed wind direction, maximum ...  ESE
 12. Prescribed dispersion day minimum ....  EXC
     Prescribed dispersion day maximum ....  FAIR
 13. Average mixing height ...............      1000. meters
```

Sensitive Receptor Information			
Receptor Number	Receptor Name	Receptor Distance	Receptor Direction
1	Los Alamos	3.0	SSW
2	Bandelier	1.0	WNW

The SASEM calculated emission statistics are:

Pollutant of interest	Particulates (TSP and PM10)
Emission factor	17.92 g/kg
Emission rate	56.09 g/s/pile
Total particulates emitted	0.9 tons
Proportion of fuel consumed	50. %
Heat content of fuel specified	7000. Btu/lb
Residence time of fire front	960. s
Heat release rate for a plume	12173249. cal/s
Persistence factor for concentration	0.17
Proportion of smoke which rises	60. %
Proportion of total particulates in PM10	80. %

Disp Day	Wind Speed (MPH)	Maximum Concen (ug/m**3)	Distance to Maximum Concen (mi)	Exceedences of Standards TSP* Distance Downwind From (mi)	To (mi)	PM10* From (mi)	To (mi)	Plume Rise (m)
EXC	2.0	1.7	2.87	NO VIOLATION		NO VIOLATION		1689.
EXC	3.0	2.3	2.00	NO VIOLATION		NO VIOLATION		1126.
EXC	4.0	3.0	1.54	NO VIOLATION		NO VIOLATION		845.
EXC	5.0	3.6	1.26	NO VIOLATION		NO VIOLATION		676.
EXC	6.0	4.1	1.07	NO VIOLATION		NO VIOLATION		563.
EXC	7.0	4.7	0.93	NO VIOLATION		NO VIOLATION		483.
EXC	8.0	5.3	0.83	NO VIOLATION		NO VIOLATION		422.
EXC	9.0	5.8	0.74	NO VIOLATION		NO VIOLATION		375.
EXC	10.0	6.3	0.68	NO VIOLATION		NO VIOLATION		338.
GOOD	5.0	2.7	2.72	NO VIOLATION		NO VIOLATION		676.
GOOD	6.0	3.2	2.22	NO VIOLATION		NO VIOLATION		563.
GOOD	7.0	3.7	1.88	NO VIOLATION		NO VIOLATION		483.
GOOD	8.0	4.2	1.62	NO VIOLATION		NO VIOLATION		422.
GOOD	9.0	4.7	1.42	NO VIOLATION		NO VIOLATION		375.
GOOD	10.0	5.2	1.27	NO VIOLATION		NO VIOLATION		338.
FAIR	7.0	1.3	9.65	NO VIOLATION		NO VIOLATION		483.
FAIR	8.0	1.6	7.62	NO VIOLATION		NO VIOLATION		422.
FAIR	9.0	2.0	6.18	NO VIOLATION		NO VIOLATION		375.
FAIR	10.0	2.3	5.13	NO VIOLATION		NO VIOLATION		338.

* The primary TSP standard is 150. micrograms per cubic meter.
The primary PM10 standard is 150. micrograms per cubic meter.

Receptor No.	Name	Dist (mi)	Dir	Disp Day	Wind Speed (MPH)	Range of Wind Dir	P&K* Visual Range (mi)	Kosh** Visual Range (mi)
1	Los Alamos	3.00	SSW	EXC	2.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	3.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	4.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	5.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	6.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	7.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	8.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	9.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	EXC	10.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	GOOD	5.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	GOOD	6.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	GOOD	7.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	GOOD	8.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	GOOD	9.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	GOOD	10.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	FAIR	7.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	FAIR	8.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	FAIR	9.0	E -ESE	NO IMPACT	
1	Los Alamos	3.00	SSW	FAIR	10.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	2.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	3.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	4.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	5.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	6.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	7.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	8.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	9.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	EXC	10.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	GOOD	5.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	GOOD	6.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	GOOD	7.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	GOOD	8.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	GOOD	9.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	GOOD	10.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	FAIR	7.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	FAIR	8.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	FAIR	9.0	E -ESE	NO IMPACT	
2	Bandelier	1.00	WNW	FAIR	10.0	E -ESE	NO IMPACT	

* Packham, D. R. and R. G. Vines, 1978, JAPCA 28:790-795.
**Koshmieder, 1924, Beitr. Phys. Freien Atm., 12:33-54.
and EPA, 1979, EPA-450/5-79-008.

Based on TSP emission rates

ATTACHMENT C

HOTSPOT Impact Modeling

Details/Assumptions of DU run

Used HOTSPOT code Version 8

Stability class D
Wind Speed = 2 m/s
No mixing layer
Deposition Velocity = 1 cm/s
No plume rise
Release height = 4 m
Instantaneous release

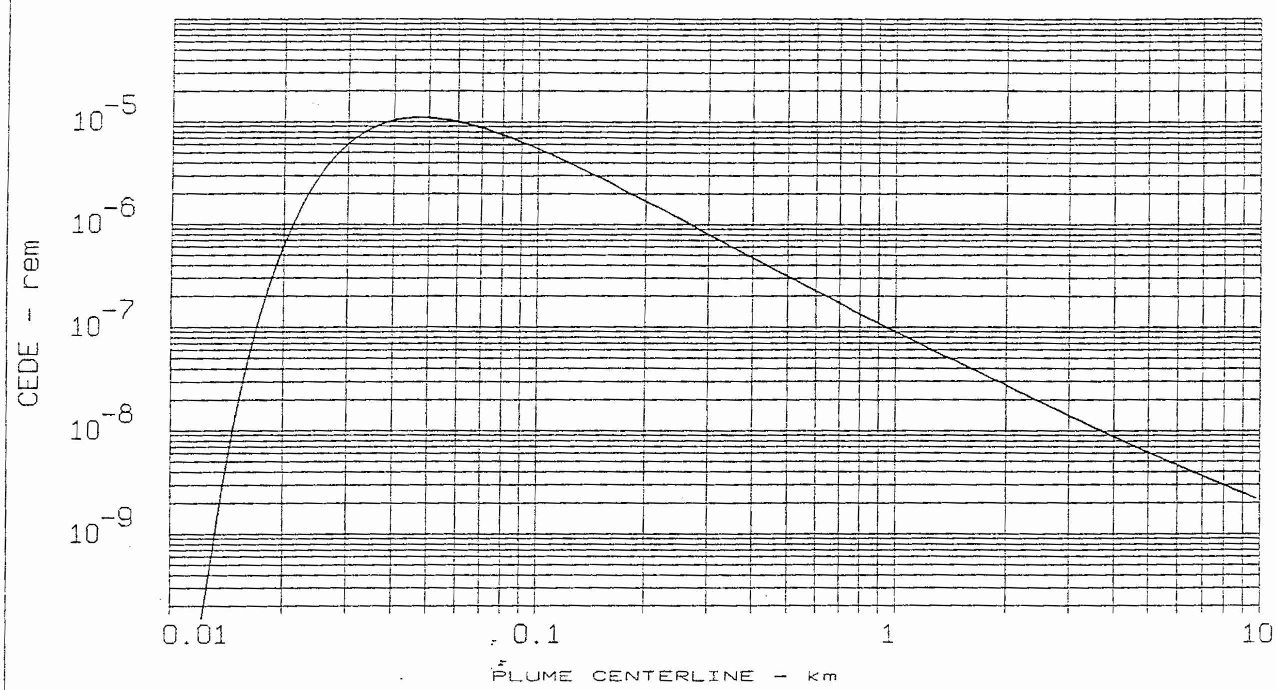
Assumes plume centerline goes over receptor

```
D =    4.000 km
DEP =   3.8E-09 uCi/m^2
CHI =   3.8E-13 (Ci-s)/m^3
50-YR DOSE COMMITMENT:
-------------------------
EFFECTIVE DOSE
EQUIVALENT      8.8E-09 rem
```

```
HOTSPOT 8.0 GENERAL PLUME       7-08-1999 14:28

USER MIXTURE : DU.MIX EFFECTIVE RELEASE HEIGHT :     4.00 m
WIND SPEED (h=2 m): 2.0 m/s
WIND SPEED (h=H-eff): 2.2 m/s
STABILITY CLASS            : D   RECEPTOR HEIGHT          : 0.0 m
INVERSION LAYER HEIGHT     : NONE
SAMPLE TIME                :   10.000 min
MAXIMUM DOSE DISTANCE      : <   0.10 km    MAXIMUM CEDE    : >  5.5E-06 rem
```

LLNL - HOTSPOT O GENERAL PLUME 7-08-1999 1 [illegible]6



EFFECTIVE RELEASE HEIGHT: 4.0 m
WIND SPEED (h = 2 m) : 2.00 m/s
WIND SPEED (h = H-eff) : 2.22 m/s
STABILITY CLASS : D

RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : NONE
MAXIMUM DOSE DISTANCE : < 0.10 km
MAXIMUM CEDE : > 5.5E-06 rem

USER MIXTURE : DU.MIX

	50-y CEDE (rem/μCi)	breathing rate (m^3/s)	conversion DCF (rem-m3/Ci-S)
U-238	120	3.33E-04	4.00E+04
Th-234	0.033	3.33E-04	1.10E+01
Pa-234	0.00074	3.33E-04	2.46E-01

```
* HOTSPOT MIXTURE DATABASE
*
* The following criticality release inventory is associated
* with a stanard depleted uranium mix.  Deposition velocity is assumed
 to equal 1.
*
*
                 Nuclide Number 1
===============================================
Radionuclide                  : U-238
Particle Class                : Y
Halflife      (Years)         :  4.5E+09
-----------------------------------------------
SUBMERSION                   (rem-m3)/(Ci-sec)
-----------------------------------------------
50-yr CEDE                    :  4.0000E+04
Skin                          :  0.0000E+00
Lung                          :  0.0000E+00
Thyroid                       :  0.0000E+00
Surface Bone                  :  0.0000E+00
Red Marrow                    :  0.0000E+00
Liver                         :  0.0000E+00
Spleen                        :  0.0000E+00
Gonads                        :  0.0000E+00
Breast                        :  0.0000E+00
-----------------------------------------------
Curies Released               :  4.2000E-08
Release Fraction              :  1.0000E+00
Deposition Velocity (cm/sec)  :  1.0000E+00


                 Nuclide Number 2
===============================================
Radionuclide                  : Th-234
Particle Class                : Y
Halflife      (Years)         :  6.60E-02
-----------------------------------------------
SUBMERSION                   (rem-m3)/(Ci-sec)
-----------------------------------------------
50-yr CEDE                    :  1.1000E+01
Skin                          :  0.0000E+00
Lung                          :  0.0000E+00
Thyroid                       :  0.0000E+00
Surface Bone                  :  0.0000E+00
Red Marrow                    :  0.0000E+00
Liver                         :  0.0000E+00
Spleen                        :  0.0000E+00
```

		Du.mix
Spleen	:	0.0000E+00
Gonads	:	0.0000E+00
Breast	:	0.0000E+00

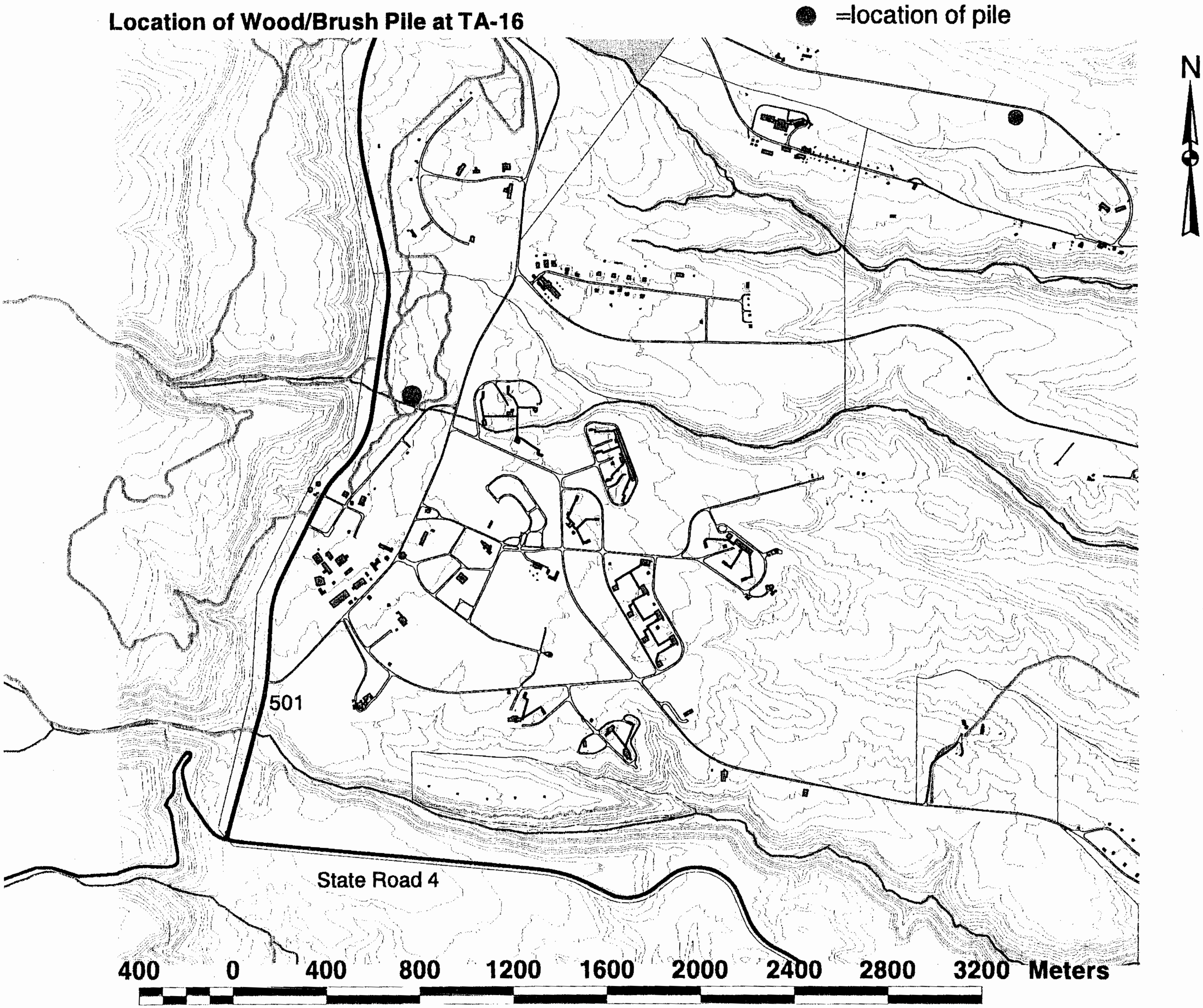
Curies Released	:	1.4000E-08
Release Fraction	:	1.0000E+00
Deposition Velocity (cm/sec)	:	1.0000E+00

ATTACHMENT D

Picture and Map

Wood Pile at TA-16

Location of Wood/Brush Pile at TA-16



STATE OF NEW MEXICO
Environment
Department

PERMIT NO. ________
(AQB assigned)

NEW MEXICO ENVIRONMENT DEPARTMENT/AIR QUALITY BUREAU
PERMIT APPLICATION AND REPORTING OF OPEN BURNING FOR
PRESCRIBED/PRESCRIBED NATURAL FIRE AREAS

PERMITTEE: USDA___ USDI___ BLM___ MILITARY___ DOE X PRIVATE___ OTHER___

ADMINISTRATIVE UNIT: Los Alamos National Laboratory COUNTY: Los Alamos

CONTACT: Leland Maez PHONE: (505)665-1240

NAME OF BURN: Wood Pile Burn @ TA-16 LOCATION: T:19N R:6E S:30
(Township, Range, Section)

PROPOSED ACREAGE n/a FUEL LOADING DETERMINATION METHOD Estimated Volume

TYPE OF FUEL Cut Ponderosa Pine and Mixed Conifer and slash TONS/ACRE 207 tons

Is burn likely to impact a smoke sensitive area? Yes___ No X
If yes, please attach a map of smoke sensitive areas (include distance and direction).

Smoke sensitive areas include: Class I areas as well as other scenic and important views, urban and rural population centers, hospitals, nursing homes, schools, transportation facilities such as roads, highways, and airports, recreational areas, and other locations that may be sensitive to smoke impacts for health, safety, and/or aesthetic reasons.

Signed [signature] [signature] Date 30 JUL 1999
Dennis Erickson, ESH Division Director — Name and Title — James Gourdoux, Fire Marshal

Submit to: New Mexico Environment Department, Air Quality Bureau
2048 Galisteo
Santa Fe, NM 87505

This application has been received by the New Mexico Environment Department and is
APPROVED X **DENIED** ___ **for the following reasons:** ________

This permit is approved for the following dates: Aug 12, 1999 — Aug 12, 2000
and is subject to the conditions set forth in 20 NMAC 2.60 and the following conditions:

1) Notify the Bureau at least 24 hours prior to the burn
2) Follow the smoke management & particulate monitoring conditions listed in the permit application

The Department reserves the right to cancel this permit at any time if the public interest so warrants it. The holder of this permit is therefore cautioned and charged that he/she and he/she alone, assumes full responsibility to exercise the utmost care and judgement before igniting any prescribed fires. The Environment Department hereby disclaims any and all liability of itself or it's agents that might be incurred by petitioner's acts.

Signed [signature] Date 8/12/99
Name and Title

NMED 8/96 White - Applicant; Canary - Applicant Main Office; Pink - Air Quality Bureau;

STATE OF NEW MEXICO
Environment
Department

COPY

PERMIT NO. AQB [redacted] 214
(AQB assigned)

Good to end of 2002.

NEW MEXICO ENVIRONMENT DEPARTMENT/AIR QUALITY BUREAU
PERMIT APPLICATION AND REPORTING OF OPEN BURNING FOR PRESCRIBED/PRESCRIBED NATURAL FIRE AREAS

PERMITTEE: USDA___ USDI___ BLM___ MILITARY___ DOE X PRIVATE___ OTHER___

ADMINISTRATIVE UNIT: LANL COUNTY: ______

CONTACT: Leland Maez PHONE: 665-1240

NAME OF BURN: Operational Burns at TA-11, 14, 16, 36* LOCATION: Los Alamos National Laboratory (Township, Range, Section)

PROPOSED ACREAGE * FUEL LOADING DETERMINATION METHOD *

TYPE OF FUEL * TONS/ACRE *

*See Attached Document

Is burn likely to impact a smoke sensitive area? Yes___ No X
If yes, please attach a map of smoke sensitive areas (Include distance and direction).

Smoke sensitive areas include: Class I areas as well as other scenic and important views, urban and rural population centers, hospitals, nursing homes, schools, transportation facilities such as roads, highways, and airports, recreational areas, and other locations that may be sensitive to smoke impacts for health, safety, and/or aesthetic reasons.

Signed ______ for DE ______ DOOR ______ Date 7/29/97
Name and Title
D. Erickson, ESH R. Day, DX R. Burick, ESA (Division Directors)

Submit to: New Mexico Environment Department, Air Quality Bureau
2048 Galisteo
Santa Fe, NM 87505

This application has been received by the New Mexico Environment Department and is
APPROVED X **DENIED** ___ for the following reasons:

As per 20 NMAC 2.60

This permit is approved for the following dates: August 18, 1997 - December 31, 2002
and is subject to the conditions set forth in 20 NMAC 2.60 and the following conditions:

- Ensure that NAAQS and NMAAQS are not violated
- Shall conduct burns on good dispersion days

The Department reserves the right to cancel this permit at any time if the public interest so warrants it. The holder of this permit is therefore cautioned and charged that he/she, and he/she alone, assumes full responsibility to exercise the utmost care and judgement before igniting any prescribed fires. The Environment Department hereby disclaims any and all liability of itself or it's agents that might be incurred by petitioner's acts.

Signed Filiberto Dominguez Env. Scientist Date 8/18/97
Name and Title

State of New Mexico
ENVIRONMENT DEPARTMENT
AIR POLLUTION CONTROL BUREAU
2048 Galisteo Street
Santa Fe, New Mexico 87505
(505) 827-1494
Fax (505) 827-1523

GARY E. JOHNSON
GOVERNOR

MARK E. WEIDLER
SECRETARY
EDGAR T. THORNTON, III
DEPUTY SECRETARY

August 27, 1996

Mr. Steven Fong
Office of Environmental Projects
Department of Energy
Los Alamos Area Office
Los Alamos, New Mexico 87544

RE: Open Burning - TA-16 Flash Pads

Dear Mr. Fong:

This letter is in response to your August 15, 1996 letter regarding open burning at Technical Area 16 (TA-16) flash pads.

Based on the information submitted and the description of the operation there are no requirements under 20 NMAC 2.72, Construction Permits or 20 NMAC 2.73, Notice of Intent and Emissions Inventory Requirements. The open burning permit issued April 4, 1996 by the Air Quality Bureau is sufficient.

Sincerely,

Richard Goodyear
Manager
Permits Section
Air Quality Bureau

cc: Fil Dominguez, Enforcement Section, Air Quality Bureau

Department of Energy
Albuquerque Operations Office
Los Alamos Area Office
Los Alamos, New Mexico 87544

AUG 1 5 1996

Mr. Richard Goodyear
New Mexico Environment Department
Air Pollution Control Bureau
2048 Galisteo
Santa Fe, New Mexico 87505

Dear Mr. Goodyear:

As a pollution prevention measure, Los Alamos National Laboratory (LANL) is proposing to change the method of operation of open burning at Technical Area 16 (TA-16) flash pads. LANL plans to discontinue the routine practice of using wood fuel fires currently used to remove High Explosives (HE) from HE-contaminated objects. In the future, LANL will flash HE by the use of outside propane burners. This would significantly decrease both the air pollutant emissions and the generation of ash. Currently, these operations are regulated by the Resource Conservation and Recovery Act (RCRA) as well as open burning as defined under New Mexico Administrative Code (NMAC) 20 NMAC 2.60. A draft RCRA permit application detailing additional operational limitations for the facility was submitted to the Solid and Hazardous Waste Bureau on March 21, 1996. The open burn permit and applicable parts of the RCRA permit application are included in Enclosure A. Operational terms and conditions from the RCRA permit application and from the open burn permit place federally enforceable limits on the number of burns and the amount of material to be flashed, thereby limiting the emissions below the thresholds that would require LANL to obtain an Air Quality permit as required by 20 NMAC 2.72. However, you indicated recently that your staff would like to review the installation of new equipment, even if it will decrease the potential emission rate for the facility. We are providing the pertinent information below and would like to meet with you to discuss the status of this change under 20 NMAC 2.72-Construction Permits.

Current Operations

This operational change will affect the following open burn pad operations as shown in Figure 1 (enclosed).

TA-16-387 flash pad, used to flash HE off contaminated debris;
TA-16-394 open pad trays, used to burn HE-contaminated solvents and oils.

Wood fuel fires are used to destroy HE on the TA-16-387 flash pad and the TA-16-394 solvent/oil trays and are regulated by open burn permits.

Proposed Modification

The proposed modifications are summarized below:

> Because of its location next to a future RCRA regulated clean site, NMED has asked that TA-16-387 be closed. During an interim period of flashing operations, three portable propane burners, each rated at approximately 1.4 million British thermal units, would be used to flash equipment instead of wood.
>
> After closure of the RCRA site, all future flashing operations are moved to TA-16-388. LANL proposes to install up to six propane burners, each rated at approximately 2 million British thermal units, at this location and begin phasing in the flashing operations prior to cleaning TA-16-387.
>
> The oil/solvent burning operations will be moved to TA-16-388 to be treated with propane instead of wood, and the existing TA-16-394 oil/solvent burning trays will be closed.

Figures 2 and 3 (enclosed) are schematics of the proposed design of TA-16-387 and -388. Wood-fuel would be used only for occasions when the propane system failed or there was HE-contaminated wood which required flashing. All of the proposed operations would be regulated by open burn permits.

Air Quality Permit 20 NMAC 2.60, Open Burning at TA-16 effective April 1996 through May 1997, places enforceable limits of 36 flash burns/year and 45 solvent burns/year. Each solvent burn can burn no more than 55 gallons at a time. The RCRA draft permit application places enforceable limits on the amount of material flashed during any burn (40,000 lb/burn). In addition, the RCRA draft permit application identifies operating procedures including that a minimum of 24 hours elapse before handling of the flashed material can occur. Because the total number of burns conducted each year at the TA-16 burn grounds would not change, the net effect of installing propane is a reduction in the potential to emit for the facility of LANL. Comparisons of emissions from the existing flashing operations and proposed change to propane are detailed in Table 1 (enclosed).

We would very much appreciate a meeting with you and/or your staff to further discuss this proposed change. Please call me at (505) 665-5534 or Doug Stavert of LANL's Air

Quality Group at (505) 665-0235, to arrange this meeting or to provide any additional information.

Sincerely,

Steve Fong
Office of Environment and Projects

LAAMEP:9SF-083

Enclosures

cc w/o enclosures:
J. Plum, AAMEP, LAAO
D. Stavert, ESH-17, LANL, MS-J978
L. Maez, ESH-17, LANL, MS-J978
ESH-Recordkeeping Files
(TA-16-Burning Grounds), LANL, MS-J978
H. Noskin, ESH-19, LANL, MS-K490
S. Goel, EPD, AL

ENCLOSURE A

20 NMAC 2.60 - APRIL 1996 OPEN BURN PERMIT FOR TECHNICAL AREA 16

APRIL 1996 SELECTED PARTS OF THE RCRA SUBPART A & B PERMIT APPLICATION

STATE OF NEW MEXICO
Environment
Department

PERMIT NO. APCB.PF.044
(APCB assigned)

NEW MEXICO ENVIRONMENT DEPARTMENT/AIR POLLUTION CONTROL BUREAU
PERMIT APPLICATION AND REPORTING OF OPEN BURNING FOR
PRESCRIBED NATURAL FIRE AREAS

PERMITTEE: USFS____ DOE X BLM____ MILITARY____ USF&WS____
USDI____ NPS____ PRIVATE____ OTHER____
ADMINISTRATIVE UNIT: ______ COUNTY Los Alamos
CONTACT: Steve Fong, Leland Maez PHONE: 665-5534, 665-1240
NAME OF BURN: TA-16-387, 394, 388 LOCATION: Los Alamos National Laboratory
(T, R, 1/4S)
PROPOSED ACREAGE/DAY: * FUEL LOADING DETERMINATION METHOD *
TYPE OF FUEL * TONS/ACRE *
* See Attachment A

Is burn likely to impact a smoke sensitive area? Yes____ No X
If yes, please attach a map of smoke sensitive areas (Include distance and direction).

Smoke sensitive areas include: Class I areas as well as other scenic and important views, urban and rural population centers, hospitals, nursing homes, schools, transportation facilities such as roads, highways, and airports, recreational areas, and other locations that may be sensitive to smoke impacts for health, safety, and/or aesthetic reasons.

Signed [signature] Date 4/1/96
Name and Title
Joseph C. Vozella, Assistant Area Manager

Submit to: New Mexico Environment Department, Air Pollution Control Bureau
2048 Galisteo
Santa Fe, NM 87505

This application has been received by the New Mexico Environment Department and is X APPROVED ____ DENIED for the following reasons:
- As per 20 NMAC 2.60 Subsection 109 C.

This permit is approved for the following dates:
April 4, 1996 - April 4, 1997
and is subject to the conditions set forth in AQCR 301 and the following conditions:
- Be sure meteorological conditions are appropriate for burning
- No TSP or PM-10 violations will be exceed
- Notify NMED/APCB 24 hrs. prior to ignition

The Department reserves the right to cancel this permit at any time if the public interest so warrants it. The holder of this permit is therefore cautioned and charged that he/she, and he/she alone, assumes full responsibility to exercise the utmost care and judgement before igniting any prescribed fires. The Environment Department hereby disclaims any and all liability of itself or it's agents that might be incurred by petitioner's acts.

Department of Energy
Los Alamos Area Office
Albuquerque Operations Office
Los Alamos, New Mexico 87544

APR 1 1996

Filiberto Dominguez
Air Pollution Control Bureau
New Mexico Environment Department
2048 Galisteo
Santa Fe, NM 87505

Dear Mr. Dominguez:

Enclosed is an open-burning permit application for the burning operations conducted throughout the year at Technical Area (TA) 16. Open-burning at the Los Alamos National Laboratory is conducted in order to diminish the safety risks associated with high explosives (HE) contaminated waste generated at this areas.

The enclosed application satisfies the information requirements specified under Title 20, Chapter 2, Part 60 of the New Mexico Administrative Code (NMAC) for open burning.

As stipulated in 20 NMAC 2.60, Section 109, paragraph C, unrestricted open-burning of HE material is allowed as a means of disposal in order to eliminate the hazards associated with transportation. Two open-burning operations conducted at TA-16 involve almost pure HE materials and therefore, not subject to permitting under 20 NMAC 2.60 and not included in the attached permit application. These two HE burning operations are:

<u>Open Burn Tables</u>
Discarded bulk HE is burned on tables.

<u>Filter Vessels</u>
Sludge dried HE particles collected from the cleaning of HE contaminated machining tools are burned in filters vessels.

This application request is for 36 flash burns and 45 liquid burns over the next 12 months. The New Mexico Hazardous and Radioactive Materials Bureau has proposed some changes to the current burning operation. These changes may take place over the period requested in the application. A brief description of these changes are included in Attachment A. In addition to the application, a detailed emissions and impact analysis is enclosed.

The format of this application remains the same as other applications submitted to your department in the past. We believe this format provides all information requested in your January 16, 1996, letter regarding open-burn permitting.

If you have any questions concerning this permit application for TA-16, please call Steve Fong of my staff at 665-5534.

Sincerely,

Joseph C. Vozella
Assistant Area Manager
Office of Environment and Projects

enclosures

ccw/enclosures:
S. Fong, LAAO, MS A316
D. Stavert, ESH-17, MS J978
T. Grieggs, ESH-19, MS K498
L. Maez, ESH-17, MS J978
C. Fesmire, LAAO, A316

TECHNICAL AREA 16

OPEN BURNING PERMIT APPLICATION

OWNER:

U.S. DEPARTMENT OF ENERGY
LOS ALAMOS AREA OFFICE
LOS ALAMOS, NEW MEXICO 87544

OPERATOR:

University of California
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

APRIL 1996

ATTACHMENT A

LOS ALAMOS NATIONAL LABORATORY (LANL)
APPLICATION FOR OPEN-BURNING PERMIT
IN TECHNICAL AREA 16 - 387, 388, AND 394

BURNING UNITS:

Burning will be conducted at two burning units within Technical Area (TA) 16 in which high explosive (HE) contaminated materials are burned to completely react the HE components. Flash pad burning is conducted at the "flashing" pad (TA-16-387) and the liquid (oil/solvent) burn is conducted at the burn tray (TA-16-394).

The New Mexico Hazardous and Radioactive Materials Bureau (HRMB) has suggested some changes to the TA-16 burning grounds in association with clean closure under the Resource Conservation and Recovery Act (RCRA) of an area called the MDAP, which is located adjacent to the northern boundary of the burn grounds. The HRMB has requested the closure of the TA-16-387 flash pad as soon as the MDAP project is completed to avoid recontamination of that area. During the cleanup, HRMB wants the TA-16-387 pad to flash only the MDAP wastes. The HRMB has suggested relocation of all non-MDAP flashing activities. The current proposal is to move the flashing operation to HE burn pad, TA-16-388. The total number of requested burns will remain the same although, some burns will take place at the proposed 388 burn pad (see reference map attachment B).

DATES BURNING REQUESTED:

The burn dates will be dependent on the amount of accumulated explosives-contaminated unburnable material and explosives-contaminated liquid waste material. It is anticipated that the number of burns mentioned below will be required to keep HE contaminated wastes from accumulating to dangerous levels. Because specific dates cannot be assigned at this time, LANL will notify NMED 24 hours in advance of the expected burn dates.

Flashing Pad

Approximately 36 burns are expected to occur over the next 12 months to mitigate the safety hazards posed by HE contaminated materials.

Liquid Burn Tray

Approximately 45 burns are expected to occur over the next 12 months to reduce the safety hazards posed by high explosive (HE) contaminated liquid waste materials.

EXACT LOCATION AND DIRECTION TO SITE:

The burns will be conducted within LANL at Technical Area 16, on flash pad 387, possibly burn pad 388, and liquid burning tray 394. TA-16-389 is a control shelter that provides operational site control for the burn grounds. The sites can be accessed by escorted personnel through security station 560, off state road 501. A reference map is found in attachment B.

TYPE AND QUANTITY OF MATERIALS TO BE BURNED:

Flashing Pad

The burns consist of approximately 800 to 1600 pounds of HE contaminated scrap lumber, uncontaminated scrap lumber, or wood pallets (used as kindling wood) placed on and around the flash pile. The amount of wood used is determined by the type and quantity of material to be flashed. The kindling wood quantity determination is made in order to insure that flashing of the HE contamination present on the unburnable material is complete.

Each burn requires approximately five gallons of kerosene and excelsior as starter aiding in the ignition of the wood. In addition, when available, 20-50 pounds of HE contaminated rags, paper, cardboard, plastics, packing material, and combustible firing site debris are mixed with the wood to aid in ignition and act as a combustion source. Rubber products (i.e. gaskets, seals, hoses, etc.) as integral part of the flashed material or contaminated with HE is also burned. The amount of unburnable material flashed in each burn is approximately one and a half tons and consists primarily of concrete, metal, and glass (concrete sumps, drain lines, fixtures, and piping, etc.). Each burn is estimated to take 2 hours.

Liquid Burn Tray

The burns consist of approximately 55 gallons of HE contaminated oil and dilute solvents poured into the burn trays and ignited. Each burn requires kerosene and excelsior as the starter fluid aiding in the ignition of the liquid. In addition, up to 500 pounds of scrap lumber, or wood pallets may be placed under the burn tray to completely combust the HE contaminated oil and dilute solvents. The solvents include toluene, acetone, alcohol, and other HE contaminated wastes resulting from HE analysis (HE desolution). Used hydraulic fluids drained from explosive processing and machining equipment is mixed with the solvents and burned. The total percentage of HE in the solvent/fluids mix is unknown.

METHOD OF IGNITION AND HOW BURNING WILL BE MAINTAINED AND CONTROLLED:

The current Standard Operating Procedures (SOPs) that will be followed during the burns are enclosed (Attachments C and D). The SOPs cover the hazards involved and precautions to be taken during the burn setup, the post burn observation period, unburnable inspection procedures, receiving and placement for the burns, and disposal of the flashed material. The SOPs also describe the ignition method which is a remotely operated ignition train made from excelsior and kerosene. These SOPs' undergo changes from time to time.

WHY IS BURNING NECESSARY:

The burning is necessary to mitigate the hazards associated with HE contaminated material generated during HE research & development operations and decontamination & decommissioning activities. Open fire flashing and liquid burning is very effective in eliminating HE contamination of wastes.

ALTERNATIVES TO BURNING AND REASONS WHY ALTERNATIVES ARE NOT FEASIBLE:

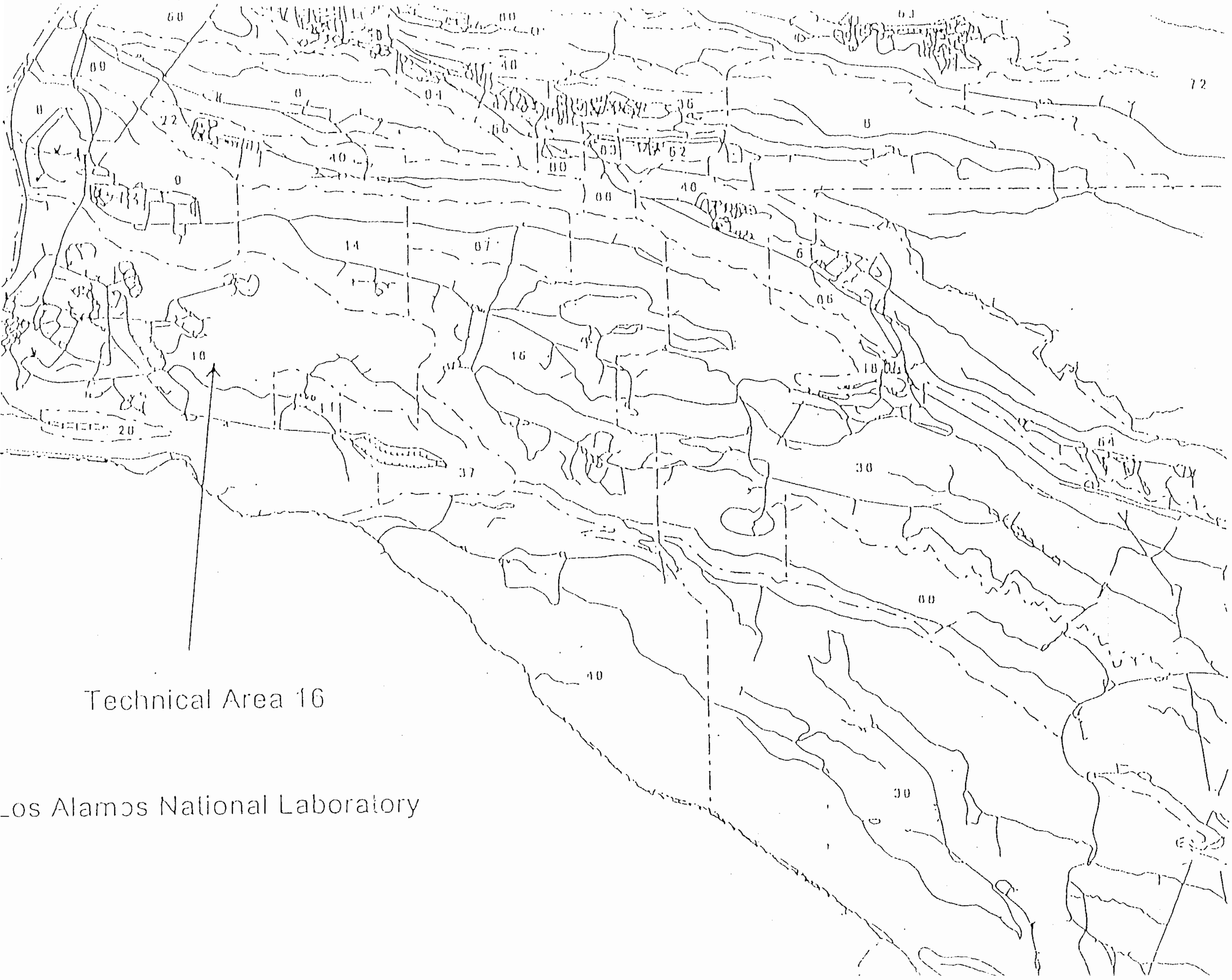
There are two current alternatives to open burning. First, the direct burial of HE contaminated material is possible. However, it is standard practice to reduce the transportation and handling of material resulting from any process associated with high explosives for safety reasons. This practice prevents accidents that might occur from the presence of HE residue. While this scenario is unlikely, there is a finite probability of its occurrence.

The second option would be to thermally treat the contaminated material in an oven or an incinerator. Due to the size of some of the contaminated objects (large filling cabinets, building structures, etc.) an extremely large treatment unit would have to be built. This option is feasible, but the cost of constructing such an enclosed structure is not practical.

The Laboratory is currently exploring the possible use of propane burners to flash unburnable material and aid in the combustion of HE contaminated oil and dilute solvents. This operational change would greatly reduce the air emissions generated from the combustion of wood.

ATTACHMENT B

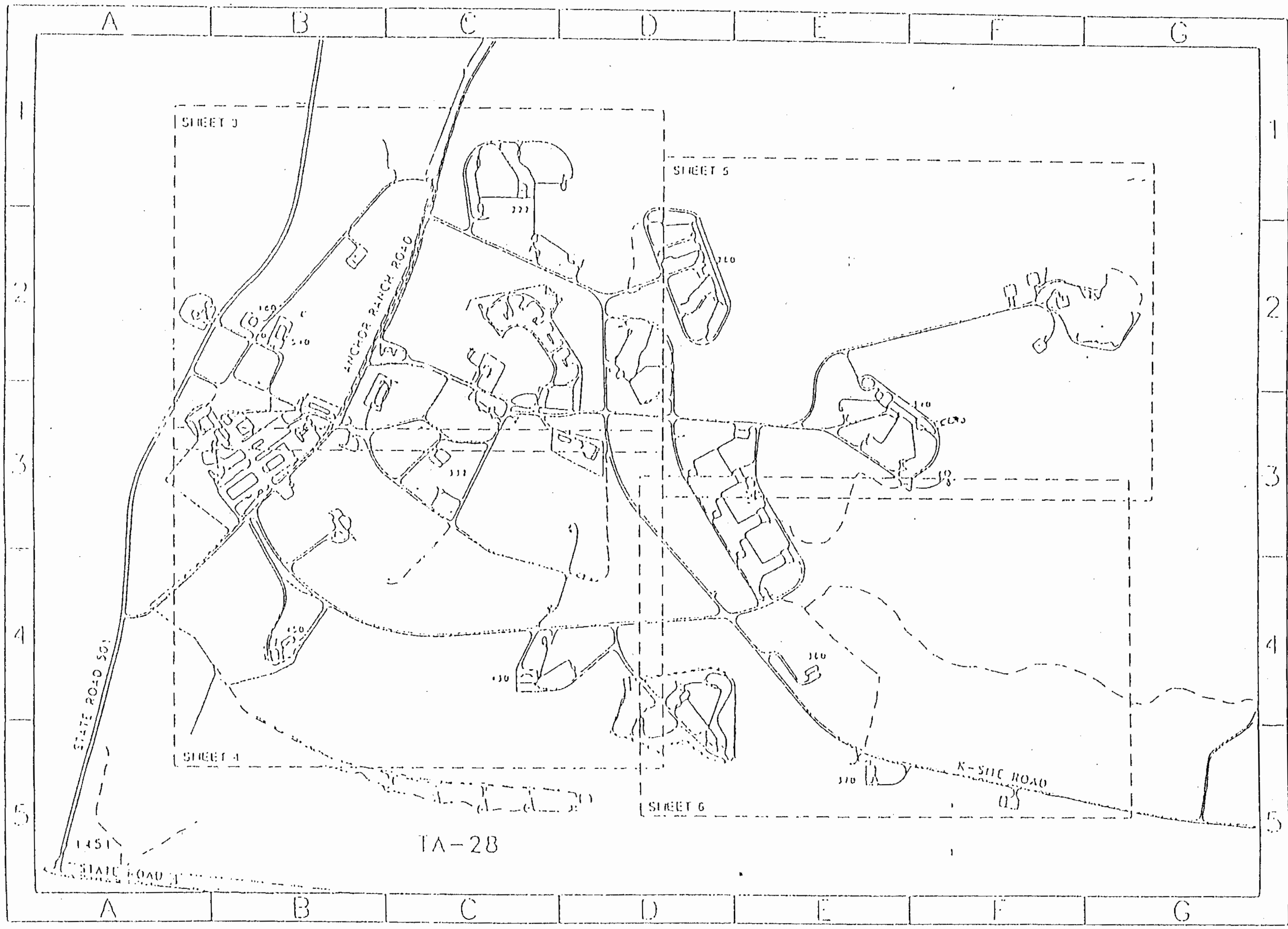
TECHNICAL AREA 16 BURNING GROUND LOCATION MAPS



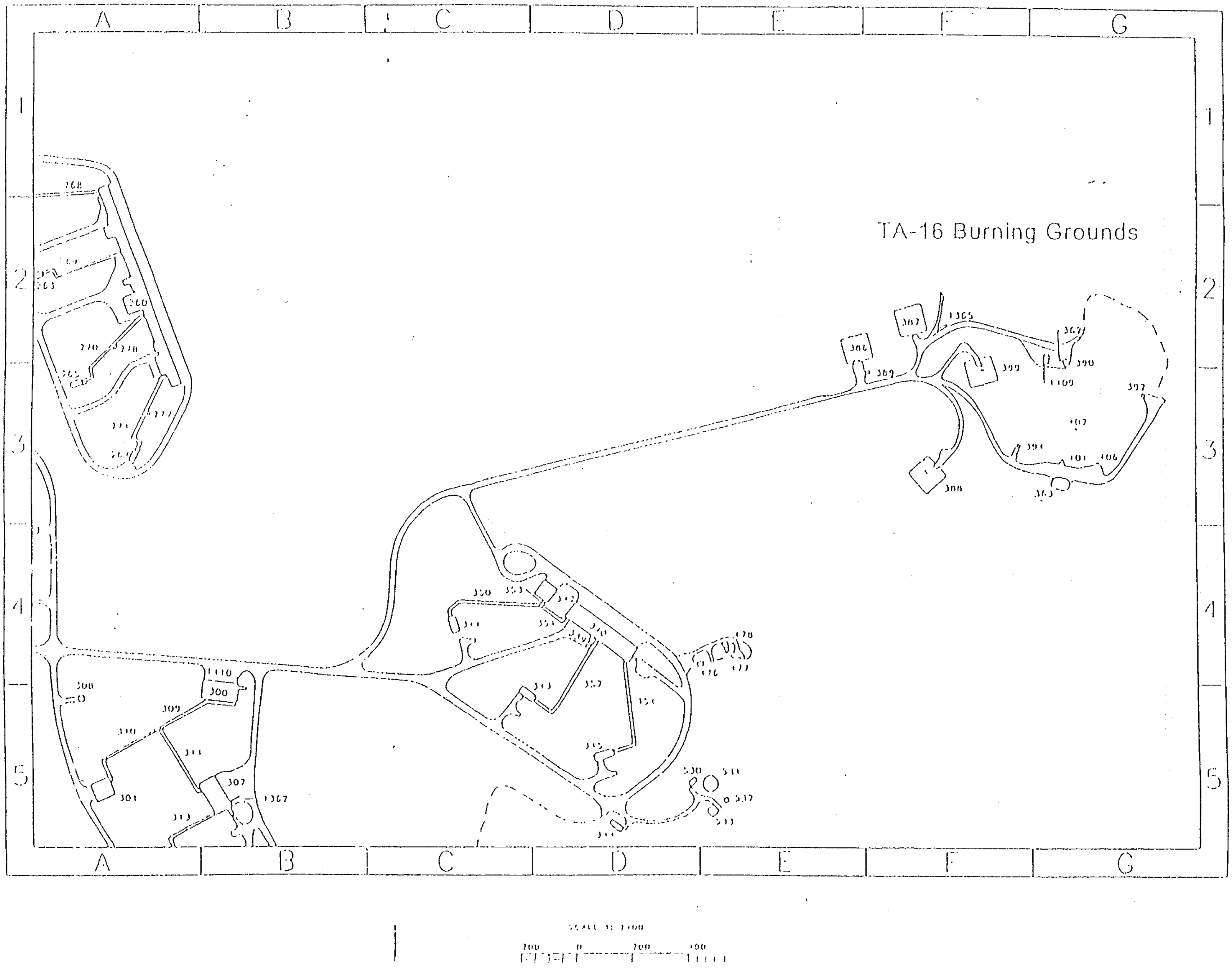
Technical Area 16

_os Alamos National Laboratory

Technical Area 16



Burning Grounds at Technical Area 16



ATTACHMENT C

STANDARD OPERATING PROCEDURES - FLASHING AND DISPOSAL OF UNBURNABLE MATERIALS

FLASHING AND DISPOSAL OF UNBURNABLE MATERIALS

I. LOCATION

Burning Pits TA-16-386 and 387; Control Shelter TA16-389; and gate, Structure TA-16-349

II. EQUIPMENT

A. Burning ground stands (SK-4377 D-1)

B. Wire screen (SK-4377 D-1, Item D)

C. Kindling wood or scrap lumber

D. Kerosene or Excelsior

E. Chain Link Fencing

III. LIMITS

A. Explosives

HE-contaminated unburnable materials

B. Personnel

1. Four at Burning Pit 387

2. Five at Control Shelter 389

IV. PROCEDURE

A. HE-Contaminated Materials

1. Preparation and Inspection

Materials to be flashed will be inspected for presence of reservoirs of oils, other fluids and excessive deposits of explosives which will be removed. Inspection covers will be removed as appropriate. Suspected materials such as asbestos or other insulating materials will be identified and/or removed in accordance with lab procedures. Any sealed containers should have their valves opened or removed.

*Indicates change

IV. A. (cont.)

2. Receiving and Placing

a. Group WX-3 disposal personnel will deliver explosives-contaminated unburnable materials to the burning ground. Any other personnel involved in the delivery will be supervised by the Disposal Crew Leader. Burning Pit 386 may be used (less than 90 days) to store HE-contaminated unburnable materials until enough have been collected to justify a flashing operation.

b. Kindling wood or scrap lumber will be placed on the bottom grill of the burning ground stands. The total amount of wood to be used will be determined by the type and quantity of materials to be flashed. In all cases, there must be a sufficient quantity of wood to ensure that the flashing will be complete and no significant HE contamination will remain.

c. The Disposal Crew Leader will supervise the unloading of trucks and placing of the materials on the stands. For small items, such as valves, a wire screen will be placed on top of the stands. This will hold the materials above the fire for proper flashing.

d. If it appears that it would be more convenient to place the materials on the sand for flashing, this is permitted. The Disposal Crew Leader must be sure that the placement of the wood will properly heat all the materials to ensure a satisfactory flashing job. If appropriate, chain link fencing may be placed under the material to be flashed. The fencing may be gripped at the corners to remove loose, flashed materials to the assembly pad.

e. The flashing operation will be performed in accordance with WX-3 SOP 12.5.1.

3. Disposal

a. On the first workday after the flashing operation (a minimum of 24 hours must lapse), the Disposal Crew Leader will inspect the flashed materials to determine whether they have been completely flashed. If he is not satisfied with the flashing, he will repeat the appropriate steps of this SOP and WX-3 SOP 12.5.1 to ensure complete flashing.

IV. A. 3. (cont.)

b. Completely flashed materials may be stored (no time limit) at the burning grounds until a suitable quantity for disposal exists.

c. When sufficient quantities of flashed materials have accumulated the site certifying agent will inspect them and certify that they are non-RCRA wastes as defined by 40CFR.261 and that they are suitable for burial (Form No. WX-12-2).

d. A record of all flashing operations will be kept on Form WX-3-70.

B. Uncontaminated Materials

1. "Unburnable, Uncontaminated" materials that are sent to the burning ground through the regular trash collection system (see WX-3 SOP 12.1.2) will be examined by disposal personnel to make sure that no HE contamination is present. If there is any indication that HE contamination is present, the materials will be flashed in accordance with the appropriate sections of this SOP. After it has been determined by disposal personnel that no HE contamination is present, the materials may be held with flashed materials without being flashed. A record of all materials that are disposed of without being flashed will be kept on Form WX-3-70.

2. Open fire flashing is very effective in eliminating HE contamination of non-burnable waste. However, Laboratory policy dictates that these wastes remain under institutional control. Therefore, these materials will be disposed of by ESE-7 in a controlled burial site only.

FLASHING AND DISPOSAL OF UNBURNABLE MATERIALS

Page 1, Revision 7
Page 2, Revision 7
Page 3, Revision 6
Page 4, Revision 7

APPROVED *M. J. Barr* DATE *10-27-87*
M. J. Barr, Unit Supervisor

APPROVED *R. A. Hildner* DATE *10-28-87*
R. A. Hildner, Section Leader, WX-3

APPROVED *J. E. Parkinson* DATE *10/28/87*
J. E. Parkinson, Group Leader, WX-3

APPROVED *W. A. Bradley* DATE *11/2/87*
W. A. Bradley, Asst. Division Leader, WX

APPROVED *Not Required* DATE
A. M. Valentine, Group Leader, HSE-1

APPROVED *Jack L. Bac... for W. C. C.* DATE *1/7/88*
H. C. Courtright, Group Leader, HSE-3
14/3

ATTACHMENT D

STANDARD OPERATING PROCEDURES - IGNITION, BURNING AND FLASHING OF EXPLOSIVES AND EXPLOSIVE-CONTAMINATED MATERIAL

IGNITION, BURNING AND FLASHING OF EXPLOSIVES AND EXPLOSIVE-CONTAMINATED MATERIAL

I. SCOPE

The procedures outlined in this SOP will be followed in igniting and burning or flashing all materials at the burning ground.

II. LOCATION

Burning Pits TA-16-387, 388, and 399; Filter Beds TA-16-392 and 394; Pressure Filters TA-16-401 and 406; Control Shelter TA-16-389; and Gate, Structure TA-16-349.

III. LIMITS

A. Personnel

Two

B. Explosives

See Group WX-3 SOP for particular disposal operation

IV. ALLOWABLE EXPLOSIVES

Explosives approved for disposal by WX-3 are those listed in Tables 1 and 2 of WX-3 SOP 1.1.0.

V. EQUIPMENT

A. Burning ground firing circuit (ENG-C-23444)

B. Periscope (13Y-101920)

* C. Blasting machine (10-cap capacity) Fidelity Electric Company (S/N 10-625A).

D. Squibs (S-94) WX-3 Code Number 225-03, or similar DuPont S-series squibs.

E. Blaster's Multimeter, Model 101.

*Indicates Change

VI. MATERIALS

A. Excelsior

B. Kerosene

VII. AREA CLEARANCE

When the Disposal Crew Leader in charge of operations has determined that a burning area has been satisfactorily loaded and is ready to be burned, a check of the burning ground will be made. Personnel who are to remain during the burning operation will assemble in the control shelter. All others will leave the area. An operator will check to make sure that the gate on the access road (Structure 349) is closed. If it is open, he will notify the Disposal Crew Leader and another check of the area will be made before the burning operation continues. If it is closed, the operator will return to the control shelter.

VIII. PROCEDURE

A. A permanent selective firing circuit is installed at the burning ground. The master controls are located inside Control Shelter 389. Proper setting of the controls directs an electrical pulse that will fire the ignition squibs at any one of the burning areas. The permanent firing circuit will always be used for igniting the squibs at the burning ground except in cases of power outage or circuit failure. In that event, it will be permissible to use the blasting machine to ignite the squibs.

B. All motor vehicles at the burning ground will be parked at Control Shelter 389 with their radios turned off.

C. The Disposal Crew Leader will check the radio located in the control shelter to make sure that it is turned off.

D. Ignition and Burning

1. The Disposal Crew Leader will determine that the firing controls are locked in the OFF position. He will keep the key to the lock in his possession during the remainder of the burning operation.

2. Squibs, excelsior, and kerosene will then be collected at Control Shelter 389.

3. The Disposal Crew Leader or his delegate will proceed on foot to the material to be burned with the materials listed in Item D.2, above.

4. The Disposal Crew Leader will check the circuit breaker in the terminal box at the burning area to make sure it is in the GROUND position and that the alligator clips are disconnected from the two lead wire reels.

5. An ignition train will be prepared by building a 1 to 2 foot long strip of excelsior up to the material to be burned. The excelsior will be dampened with kerosene.

VIII. D. (cont.)

* 6. The Disposal Crew Leader will assure himself of the integrity of existing wire and if necessary, remove enough wire from the two reels located in the terminal box to reach the ignition train. He will return to the terminal box and connect the end of each lead wire to one of the two alligator clips in the box. The circuit is then ready for two squibs to be spliced in parallel to the end of the wires. The spliced wires must be kept separated. If there is danger of the splices touching the explosive or some conductor, it must be insulated with electrician's tape.

* 7. The squibs will be placed approximately one inch from the excelsior so that the squibs, when fired, will light the ignition train. Do not place squibs within the excelsior as there is a possibility of snuffing the squib before ignition.

8. The circuit breaker in the terminal box at the burning area will be thrown to the fire position.

9. A continuity check will be made on the squib circuit from the terminal box outside the fence of the burning pit by using the approved multimeter.

* 10. The Disposal Crew Leader will proceed to the control shelter.

11. The Disposal Crew Leader will follow the following sequence in firing the squibs:

   a. Unlock the firing controls and rotate the selector switch to the number that corresponds to the identifying number of the area being burned.

   b. Turn the circuit breaker switch behind the fire button to the ON position.

   c. Press the fire button to energize the circuit.

* d. An observer should confirm squib firing and ignition by using the periscope located in the control shelter.

* 12. Squib failures will be handled as follows:

   a. If no evidence of squib ignition was observed the Disposal Crew Leader will repeat the firing procedure.

   b. If ignition is not obtained on a second attempt the firing circuit should be saved and the burn pad observed for a minimum of five minutes.

   c. When the Disposal Crew Leader considers the pad area safe, he or his designate may proceed to the pad to review hook-up wire integrity. The Crew Leader may be accompanied by no more than one man when investigating a failure.

VIII. D. 12. (cont.)

d. Should the cause of squib failure not be determined, the pad should be cleared and the HE and/or inert may be placed in a magazine or burned on the second pad. The responsible engineer should be notified.

* 13. Ignition train failures will be handled as follows:

* a. If there is evidence of squib initiation (flash upon squib initiation) but the excelsior train or HE does not appear to burn, the pad should be viewed from the control building for a minimum of 30 minutes past the last visual indication of smoke.

* b. The firing circuit should be saved and the Disposal Crew Leader and/or responsible engineer may then approach the burn pad. Ignition problems have occurred from.

* (1) Squib placement was too close (less than 1") or too far (greater than about 6-8") from the excelsior.

* (2) Inadequate wetting (from kerosene) of the excelsior.

* (3) HE or inert material did not sustain burning.

* (4) Squib position changed between setup and ignition (wind or movement of refractory brick.

* c. A new ignition train should be fabricated using new squibs and additional excelsior and kerosene as necessary.

14. When it has been determined that the ignition train has ignited, the Disposal Crew Leader will:

a. Rotate the selector switch to the OFF position,

b. Lock the firing controls, and

c. Turn the circuit breaker switch behind the fire button to the OFF position.

15. The vehicle radios and the radio located in the control shelter may then be turned on.

* 16. When the materials that are being burned have been reduced to a smoldering condition, the crew may leave the burning ground. A minimum of 24 hours must lapse after burning before ashes and other debris can be collected. Ashes will be disposed of in accordance with SOP 12.1.0., paragraph VI.R.1 and 2.

VIII. D. (cont.)

17. The key for the firing control circuit will be placed in the squib storage box in the storage room at the control shelter. The key will always be kept in this box when not in the possession of the Disposal Crew Leader.

18. A record of each burn will be noted on Form WX-3-70.

E. Use of Blasting Machine

1. Preparation

a. In the event that the burning ground selective firing circuit is inoperative and the explosive material is of such a nature that its destruction is urgent, the blasting machine may be used to ignite the squibs.

b. No part of the selective firing circuit will be used in conjunction with the blasting machine.

c. A temporary firing wire will be laid along the ground from the control shelter to the area to be burned. The Disposal Crew Leader will positively connect the bared ends of the firing wire at the control shelter and the burning area to get rid of any static electricity that may have accumulated in the wire.

d. The Disposal Crew Leader must have the blasting machine in his possession at all times during the rest of the burning operations, as described in the following paragraphs.

2. Ignition and Burning

a. The blasting machine, squibs, excelsior, and kerosene will be collected at Control Shelter 389.

b. The Disposal Crew Leader or his delegate will proceed on foot to the material to be burned with the materials listed in Item E.2.a, above.

c. An ignition train will then be prepered by putting a wad of excelsior about 1 to 2 feet long on the material to be burned. The excelsior will be dampened with kerosene. The ignition train must be arranged so that both it and the explosives burn toward the direction from which the wind is blowing.

d. The Disposal Crew Leader will then connect two squibs to the temporary firing line and will make sure that the squibs are wired in series. The spliced wires must be kept separated. If there is danger of the splices touching the explosive or some conductor, it must be insulated with electrician's tape.

VIII. E. 2. (cont.)

e. The squibs will then be placed in the excelsior so that the squibs, when fired, will light the ignition train.

* f. The Disposal Crew Leader will then proceed to the control shelter.

g. The Disposal Crew Leader will fasten the lead wires to the blasting machine and energize the circuit.

h. The Disposal Crew Leader, or his alternate, will then check to see whether the ignition train is ignited by using the periscope in the control shelter.

i. If the materials fail to burn, the Disposal Crew Leader shall proceed as follows:

(1) Disconnect the blasting machine and positively connect the bared ends of the wire to get rid of any residual electrical charge in the circuit.

(2) Repeat firing procedure.

(3) Wait 30 minutes and then, after surveying the area with the periscope, proceed to the area and inspect the squibs and other parts of the firing system.

(4) When necessary, the used squibs may be replaced by new ones, and the appropriate parts of Item VIII.E.2.a through g, above, may be repeated.

(5) Faulty squibs will be collected for subsequent disposal by flashing with other HE-contaminated unburnable material, in accordance with WX-3 SOP 12.3.6.

(6) Each time that a failure occurs, the Disposal Crew Leader will disconnect the bared ends of the wire to get rid of any residual electrical charge in the circuit. Wait 30 minutes before proceeding to inspect the squibs and other parts of the firing circuit

* j. When the materials that are being burned have been reduced to a smoldering condition, the crew may leave the burning ground. A minimum of 24 hours must lapse after burning before the ashes and other debris can be collected. Ashes will be disposed of in accordance with SOP 12.1.0, paragraph VI.R.1 and 2.

k. The vehicle radios and the radio in the control shelter may then be turned on.

VIII. E. 2. (cont.)

l. The blasting machine will be placed in the squib storage box in the storage room at the control shelter. The blasting machine will always be kept in this box when not in the possession of the Disposal Crew Leader.

m. A record of each burn will be noted on Form WX-3-70.

IGNITION, BURNING, AND FLASHING OF
EXPLOSIVES AND EXPLOSIVE-CONTAMINATED MATERIAL

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Page 2, Revision 7	Page 6, Revision 7
Page 3, Revision 8	Page 7, Revision 8
Page 4, Revision 8	Page 8, Revision 2

APPROVED *M. J. Barr* DATE *10-28-87*
M. J. Barr, Unit Supervisor

APPROVED *M J Barr for R.L.H.* DATE *10-29-87*
R. J. Hildner, Section Leader, WX-3

APPROVED *[signature]* DATE *10/29/87*
J. W. Parkinson, Group Leader, WX-3

APPROVED *W. A. Bradley* DATE *11/2/87*
W. A. Bradley, Asst. Division Leader, WX

APPROVED *[signature]* DATE
A. M. Valentine, Group Leader, HSE-1

APPROVED *[signature]* DATE *11/25/87*
W. C. Courtright, Group Leader, HSE-3
[initials]

ATTACHMENT E

TECHNICAL APPROACH TO ESTIMATING EMISSIONS FROM HE CONTAMINATED SOLVENT AND OIL BURNING AT TA-16 SOLVENT BURN TRAYS AND THE AIR QUALITY IMPACTS OF THESE EMISSIONS

Flashing Pad

Air emissions from flash burning of HE contaminated materials result primarily from the combustion of the wood used to bring the unburnable material up to a temperature high enough to react or combust any HE present. The burns consist of approximately 800 to 1600 pounds of HE contaminated scrap lumber, uncontaminated scrap lumber, or wood pallets, approximately one-half gallon of kerosene and excelsior, 20-50 pounds of HE contaminated rags, paper, cardboard, plastics, packing material, and combustible firing site debris. Each burn is estimated to take 2 hours. Emissions from the flashing operation are estimated using emission factors developed by the Environmental Protection Agency (EPA) and published in AP-42, 1995, which includes; the combustion of wood in residential fireplaces with no emission control devices installed, the burning of municipal waste to account for any plastics or paper present, and the burning of distillate oil to account for the kerosene used as a starter aid. (Table 1).

TABLE 1, EMISSION ESTIMATES FOR FLASHING OPERATIONS

EMISSION SOURCE	CHEMICAL EMITTED	AVERAGE YEARLY EMISSIONS (lb/yr)	HOURLY EMISSIONS (lb/hr)
HE Contaminated Equipment Building Material Flashing			
1600 lb wood	CO	7275	101
	NOx	75	1
	SOx	12	0.2
	PM	374	5
0.5 gal kerosene	CO	0.1	0.001
	NOx	0.4	0.005
	PM	0.04	0.001
50 lb rags, paper, etc.	CO	77	1
	NOx	5	0.1
	SOx	1	0.01
	PM	14	0.2
TOTALS	CO	7351	102
	NOx	81	1
	SOx	12	0.2
	PM	389	5

Liquid Burn Tray

In addition to flash burning operations, high explosives (HE) contaminated dilute solvents and lubricant oils are burned in a liquid burn tray at the TA-16 burn grounds. Approximately 2500 gallons per year of HE contaminated dilute solvents and lubricant oil are generated during HE processing operations at LANL. These solvents and oils are open burned in specialized solvent trays. Forty-five burns per year, each consisting of up to 55 gallons make up the burn tray operations. The average make-up of the dilute solvent solution is 30% methanol, 25% water, 20% acetonitrile, 20% tetrahydrofuran, 5% of any the solvents in Table 2, and trace amounts of HE. Because of the high combustion temperatures required to sustain burning of these liquids, a wood fire is built under the 3 foot tall tray and continually stoked until the HE contaminated liquids have been combusted. These burns take approximately 4 hours each and require approximately 500 pounds of wood as kindling. The burning of pump oil contaminated with HE makes-up approximately 10% of the burns. Table 2 also gives the chemical properties and assumptions required for the emission calculations. Combustion emissions except for NOx were estimated from a study performed by A. Tewarson entitled Prediction of Fire Properties of Fuels, Factory Mutual Research Corporation, 1985 (Enclosure F). NOx emissions were estimated from emission factors provided in EPA's AP-42, Section 1.3 (Fuel Oil Combustion). Emissions from solvent burning and oil burning are shown in Table 3. Emissions from wood burning were again estimated from the combustion of wood in residential fireplaces with no emission control devices installed found in AP-42.

TABLE 2, CHEMICAL PROPERTIES OF SOLVENTS AND PUMP OIL

SOLVENT TYPE	MOLECULAR WEIGHT (g/mole)	DENSITY (g/ml)	NUMBER OF CARBONS	ASSUMPTIONS USED FOR CALCULATIONS
pump oil*	72	0.9050	5	**
methanol	32	0.7914	1	experimental data available
acetonitrile	41	0.7868	2	C_2 linear alkanes
tetrahydrofuran	72	0.8888	4	C_3-C_6 linear ketones
methyl ethyl ketone	72	0.8054	4	C_3-C_6 linear ketones
butyl acetate	116	0.8825	6	C_5-C_{10} acetate
ethyl acetate	88	0.9003	4	C_4 acetate
toluene	92	0.8669	7	experimental data available
ethanol	46	0.7893	2	experimental data available
acetone	58	0.7899	3	experimental data available
cyclohexane	84	0.7785	6	C_5 -C_{10} cyclo alkane

* Approximated as n-Pentane (C_5H_{12}).

** Used average of values given for linear, branched, and cyclic alkanes (paraffins).

TABLE 3, EMISSION ESTIMATES FROM HE CONTAMINATED SOLVENT AND LUBRICANT OIL BURNING

EMISSION SOURCE	CHEMICAL EMITTED	YEARLY EMISSIONS (lb/yr)	HOURLY EMISSIONS[a] (lb/hr)
HE Contaminated Solvent Burning			
55 Gallons of Dilute Solvent	CO	17	0.1
Approximately 41 burns annually	NOx	1478	9
Each burn lasts 4 hours	SOx	0	0
	PM[c]	243	2
HE Contaminated Lubricant Oil Burning			
55 Gallons of Lubricant Oil	CO	7	0.4
Approximately 4 burns annually	NOx	0	0
Each burn lasts 4 hours	SOx	0	0
	PM[c]	73	4
Additional Materials Used to Achieve Proper Combustion			
500 lb of Wood	CO	2842	16
	NOx	29	0.2
	SOx	5	0.03
	PM	146	1
0.25 Gallons of Kerosene	CO	0.06	0.0003
	NOx	0.2	0.001
	SOx	0	0
	PM	0.02	0.0001
TOTALS			
Solvent Burning	CO	2574	16
	NOx	1505	9
	SOx	4.1	0.003
	PM	375	2
Oil Burning	CO	291	16
	NOx	3	0.2
	SOx	0.5	0.03
	PM	88	5

[a] All numbers have been rounded to achieve the least number of significant digits.
[b] Lubricant oil burning accounts for approximately 10% of the burn tray operations.
[c] Tewarson estimates soot; for this discussion it is noted as PM.

Air Quality Impacts

Air quality regulations require that emissions from the burning operation must not impact ambient air quality standards set forth by federal statutes and adopted by the State of New Mexico. Operations of this type must meet ambient air standards for the criteria pollutants carbon monoxide (CO), oxides of nitrogen (NOx), sulfur dioxide (SO_2), and particulate matter (PM).

Air quality impacts of the combustion products CO, NOx, SO_2, and PM were assessed at the maximum impact point determined by the flash burning operations and at the nearest off-site receptor (State Road 4 bordering Bandelier National Monument) 1828 meters to the south for ambient air. Compliance with the standard was evaluated using the SCREEN 3 air emissions dispersion model. The SCREEN 3 model has been approved by the EPA as a screening procedure for estimating air quality impacts of stationary sources. SCREEN 3 is a conservative model which uses worst case meteorological data to determine emission impacts. The SCREEN 3 model assumes that emissions are from a continuous source or operation. Because open burning operations at TA-16 are intermittent with varying burn times, source terms supplied to the SCREEN 3 model were determined as follows:

- 1-hr impacts were estimated using the total emissions from a burn divided by the number of hours the burn lasted.
- 8 and 24-hr impacts were estimated by taking the 1-hr impact and multiplying it by constants developed by EPA (i.e. 0.7 and 0.4 respectively).

Results of this exercise as well as the parameters used are shown in Table 4. In addition, the heat released for the solvent oil burn was estimated to be 87030 cal/sec. The heat release for the flash burn was estimated to be 335948 cal/sec.

TABLE 4, AIR QUALITY IMPACTS FROM BURNING OPERATIONS

CHEMICAL POLLUTANT	MODELING PARAMETERS	AMBIENT AIR QUALITY STANDARD		MAXIMUM 498 m	IMPACT 1828 m
CO	D Stability	8-hour average[1] 1-hour average[1]	8.7 ppm 13.1 ppm	0.4 ppm 0.2 ppm	0.1 ppm 0.6 ppm
NOx	2.5 m/sec wind speed	24-hour average[1] Annual arithmetic average[2]	0.1 ppm 0.05 ppm	2E-03 ppm 0.002 ppm	6E-04 ppm 0.0003 ppm
SOx	Heat Release *Flash Burn*: 262176 cal/sec	24-hour average[1] Annual arithmetic average[2]	0.1 ppm 0.02 ppm	2E-04 ppm 7E-06 ppm	6E-05 ppm 2E-06 ppm
PM	*Solvent/Oil Burn*: 97674 cal/sec	24-hour average[1] 7-day average[3] 30-day average[4] Annual geometric mean[2]	150 $\mu g/m^3$ 110 $\mu g/m^3$ 90 $\mu g/m^3$ 60 $\mu g/m^3$	15 $\mu g/m^3$ N/E N/E 1 $\mu g/m^3$	5 $\mu g/m^3$ N/E N/E 0.2 $\mu g/m^3$

[1] 8-hour and 24-hour evaluations took the maximum 1-hour impacts from flash burning and multiplied by the factors of 0.7 and 0.4 respectively supplied by EPA for averaging time adjustments.

[2] Annual arithmetic average and the annual geometric mean were derived by summing emissions from all burning operations and dividing by 8760 hours.

[3] The 7-day average and 30-day average were not evaluated.

N/E - No Evaluation Performed.

ATTACHMENT F

REFERENCE PAPER BY A. TEWARSON, "PREDICTION OF FIRE PROPERTIES OF FUELS'

Tamura, G. T.
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Available from National Technical Information Services
PB87-140240

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PB86-110004
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Available from National Technical Information Services

PREDICTION OF FIRE PROPERTIES OF FUELS

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Subject Categories

(3) Combustion and Practical Systems

(9) Fire

(18) Modeling and Scaling

For presentation at the Twenty-First International Symposium on Combustion, Technical University of Munich, West Germany, August 3-8, 1986

Factory Mutual Research

1. INTRODUCTION

Fire properties are defined as the parameters which characterize the combustion and pyrolysis behavior of fuels in fires[1]. In conjunction with fire models, fire properties are used to assess hazards presented by various types of fires and protection needs. A fundamental understanding of diffusion flames has always been found to be very useful in the prediction of fires. In this paper, an attempt has thus been made to use the understanding of the soot formation in diffusion flames to develop relationships for the prediction of fire properties.

The soot formation in diffusion flames has been of great interest because of the relationship with flame radiation and heat transfer, combustion efficiency, and emission of particulates and other chemical compounds some of which may be toxic and corrosive in nature.

In this study, we have used the concept of the smoke point height, L_s, which has been used by many investigators to describe the sooting tendency of fuels. L_s is defined as the height of an overventilated diffusion flame at which soot just begins to be released at the flame tip. The smaller the value of L_s, the greater the tendency to soot. Extensive data for L_s are available in the literature for liquid and gaseous fuels[2-8]. Many investigators find that L_s depends on the nature of chemical bonds and flame turbulence. It has been shown that L_s is related to flame temperature (flame convection)[6] and to flame radiation[9].

In order to use the literature data for L_s to develop predictions for fire properties, it was necessary to perform experiments in our flammability apparatus. In the experiments, simultaneous measurements were made for L_s and fire properties of fuels of known chemical structures and L_s values. In addition to gaseous and liquid fuels, solid fuels were used in the experiments.

The radiative component of the combustion efficiency, χ_R, is defined as

$$\chi_R = \chi_A - \chi_C \,. \tag{7}$$

3. EXPERIMENTS

Experiments were performed in our apparatus, shown in Fig. 1[10]. For gaseous samples, a burner tube very similar to one in Ref. 9 was used. For liquid and solid samples, a 250 ml Pyrex Erlenmeyer flask with a 14/35 ground glass joint was used. The ground glass joint was attached to a 0.12-m long Pyrex glass tube with an internal diameter of 0.009 m to reduce the effects of temperature on L_s values. External heat flux was used for solid and low vapor pressure liquids; for high vapor pressure liquids, a heating mantle placed around the flask was used. The rate of generation of the fuel vapors and flame height were varied by varying either the external heat flux or the heating rate of the mantle.

L_s value was measured visually and for the measurement of fire properties, all the combustion products were captured along with air in the sampling duct of our apparatus. In the duct, measurements were made for the gas temperature, mass fractions of CO_2, CO, total gaseous hydrocarbons (CH), soot (S), and O_2, and $\dot{m}_T$. Measurements were also made for optical transmission through soot, but data have not been discussed in this paper. The generation rate of fuel vapors was measured by a load cell assembly.

In the experiments, data were recorded by a computer at a time interval of about one second. Data were averaged by the computer at the steady state, lasting for about 10 minutes. Each experiment was performed at least twice and the data were averaged. The accuracy of all the averaged experimental data is about ±2%.

All the experiments were performed under natural air flow conditions and thus represent overventilated fire conditions.

The relationship between f_{CO_2} and L_s is same as between χ_A and L_s as expected from Eq. (5) for overventilated fires.

Predictions of Fire Properties of Fuels

If it is assumed that the relationships given in Eqs. (8) to (13) are of general applicability, then it is possible to use the L_s values from the literature to predict χ_i and f_j values for many fuels. The literature values for L_s, however, cannot be used directly because of variations due to differences in the experimental conditions used by various investigators.[11] The following approach was thus taken in this study: 1) relationships between L_s values measured by us and reported in the literature, for selected fuels, were established separately for each investigator; 2) these relationships were then used to recalculate all other L values separately for each investigator; and 3) for fuels which were used by several investigators, the recalculated values of L_s were averaged. The recalculated values of L_s were then used in Eqs. (8) to (13) to predict the χ_i and f_j values. The predicted values of χ_i and f_j are listed in Table II. The detailed tabulation of the data is given in Ref. 12. Values of f_{others} in the table are calculated from the atom balance, i.e., $f_{others} = 1 - \Sigma f_j$.

5. DISCUSSION

Comparison Between the Predicted and Measured Values of Fire Properties

Table III lists the experimental and predicated data for some selected fire properties (f_{CO_2} or χ_A and f_S). A reasonable agreement can be noted between the predicted and measured values. Also our predictions for f_S and those of Pagni's[15], based on entirely different principles, are very similar, except for octane and polystyrene. The new measurements suggest that our older f_S value of 0.18 for polystyrene[17], referred in Ref. 15, appears to be somewhat higher.

and soot, in that order. Butadiene, which is at the top within the aliphatic fuels group, is expected to follow the above aromatic group of compounds.

Relationship Between the Generation Efficiencies of CO and CO_2

In combustion systems, the ratio of CO to CO_2 is used as an indicator of the burning efficiency of fuels. For fuels burning under overventilated conditions, the ratio will vary with the chemical structure of the fuels. For fuels with fixed chemical structure, the ratio will vary with ventilation.

For fuels with variable chemical structure, burning under overventilated conditions, the relationship between f_{CO} and f_{CO_2} can be predicted from Eqs. (10) and (11). The predicted relationship is shown by the solid line in Fig. 3. Experimental data obtained under variable ventilation conditions for wood cribs, heptane, and PMMA from Ref. (18) to (20) have also been included in Fig. 3. Data for enclosure fires of wood cribs with variable ventilation were averaged for similar f_{CO_2} values, and were restricted to the flaming fires only. Data in Fig. 3 indicate that as f_{CO_2} decreases, f_{CO} approaches an asymptotic limit, which is about 0.12 for wood, which is a char forming fuel, and about 0.08 for heptane and PMMA, which are non-char forming fuels.

The results in Fig. 3 indicate that, up to the asymptotic limit of f_{CO}, the relationship between f_{CO} and f_{CO_2} is expected to be the same for the combustion of fuels with: 1) fixed chemical structure and variable ventilation; and 2) variable chemical structure with overventilation. It may be possible to define the asymptotic limit for f_{CO} for underventilated fires of fuels based on their chemical structure.

Relationship Between the Generation Efficiencies of CO and Soot

Emissions of CO and soot from combustion systems are associated with reduced ventilation and/or involvement of fuels which burn inefficiently because of their chemical structures.

From Eqs. (3), (4), and (14),

$$\dot{E}_j'' = (f_j\ k_j / [\int_0^{T_v} c_p\ dT + H_v])\ (\dot{q}_{fs}'' - \dot{q}_{rr}'')\ , \tag{16}$$

where $\dot{E}_j''$ is the emission rate of a compound j per unit fuel surface area (kg/m^2s). In Eqs. (14), (15), and (16), $\int_0^{T_v} c_p\ dT + H_v$ is defined as heat of gasification of the fuel, L_g (kJ/kg). H_T values are known from the literature and k_j values can be calculated from the elemental composition of the fuel.

L_g values can also be calculated from the literature values for c_p, T_v, and H_v[21], or can be measured. Within a generic group of fuels, L_g increases with the molecular weight of the fuel, primarily due to increase in T_v, and can be estimated for fuels of higher molecular weight. The measured value of L_g for PE is 1750 kJ/kg[17], and from the relationship between L_g and the molecular weight of alkenes, it can be estimated that the molecular weight of the oligomer produced by the vaporization of PE is about 0.601 kg/mole, which is reasonably close to a value of 0.692 kg/mole reported for the molecular weight of the PE oligomer in pyrolysis[22]. In a similar fashion, the molecular weight of PP oligomer is estimated to be 0.720 kg/mole.

From the values of L_g, H_T, k_j, and the data from Table II, emission rates can be calculated for the fuel vapors and the combustion products for defined values of $\dot{q}_{fs}'' - \dot{q}_{rr}''$, for example, at the asymptotic limit of $\dot{q}_{fs}'' - \dot{q}_{rr}''$, which is approximately constant for fuels with variable molecular weight within a generic group of fuels. Within the aliphatic fuels group, the asymptotic limit for $\dot{q}_{fs}'' - \dot{q}_{rr}''$ is equal to 41 kW/m^2, with a variation of ± 15% (as derived from the data for polyoxymethylene, PMMA, heptane, polyethylene, and polypropylene[1,10,16,17]). The emission rates for heat, CO, and soot calculated in this fashion for alkanes and alkenes, as examples, are shown in Figs. 5 and 6, respectively. Experimental data for PE and PP are also included in Fig. 6. The emission rates decrease with increase in the molecular weight of the fuel,

NOMENCLATURE

C_p	specific heat (kJ/kg K)
$\dot{E}''$	emission rate per unit fuel surface area (kg/m^{2}s)
f_j	generation efficiency of compounds j or oxygen depletion efficiency (-
$\dot{G}_f$	generation rate of fuel vapors (kg/s)
H_{CO}	heat of combustion of CO (kJ/kg)
H_T	net heat of complete combustion (kJ/kg)
H_v	heat of vaporization (kJ/kg)
k_j	maximum possible total (theoretical) yield of compound j or stoichiomet mass oxygen to fuel ratio (kg/kg)
L_g	heat of gasification of the fuel (kJ/kg)
L_s	smoke point height (m)
$\dot{m}_T$	total mass flow rate of combustion product-air mixture (kg/s)
$\dot{Q}_A$	actual heat release rate (kW)
$\dot{Q}_T$	total (theoretical) heat release rate (kW)
$\dot{q}''_{fs}$	flame heat to the surface of the fuel (kW/m^2)
$\dot{q}''_{rr}$	surface heat loss due to reradiation (kW/m^2)
ΔT	gas temperature above ambient (K)
T_v	vaporization temperature (K)
X_j	mass fraction of compound j (kg/kg)
Y_j	yield of compound j (kg/kg)
χ_A	combustion efficiency (-)
χ_C	convective component of combustion efficiency
χ_R	radiative component of combustion efficiency

Subscripts

f	fuel vapors
i	heat
j	chemical compound

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TABLE I

Experimental Data for Smoke Point Height and

Selected Fire Properties of Fuels

Fuel	L (m)	χ_A	χ_C	χ_R	f_{CO_2}	f_{CO}	f_{CH}	f_S
Methanol	N	0.97	0.83	0.14	0.97	0.001	0.001	N
Ethanol	0.225	0.97	0.74	0.23	0.97	0.001	0.001	0.021
Acetone	0.205	0.96	0.73	0.23	0.96	0.001	0.001	0.022
Pentane	0.155	0.94	0.65	0.29	0.94	0.002	0.001	N
Isopropanol	0.148	0.94	0.65	0.29	0.94	0.002	0.001	N
Hexane	0.125	0.93	0.63	0.30	0.93	0.004	0.002	N
Nylon	0.120	0.90	0.58	0.32	0.90	0.004	0.002	0.030
Ethylene	0.106	0.91	0.61	0.30	0.91	0.003	0.002	0.032
Heptane	0.110	0.93	0.61	0.32	0.93	0.004	0.003	0.032
PMMA	0.105	0.95	0.63	0.32	0.95	0.006	0.001	0.027
Cyclohexane	0.085	0.91	0.56	0.35	0.91	0.005	0.001	N
Isooctane	0.080	0.91	0.60	0.31	0.91	0.007	0.003	N
Polypropylene	0.050	0.89	0.52	0.37	0.89	0.015	0.003	0.050
Polyethylene	0.045	0.87	0.50	0.37	0.86	0.013	0.002	0.060
Propylene	0.029	0.81	0.41	0.40	0.81	0.011	0.006	0.064
Polystyrene	0.015	0.66	0.26	0.40	0.65	0.027	0.023	0.101
Toluene	0.005	0.68	0.28	0.40	0.68	0.030	0.023	0.190

N not measured

TABLE II

(continued)

Fuel	C atoms	X_A	X_C	X_R	f_{CO_2}	f_{CO} x100	f_{CH} x100	f_S x10	f_{others} x10
Butyrate	5 to 6	0.97	0.72	0.25	0.97	0.20	0.11	0.24	0.04
	7 to 8	0.93	0.63	0.30	0.93	0.31	0.15	0.30	0.35
Laurate, oxalate, malonate, lactate	4 to 14	0.97	0.71	0.26	0.97	0.22	0.11	0.24	0.03
<u>C-H-N Structure</u> Amines	4 to 12	0.90	0.57	0.33	0.90	0.43	0.21	0.36	0.58
<u>C-H-S Structure</u> Mercaptans and Sulfides	6 to 12	0.90	0.57	0.33	0.90	0.43	0.21	0.36	0.58
				<u>Aromatic Fuels</u>					
<u>C-H Structure</u> Arenes	6 to 21	0.71	0.30	0.41	0.70	3.80	1.58	1.32	1.14
Cyclic Arenes	10 to 12	0.76	0.36	0.40	0.75	1.96	0.85	0.89	1.32
PAH (polycyclic aromatic HC's → 3 or more rings)	9 to 12	0.68	0.27	0.41	0.68	5.20	2.13	1.59	0.88
<u>C-H-O Structure</u> Alcohols	7 to 8	0.71	0.30	0.41	0.71	3.49	1.46	1.25	1.16
Ketones	11	0.76	0.36	0.40	0.76	2.01	0.87	0.90	1.20
Aldehydes	7	0.75	0.35	0.40	0.75	2.26	0.97	0.97	1.21
Esters	9	0.76	0.36	0.40	0.76	1.96	0.85	0.89	1.22
<u>C-H-N Structure</u> Amines and Heterocylics	6 to 11	0.73	0.32	0.41	0.73	3.00	1.26	1.14	1.13
<u>C-H-S Structure</u> Mercaptans and Sulfides	6 to 8	0.67	0.26	0.41	0.67	6.18	2.50	1.76	0.67

N: not predicted

FIGURE CAPTIONS

Fig. 1 Flammability apparatus

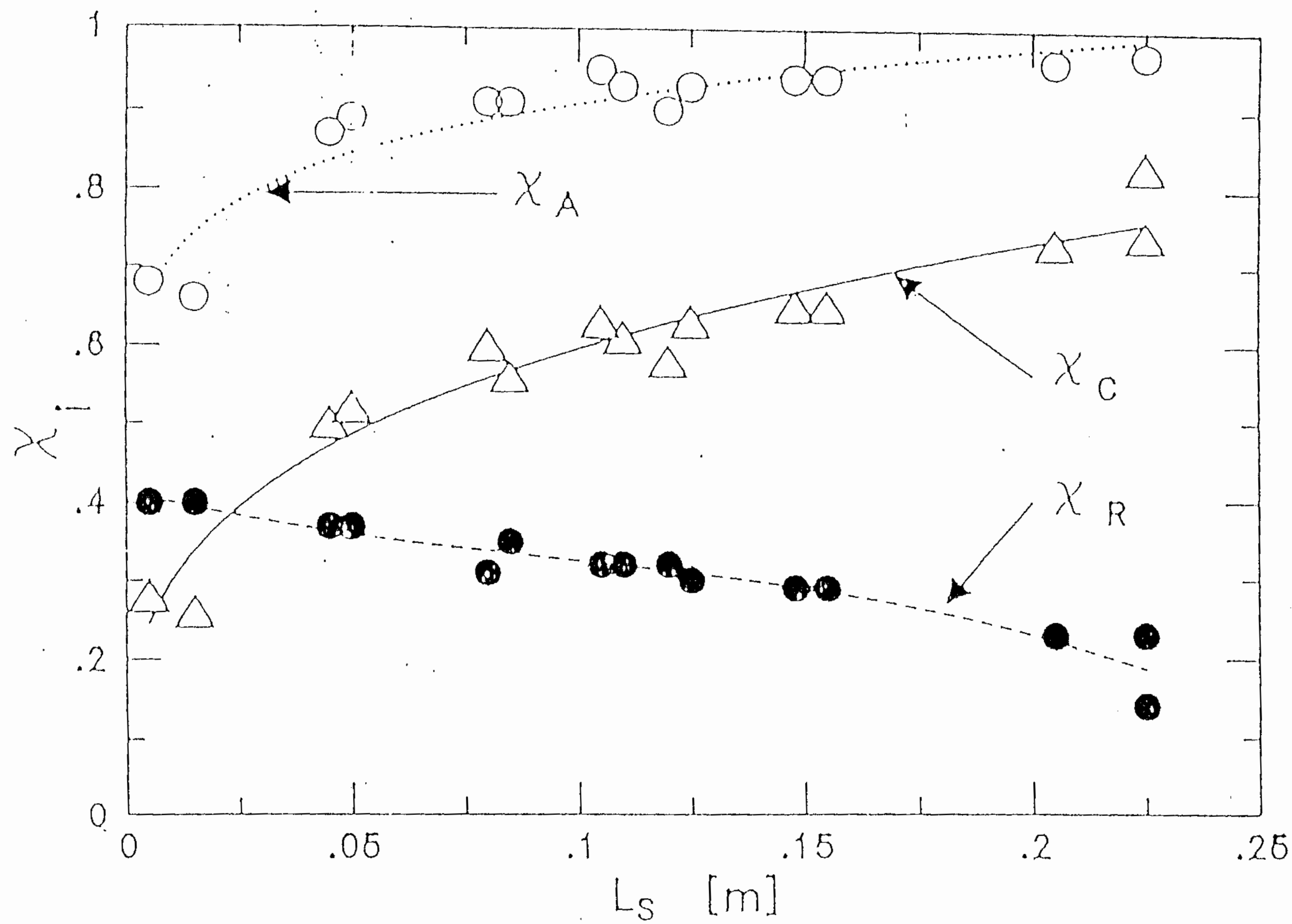
Fig. 2 Combustion efficiency and its convective and radiative components as functions of smoke point height

Fig. 3 Relationship between the generation efficiencies of CO and CO_2. Solid line represents our predictions for fuels with variable chemical structures. Experimental data points connected by dashed lines are for variable ventilation conditions: O, enclosure fires of wood cribs, Ref. 18; ●, Heptane, Ref. 19; ■, wood cribs, Ref. 18; *, PMMA, Ref. 20.

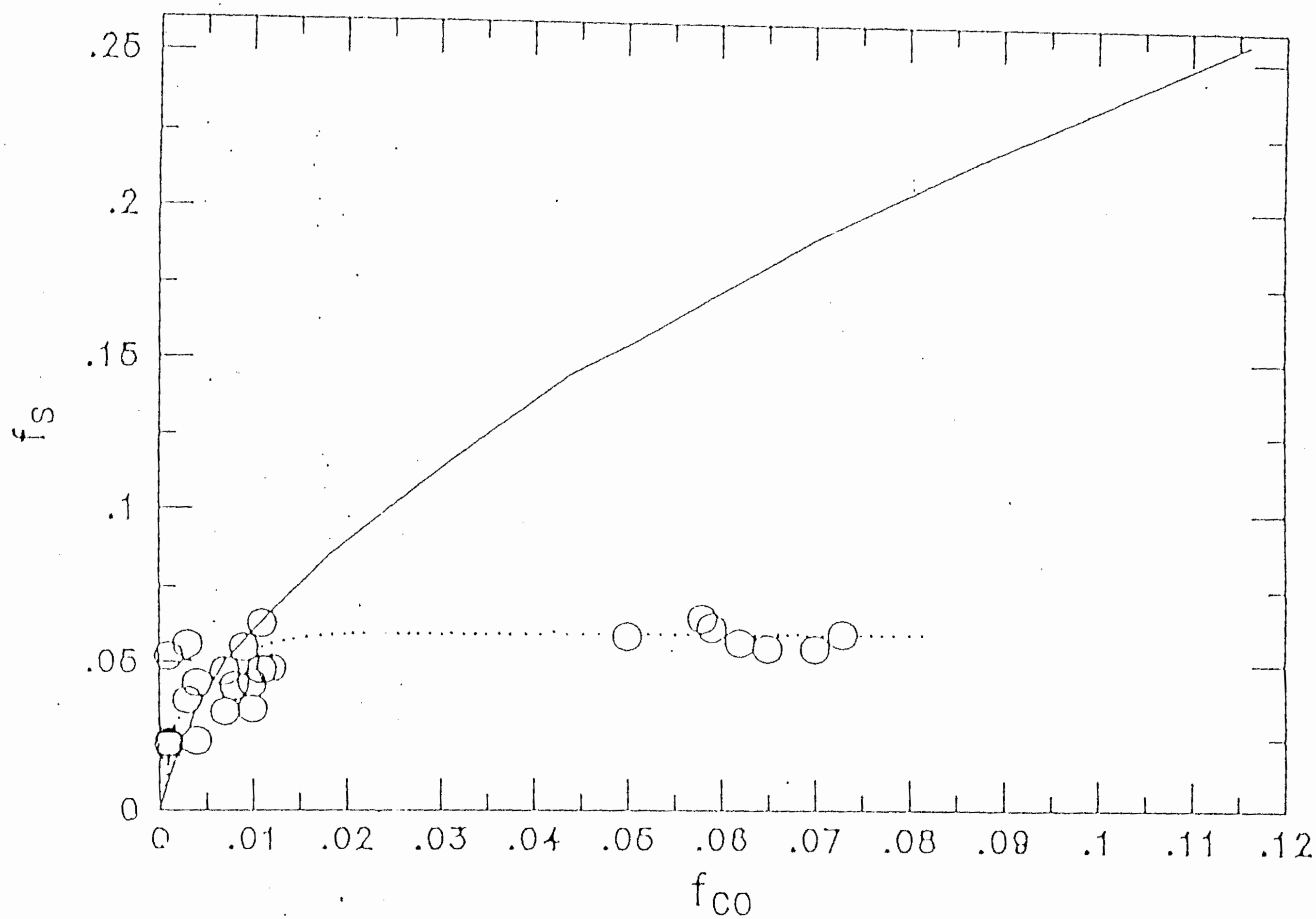
Fig. 4 Relationship between the generation efficiencies of soot and CO. Solid line represents our predictions for fuels with variable chemical structures. Symbols connected by dashed lines represent experimental data for PMMA with variable ventilation conditions, Ref. 20.

Fig. 5 Estimated emission rates of heat, CO, and soot as functions of the molecular weight of alkanes for overventilated fires.

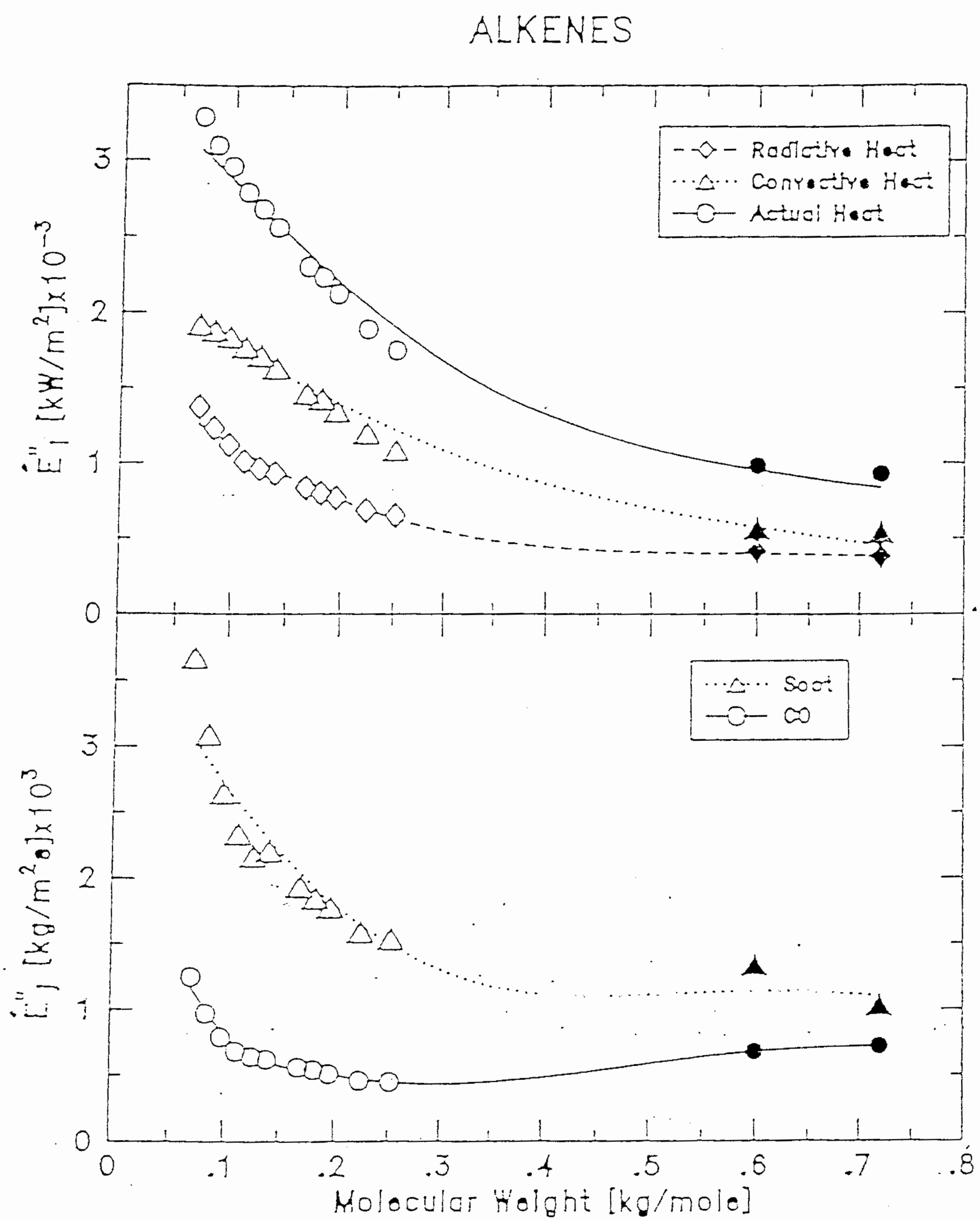
Fig. 6 Estimated emission rates of heat, CO, and soot as functions of molecular weight of alkenes for overventilated fires. Dark symbols represent experimental data for polyethylene and polypropylene.



χ_A
χ_C
χ_R
χ_i
1
.8
.6
.4
.2
0
0
.05
.1
.15
.2
.25
L_S [m]



f_S
.25
.2
.15
.1
.05
0
0
.01
.02
.03
.04
.05
.06
.07
.08
.09
.1
.11
.12
f_{CO}


ALKENES
Radiative Heat
Convective Heat
Actual Heat
Soot
CO
$\dot{E}''_l$ [kW/m^2]x10^{-3}
$\dot{E}''_j$ [kg/m^{2}s]x10^3
0
1
2
3
0
.1
.2
.3
.4
.5
.6
.7
.8
Molecular Weight [kg/mole]

APRIL 1996 SELECTED PARTS OF THE RCRA SUBPART A & B PERMIT APPLICATION

Please print or type with ELITE ... 12 characters per inch in the unshaded areas of ...

EPA I.D. Number (enter from page 1) | Secondary ID Number (enter from page 1)

N M 0 8 9 0 0 1 0 5 1 5

XII. Process Codes and Design Capacities (continued)

... in line numbers X-1 and X-2 below: A facility has two storage tanks, one tank can ... gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

Line Number	A. Process Code	B. Process Design Capacity: 1. Amount (specify)	2. Unit of Measure (enter code)	C. Process Total Number of Units	For Official Use Only
X-1		600	G	0 0 2	
X-2		20	E	0 0 1	
	S 0 1	275	G	0 0 1	

NOTE: If you need to list more than 12 process codes, attach an additional sheet(s) with the information in the same format as above. Number the lines sequentially, taking into account any lines that will be used for additional treatment processes in Item XIII.

XIII. Additional Treatment Processes (follow instructions from Item XII)

Line Number (enter numbers in sequence with Item XII)	A. Process Code	B. Treatment Process Design Capacity: 1. Amount (specify)	2. Unit of Measure (enter code)	C. Process Total Number of Units	D. Description of Process
0 2	T 0 4	40,000	See Att.	0 0 2	See Attachment 1 to this Part A.
0 3	T 0 4	1,000	J	0 0 2	See Attachment 1 to this Part A.
0 4	T 0 4	250/100	E	0 0 2	See Attachment 1 to this Part A.
0 5	T 0 4	1,000	J	0 0 2	See Attachment 1 to this Part A.

EXPLANATION OF PROCESS CODE LISTINGS AND DESIGN CAPACITIES FOR HAZARDOUS AND MIXED WASTE UNITS[a]

Description	Capacity	SWMU[b] No.	Associated Str No./Area
<u>Line 1 S01 Container Storage</u>[c]			
Container storage area	275 gallons	16-012(a2)	Technical Area 1 Building 88 (TA-
<u>Line 2 T04 Treatment - Open Burning</u>			
Flash Pads 387[d] and 388 (two flash pads for burning potentially high explosives [HE]-contaminated equipment/materials)	40,000 pounds[e] (of waste per burn) at each unit	16-010(b)	TA-16-387 TA-16-388
<u>Line 3 T04 Treatment - Open Burning</u>			
Burn Pads 388[f] and 399 (two burn pads for burning HE solids)	1,000 pounds (of waste per burn) at each unit	16-010(c) 16-010(d)	TA-16-388 TA-16-399
<u>Line 4 T04 Treatment - Open Burning</u>			
Burn Tray 388 (one burn tray for burning HE-contaminated oil/ solvent mixtures)	100 gallons (of waste per burn)	To be determined	TA-16-388
Burn Tray 394 (one burn tray for burning HE-contaminated oil/solvent mixtures)	250 gallons (of waste per burn)	16-010(j)	TA-16-394
<u>Line 5 T04 Treatment - Open Burning</u>			
Filter Vessels 401 and 406 (two filter vessels for burning HE-contaminated sludges)	1,000 pounds (of waste per burn) at each unit	16-010(e) 16-010(f)	TA-16-401 TA-16-406

<u>Explanation of Symbols/Abbreviations</u>

a EPA Hazardous Waste Numbers for wastes that may be managed at the units are listed in the following table

b SWMU = solid waste management unit.

c "Line 1 S01 Container Storage" refers to the total amount of container storage for hazardous and mixed was Technical Area (TA) 16, provided in Section XII, page 4 of 7, of this Part A permit application. For informatio locations and capacities of other container storage areas for hazardous and mixed waste at Los Alamos Nati Laboratory (LANL), refer to Section 1.0 (i.e., the Part A Permit Application) of Revision 4.1 of LANL's Pa Permit Application for Hazardous Waste, November 1988 and to LANL's "RCRA Part A Permit Application Mixed Waste," Rev. 2.0, September 1994.

d Flash Pad 387 will be used to treat wastes from Material Disposal Area (MDA) P only and will undergo clo following closure activities at MDA P and approval of Flash Pad 388 operations.

e This amount is the estimated maximum weight of equipment or structures (with HE surface contamination o that may be burned at a flash pad at one time.

EXPLANATION OF PROCESS CODE LISTINGS
AND DESIGN CAPACITIES FOR HAZARDOUS AND MIXED WASTE UNITS[a]
(Continued)

f LANL plans to convert Burn Pad 388 to a flash pad/burn tray area. Upon conversion, wastes formerly treat Flash Pad 387 (other than MDA P wastes) and Burn Tray 394 will be treated at TA-16-388. Burn Tray 39 undergo closure after operations there are relocated to Burn Tray 388 and Burn Tray 388 is approved for use

Descriptions of Hazardous Waste Treated by Open Burning at Los Alamos National Laboratory

Waste Description	Waste-Generating Process Description	Technical Areas (TA) Where Waste Is Generated	Basis for Characterization	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
			Heterogeneous Wastes			
Solvent/HE-contaminated waste, may include paper, glassware, tools, and other waste contaminated with solvents	HE processing, plastic forming, and from general laboratory use	TA-9, TA-11, TA-16, TA-22, TA-37, and TA-40	Process knowledge	D003 F001 F003	Reactivity Freon, Trichlorofluoroethane Acetone	NA[c] NA[c] NA[c]
HE-contaminated equipment	HE processing	TA-9, TA-11, TA-16, TA-22, and TA-40	Process knowledge	D003	Reactivity	NA[c]
HE-contaminated waste rags and wipes	HE processing, (e.g., hydraulic press operations, laboratory analysis, or other miscellaneous uses)	TA-16, TA-9, TA-22, and TA-40	Process knowledge	D001 D003 F001 F002 F003 D022 U044 U003	Ignitability Reactivity 1,1,1-Trichloroethane 1,1,1-Trichloroethane Acetone Chloroform Chloroform Acetonitrile	NA[c] NA[c] NA[c] NA[c] NA[c] 6.0 NA[c] NA[c]
HE-contaminated liquid acids, bases, and/or inorganic salts	Materials used as titrates, solvents and cleaning fluids and material from hydrolysis research	TA-9	Process knowledge	D002 D003 D005 D007 D009	Corrosivity Reactivity Barium Chromium Mercury	NA[c] NA[c] 100.0 5.0 0.2

a U.S. Environmental Protection Agency.

b A solid waste exhibits the characteristic of toxicity if the extract from a representative sample of the waste contains any of the contaminants listed at a concentration equal to or greater than the respective value given in the New Mexico Administrative Code, Title 20, Chapter 4, Part 1 (20 NMAC 4.1), Subpart II, 261, Subpart D.

c Not applicable: refers to the absence of regulatory limits for ignitable, corrosive, reactive wastes, and F-, K-, and U-listed wastes.

Table 1.
Open Burning Air Pollutant Emissions Before and After the Conversion of the TA-16 Burning Pads to Propane

Pollutant	Activity
	Flashing
Emissions per Burn with Wood (pounds/burn)*	
CO	202
NO_x	2
SO_x	0
VOC	183
PM	26
Emissions per Burn with Propane (pounds/burn)**	
CO	0.04
NO_x	0.2
SO_x	0
VOC	0.006
PM	0.008

* Section 1.9 - Residential Fireplaces, 5th Ed., AP-42, 1600 lbs. wood waste
** Section 1.9 - Liquified Petroleum Gas Combustion, 5th Ed., AP-42, 13 gallons propane.

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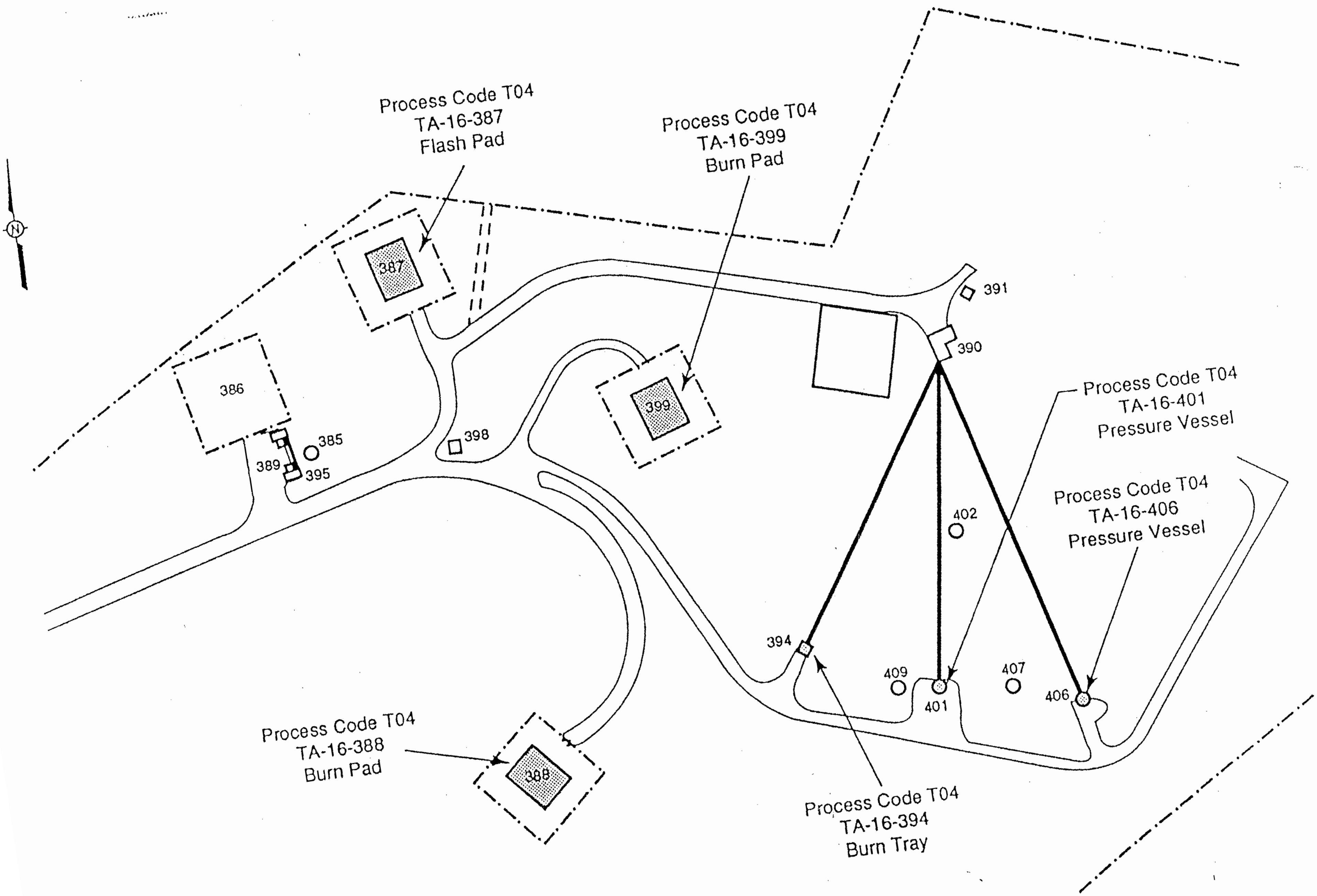

Figure 1
Technical Area (TA) 16 Burn Ground

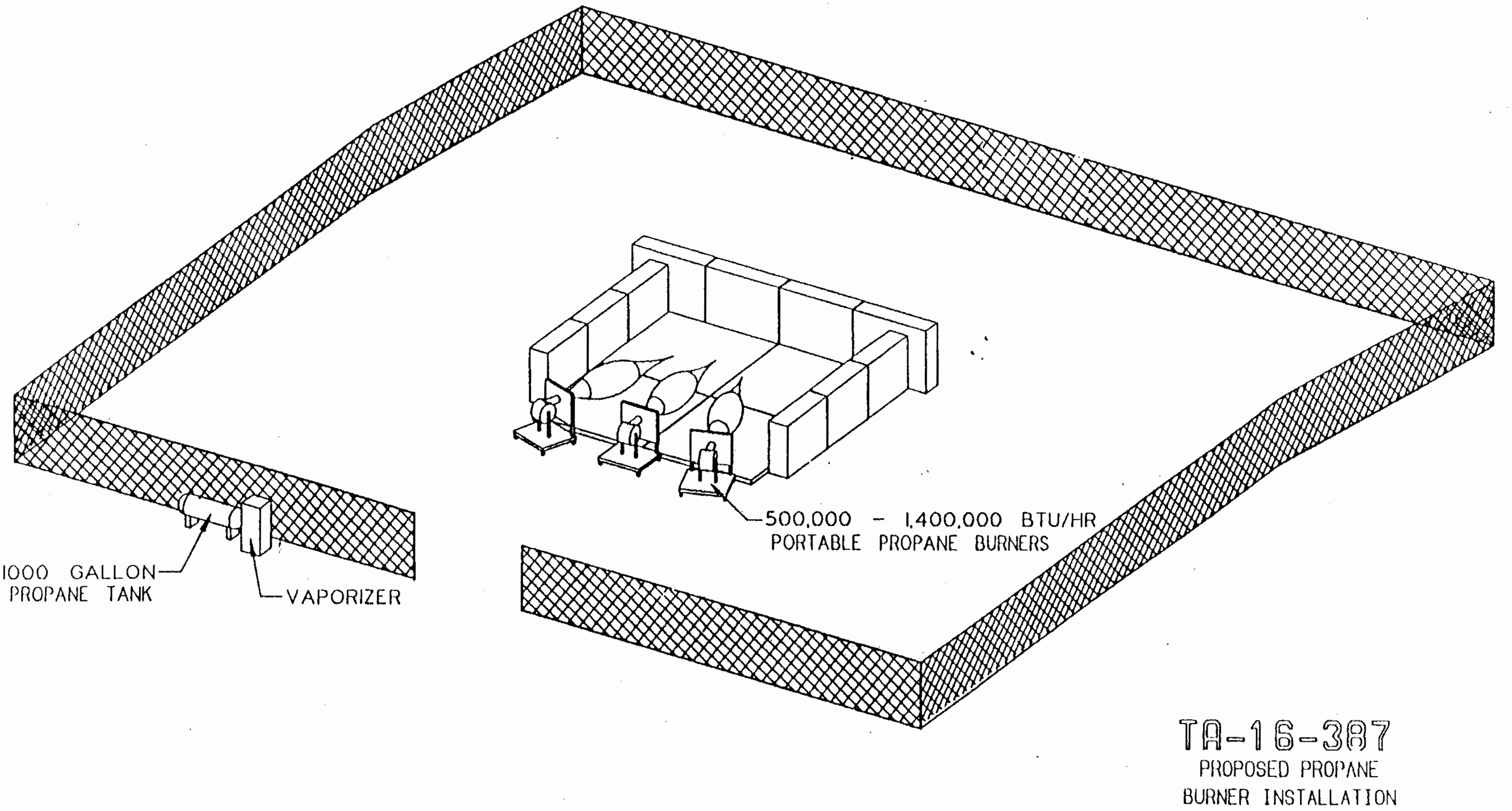

Figure 2

Schematic Drawing of and Proposed Modifications to the TA-16-387 Flash Pad

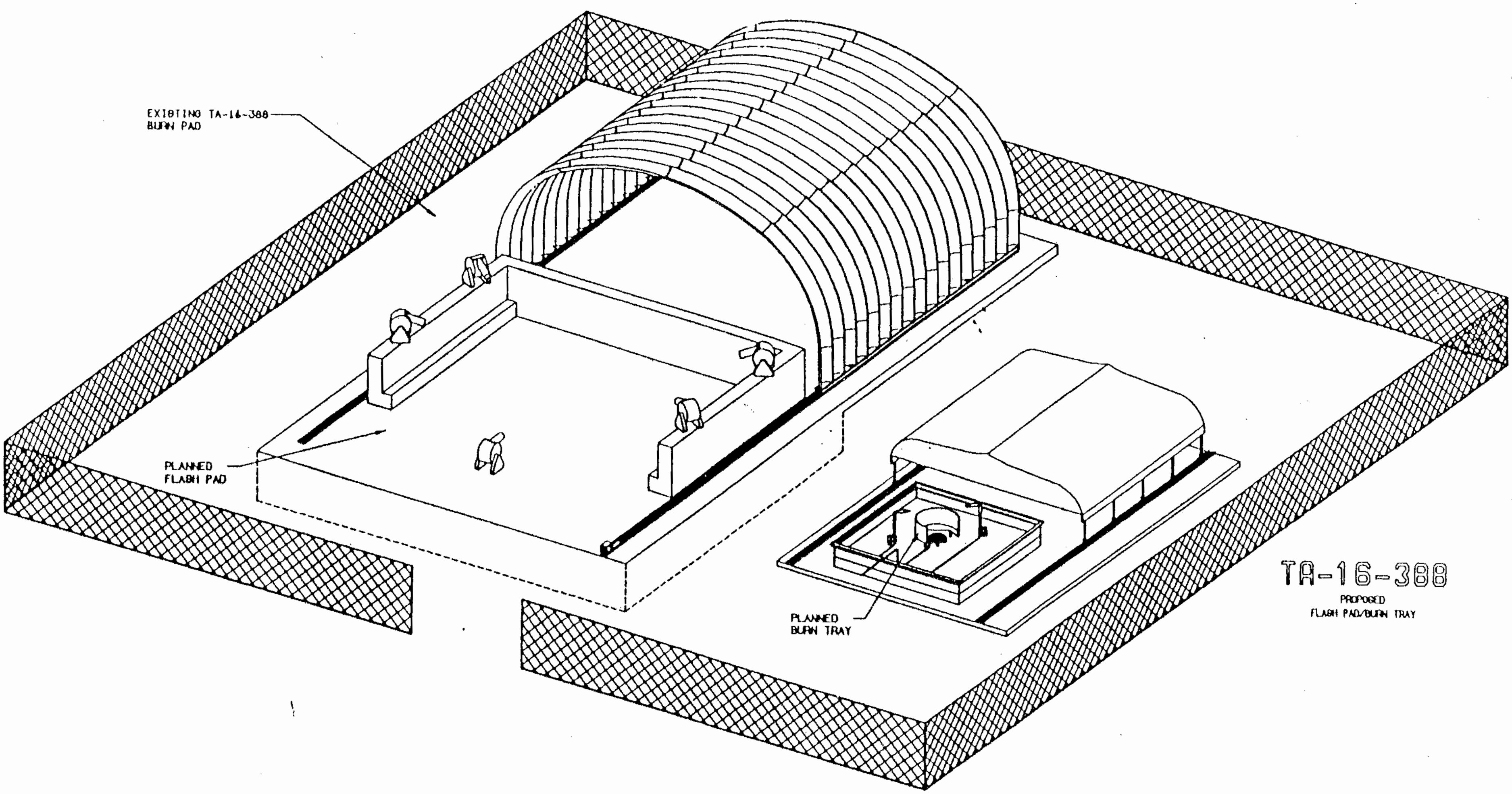

Figure 3

Schematic Drawing of the Planned TA-16-388 Flash Pad/Burn Tray