

BURN PIT CHEMICAL PROFILE (PHASE I)

MPR 81-0547

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PROPOSED EFFORT TO BE PERFORMED BY:  
SSFL ANALYTICAL CHEMISTRY UNIT, M & P

Submitted by

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BNA03472432

## BURN PIT CHEMICAL PROFILE (PHASE I)

### Reference:

Bjorklund letter to Regional Water Quality Control Board, 4 March 1981  
(81RC02364), Re: Inactive Burning and Disposal Site ("Burn Pit")

### SUMMARY

This work plan delineates in detail how the site will be examined on a "first pass" basis to appropriately estimate the level of effort that will be required for Phase II, the rigorously conducted sampling and analysis according to the guidelines established in the EPA manual of test procedures covering such situations, "Test Methods for Evaluating Solid Wastes", (SW-846, 1980), published by the Office of Water and Waste Management. This work plan also recommends the use of various other technical disciplines (geologist, ground water specialist) and other laboratory services (Pacific Spectrochemical, West Coast Technical Services, Rockwell Environmental Monitoring Center) as well as literature reviews on appropriate activities and consulting firms that Rocketdyne may wish to consider. In addition, this presentation includes the labor estimate for this assignment as well as the capital equipment that may be required for Phase II. A proposed work schedule is submitted with targeted completion dates to provide flexibility according to the chemical analysis results.

### BACKGROUND

#### General Site History

The "Burn Pit" site was established in approximately 1958 for the safe disposal of chemical fuels by combustion in order to minimize potential public exposure which could result from transport across public highways to dispose in a conventional landfill. This site was operated by qualified Rocketdyne Protective Services personnel until 1971. At that time, the site was closed because of air pollution considerations. Since its closure, the site has been essentially inactive with the exception of a few fire department demonstrations and training



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exercises to maintain their proficiency in dealing with chemical fires and emergency incidents.

#### Site Description

Located in Rocketdyne's 2,400-acre Santa Susan Test Facility (SSFL) is a six-acre area which is referred to as the "Burn Pit". Within the bounds of the six-acre area are six pits which range in volume from approximately 200 gallons to 10,000 gallons. Of these six pits, three of them are lined with concrete and three unlined earthen pits. The enclosed maps give the geographic location, topography, draining outfalls and a rough plan of the "Burn Pit".

#### Area Water Run Off

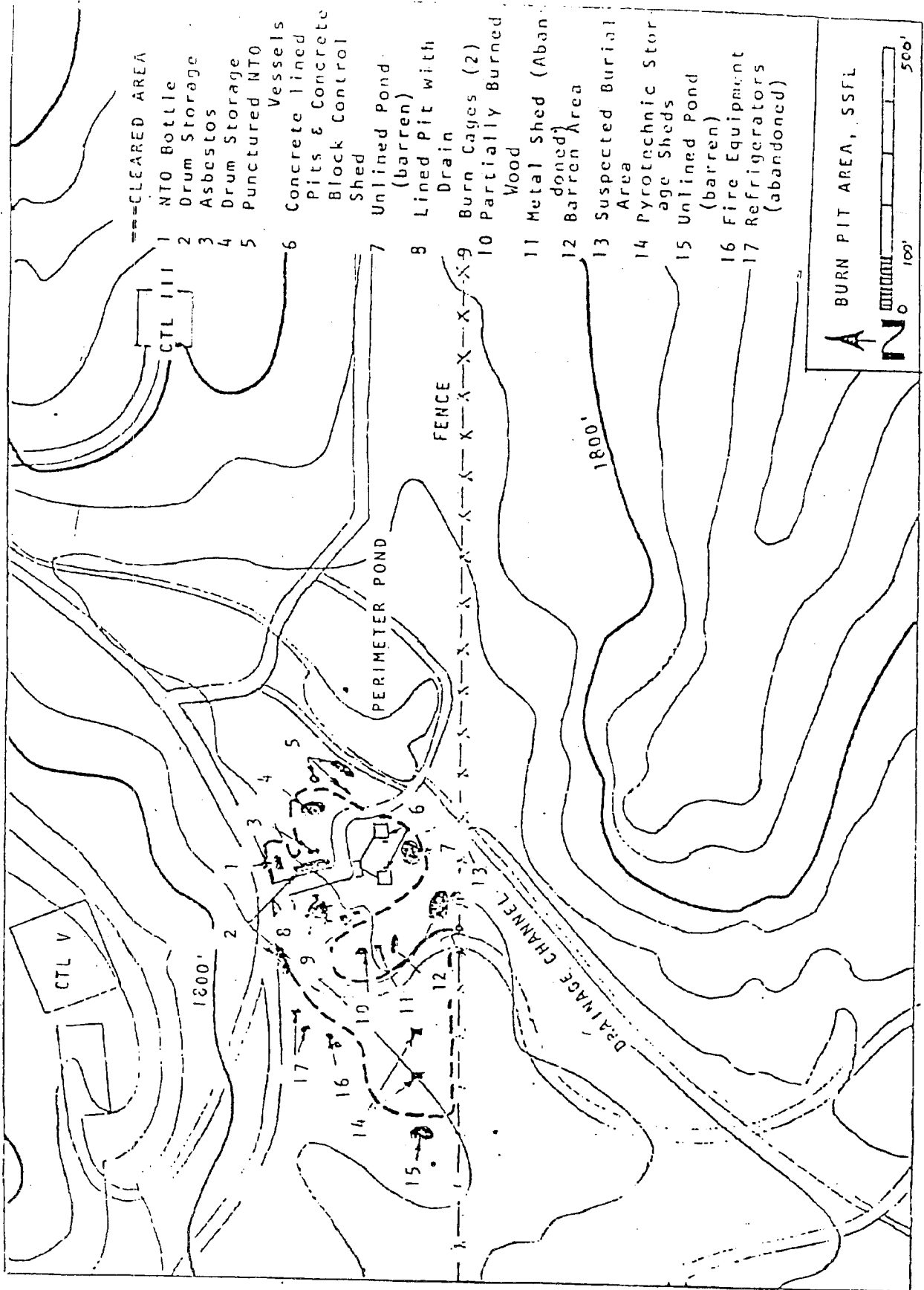
A preliminary review of the water runoff has led the Rocketdyne Environmental Control Office to believe that no dischargeable hazardous residues resulted from the combustion processes. Routine sampling at the adjacent perimeter pond has not shown any unusual concentrations of any of the substances required to be sampled by the current NPDES permit (expiration date = August 31, 1981). It is believed, therefore, that surface runoff is not the problem.

#### Ground Water

The Rocketdyne SSFL is serviced by one well which is maintained by Rocketdyne. Two additional wells are planned to be brought on line in six (6) months. None of these wells are located near the burn pit area and are upgradient. Rocketdyne believes that there has been no ground water contamination resulting from the past activities in the burn pit area. This conclusion is based on an evaluation of the type of the disposal practices which were employed and a 1958 geologic and hydrologic survey of the underground water conditions. The study was performed by C. C. Killingsworth, a consulting geologist from Los Angeles, whose findings revealed that "the overall average effective porosity appears to be less than one percent (1%) over the 2,000 acres of property". Furthermore, of the wells that have been driven or that are currently in operation, the distance from the surface to reach the aquifer is of the order of 415 feet.







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## WORK STATEMENT

The California Department of Health Services prepared a document on "Samplers and Sampling Procedures for Hazardous Waste Streams" that offers the approach consistent with the Burn Pit chemical profile. Thus, the attached procedures submit a plan of action to maximize safety of sampling personnel, minimize sampling time and cost, reduce errors in sampling, and protect the integrity of the samples after sampling.

1. The background information about the Burn Pit has been researched and is submitted as Table 1, ("SUMMARY OF MATERIALS AND DISPOSAL METHODS"). Records have been kept for years on the general pond/water system/runoff chemical constituency, so that Rocketdyne's pollution control program has voluminous documentation on constituents that required reporting under the NPDES permit currently held. These records substantiate that surface runoff has been monitored continually. Rocketdyne has had voluntary projects as well as complying with all the existing regulations and codes of the agencies during the time frame and with the perspective that applied, nationally, before the advent of legislation that more specifically addressed the need for restrictive environmental controls.
2. A list is attached that describes the constituents for which the analyses may be performed. See Table 2, ("SUMMARY OF CHEMICAL CONSTITUENT TESTS"), that has been compiled from the data assembled and tabulated as in Table 1.

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TABLE 1 - SUMMARY OF MATERIALS AND DISPOSAL\* METHODS

<u>Type of Material</u>	<u>Volume or Mass</u>	<u>Disposal Method</u>
A. Fuels	450,000 gallons	
1. Nitrogen Tetroxide		Combustion
2. Misc. Contaminated Fuels		Combustion
3. Pentaborane		Combustion
4. RP-1 (Kerosene Base)		Combustion
5. JP-4 (Kerosene Base)		Combustion
6. Hydrazines		Combustion
7. Triethyl Aluminum		Combustion
8. Triethyl Aluminum Borane		Combustion
B. Igniters	#6924	Detonation
C. Process Chemicals	21,300 gallons	Dilute and place in earthen pits
1. Acids		
2. Bases		
D. Reactive Metals	13,810 pounds	
1. Aluminum		Burning
2. Magnesium		Burning
3. Sodium		Burning
4. Potassium		Burning
E. Organic Solvents	31,717 gallons	
1. Tetraisobutylene		Combustion
2. Alcohols		Combustion
3. Heptane		Combustion
F. Explosives	5,121 pounds	
1. Nitrocellulose		Detonation
2. Mix Oxides		Detonation
3. Dynamite		Detonation
G. Toxic Gases	32,932 feet <sup>3</sup>	
1. Oxygen Difluoride Gas		Combustion
2. Fluorine Gas		Combustion
3. Chlorine Gas		Combustion
H. Heavy Metal Toxics	191 gallons	
1. Leaded Paint (189 gallons)		Combustion
2. Potassium Cyanide		Combustion
3. Sodium Arsenite		Dilution
4. Mercury		Dilution

\*NOTE: From Fed. Register, May 19, 1980, p. 33119: "A material is 'disposed of' if it is discharged, deposited, injected, dumped, spilled, leaked or placed into or on any land or water so that such material or any constituent thereof may enter the environment or be emitted into the air or discharged into ground or surface waters."

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## TABLE 2 - SUMMARY OF CHEMICAL CONSTITUENT TESTS

The fundamental first step prior to the various separations into classes and groups of compounds is called the Extraction Procedure (Federal Register, Vol. 45, No. 98, Monday, May 19, 1980, E. Section 261.24, Characteristic of E. P. Toxicity). The equipment required to perform this operation has been ordered and should arrive by August 1, 1981. Thus, the following list includes the analytical chemistry protocol that utilizes the manipulations cited by the Federal Register methodology as appropriate and designed to identify wastes likely to leach hazardous concentrations of particular toxic constituents into the groundwater supply.

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# IDENTIFICATION OF HAZARDOUS WASTE

EPA REG. 40-261

• IGNITABLE

• CORROSIVE

• REACTIVE

• EXTRACTION PROCEDURE TOXIC

• ACUTE HAZARDOUS

• TOXIC

P H A S E I

COMPACTION

TESTER

PULVERIZER

ROTARY

EXTRACTOR

PRESSURE

FILTER

PHOTO-IONIZATION

DETECTOR

SONIC

DISMEMBRATOR

\$ 185

\$ 645

\$2100

\$1100

\$3500

\$1211

SHOULD  
ARRIVE

BY

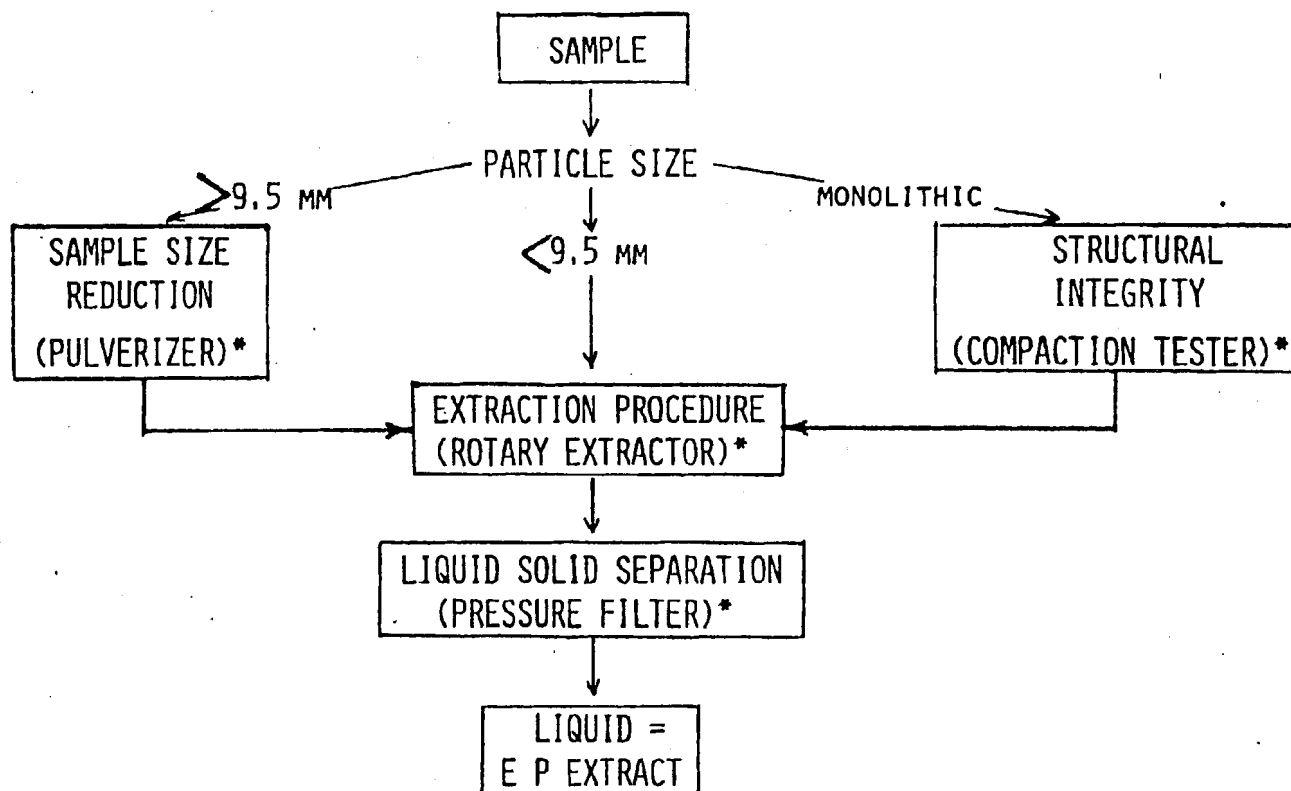
AUGUST,  
1981

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# TEST PROCEDURE FOR DRY SAMPLE EXTRACTION

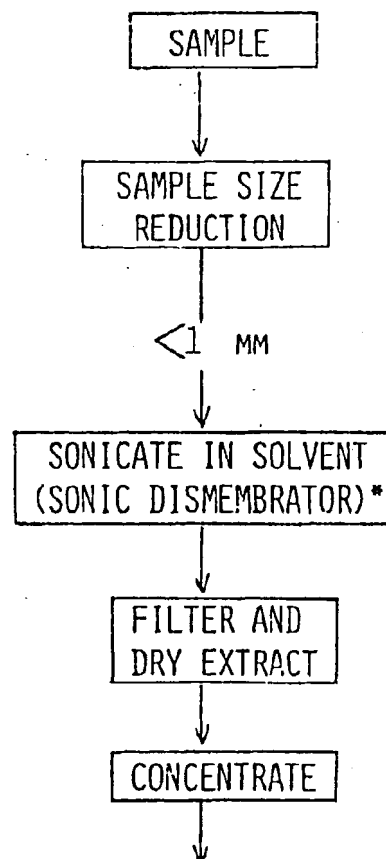


\*REQUIRED CAPITAL ITEMS

- METALS (AA)
- VOLATILE ORGANICS (GC)
- VOLATILE AROMATICS, KETONES AND ETHERS (GC)
- ACRYLONITRILE, ACETONITRILE AND ACROLEIN (GC)
- PHENOLS (GC)

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# TEST PROCEDURE FOR SONICATION METHOD



\*REQUIRED CAPITAL ITEMS

- EXTRACTABLE ORGANICS (GC)
- PCB'S AND ORGANOCHLORINE PESTICIDES (GC)
- SEMIVOLATILE AROMATICS (GC)
- POLYNUCLEAR AROMATIC HYDROCARBONS (GC OR HPLC)
- CHLORINATED HYDROCARBONS (GC)

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TABLE 2 - SUMMARY OF CHEMICAL CONSTITUENT TESTS

<u>METALS</u> <sup>1</sup>	<u>VOLATILE ORGANICS</u> <sup>2</sup>	<u>OTHER ORGANICS</u> <sup>3</sup>	<u>ANIONS</u> <sup>4</sup>
Aluminum	Carbon tetrachloride	Benz (a) anthracene, pyrene	Chloride
Arsenic	Chlorobenzene	Benz (b) fluoranthene	Fluoride
Barium	Chloroform	Chrysene	Nitrate
Beryllium	Chloromethane	Creosote	Phosphate
Boron	Dichlorobenzene	Mercaptans	Sulfate
Cadmium	Dibromomethane	Napthalene	
Chromium	Ethyl ether	Phenols	
Copper	Formaldehyde	Pyridine	
Iron	Methanol	Toluene diisocyanate	<u>AMINES</u> <sup>5</sup>
Lead	Methyl ethyl ketone		Hydrazine
Magnesium	Methyl isobutyl ketone		Monomethylhydrazine
Mercury	Tetrachloroethane		
Molybdenum	Tetrachloroethene		
Nickel	Trichloroethene		
Phosphorus	Trichloropropane		
Potassium	Vinyl chloride		
Selenium	Vinylidene chloride		
Silicon			
Silver			
Sodium	<u>VOLATILE AROMATICS, KETONES</u>		
Sulfur	<u>&amp; ETHERS AND NITRILES</u> <sup>2</sup>		
Tin	Acetonitrile		
Titanium	Benzene		
Zinc	Chlorobenzene		
	Dichlorobenzene		
	Ethyl ether		
	Methyl ethyl ketone		
	Methyl isobutyl ketone		
	Toluene		
	Xylene		

1. By atomic absorption spectroscopy or emission spectrography.
2. By gas chromatography or high pressure liquid chromatography.
3. By sample preparation followed by gas chromatography.
4. By specific ion electrode/classical wet chemical techniques.
5. By colorimetric tests.

OR EQUALLY SUITABLE METHODS

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WORK STATEMENT (Continued)

3. The proper samplers will be selected in accordance with the State and EPA SW-846 manuals, as well as devices that are uniquely suited to the SSFL terrain.
4. The proper sample containers and closures will be obtained using the referenced regulatory documents as guides.
5. The sampling plan will include the choice of proper sampling points, and the number and volume of the samples to be taken, including the boring depth.
6. All proper sampling precautions will be observed.
7. The samples will be handled properly with the appropriate chain of custody paperwork.
8. All samples will be identified correctly and protected from tampering.
9. All sample information will be recorded and identified in a field notebook.
10. The chain of custody record will be completed.
11. The sample analysis request sheet will be filled out.
12. The samples will be submitted to the appropriate laboratory.
13. The results of the selected testing will be reviewed and decisions made where there are questions that need to be answered or issues resolved. If additional samples are required or further pretreatment or sample preparation necessitated, then actions will be taken to complete these tasks.
14. A report will be written summarizing the work performed, data generated, results found, and recommendations tendered. This report will be submitted to the Rocketdyne Environmental Control Office as the document covering PHASE I.

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## DISCUSSION

The sample collection would be performed by maintenance personnel specifically instructed in and assigned the task by Rocketdyne Facilities and Industrial Engineering management. A minimum of 50 samples would be obtained over the six-acre area. The specific sampling sites would be chosen by the Rocketdyne F & IE Burn Pit Project Engineer on the advice and counsel of those who have knowledge of the area and its history and drainage patterns so that representative sampling could be performed. The Rocketdyne Environmental Control Office would approve of the sampling grid prior to the execution of the undertaking so that the historical data on past events would provide guidance and direction for the sample handling. The choice of the chemical tests to accomplish the chemical profile of the Burn Pit area would be the responsibility of the Manager of the Rocketdyne M&P SSFL Analytical Chemistry Unit. If, in her opinion, samples were to be sent out to other laboratories, these decisions would be made and subsequent actions taken to accommodate the best technical resolution of the problem in the most expeditious and economical way.

## COST FOR CHEMICAL ANALYSIS FOR PHASE I ONLY

The pricing (as an internal control document) for the SSFL Analytical Chemistry Unit effort is attached as Table 3. The basic considerations are that from 50-100 samples would be submitted for chemical analyses, and that the number of constituents per sample, following the initial extraction procedure, could vary from 25 to 60 depending on type, matrix, level of complexity, and detection parameters.

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TABLE 3 - PRICING FOR CHEMICAL ANALYSIS ONLY  
(F & IE Sampling, etc. Not Included)

50 - 100 samples @ a minimum of 25 hours each = 1250 to 2500 hours

Every solid sample would be split and a portion would go out to Pacific Spectrochemical Labs for a semi-quantitative emission spectrographic determination for metals, at \$45/sample. Thus, this cost would be in the range of \$2250 to \$4500.

Special field sampling bags (for chain of custody identification) and other containers would run about \$200.

Chemical standards, liquid chromatography columns (at a current rate of \$400 each), and other calibration-type supplies would amount to about \$3000.

Therefore, the pricing for the SSFL Analytical Chemistry Unit effort is:

<u>MINIMUM, 50 SAMPLES</u>			<u>MAXIMUM, 100 SAMPLES</u>	
<u>\$</u>	<u>HOURS</u>		<u>\$</u>	<u>HOURS</u>
	1250	M&P Personnel & Burden Labor		2500
\$2,250		Emission Spec.	\$4,500	
\$ 100		Containers	\$ 200	
\$1,500		Chemical Standards	\$3,000	
<hr/>			<hr/>	
\$3,850	& 1250 Hrs.	<u>TOTAL</u>	\$7,700	& 2500 Hrs.

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## RECOMMENDATIONS

It is recommended herewith that several other activities take place concurrently with the "first pass" profiling of the Burn Pit area. These are:

(1) Another geological and hydrological survey should be done by a professional firm with excellent credentials in this discipline. Newer techniques and methods should be available than those utilized in 1958 when C. C. Killingsworth made his evaluation. Stone being stone, the porosity values should remain the same, but perhaps other data about the SSFL property would be generated which would be helpful for the company's future plans as well as its heritage.

(2) A review of the available literature should be made to ascertain how other companies have been handling the subject of hazardous wastes - particularly the aerospace waste generators since their activities and Rocketdyne's are similar. For example, TRW prepared a sixteen-volume report for the EPA on recommended methods of reduction, neutralization, recovery, or disposal of hazardous wastes (EPA #670/2-73-053-a).

(3) Outside firms who are in good repute with the regulatory agencies should be consulted as to their general approach to this type of problem and a rough estimate of their charges, etc. for comparison with what might be necessary for Phase II of the Burn Pit Chemical Profile.

(4) The possible capital equipment requirements for Phase II should not be overlooked if serious considerations are made about performing the project according to the full extent outlined in the EPA's SW 846 (Test Methods for Evaluating Solid Waste), on an in-house basis. This could easily amount to \$200,000 worth of equipment. Table 4 lists these. Although the Burn Pit project is viewed as a "one time thing", all indications and legislative proclamations point to continual examination of things on-site in order to reduce the dependency on the unavailable outside commercial disposal sites.





TABLE 4 - CAPITAL EQUIPMENT REQUIREMENTS FOR PHASE II

(PRELIMINARY ESTIMATE)

(Provided that the decision is made for the work to be done in-house by the SSFL Analytical Chemistry Unit)

<u>INSTRUMENT</u>	<u>APPROX. COST</u> <u>\$1981</u>	<u>PURPOSE</u>
Thermal Analysis Systems	\$32,000	Examine samples for reactivity according to the Federal Register - ASTM methods.
Ion Chromatograph	\$33,000	Excellent screening instrument for examining organic and inorganic ions more quickly than classical wet chemical techniques.
Inductively Coupled Plasma Atomic Emission Attachment for the Rocketdyne-owned Atomic Absorption Spectrophotometer	\$80,000	Rapid-fire analysis instrumentation <u>suggested</u> by EPA but not currently required because the whole package (aa+ICP) amounts to \$130,000.
Gas Chromatograph/ Mass Spectograph Computer Data + Tape Storage Systems	\$55,000	To provide the <u>accessible</u> data base of samples, standards, profiles already established at SSFL to use for all future cases as well as provide graphical representation of information gleaned in the event that litigation requires such declaration of technical data and performance of compliance.

16.



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[illegible]

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REFERENCE DOCUMENTS

18



BNA03472450

Rocketdyne Division  
6633 Canoga Avenue  
Canoga Park, California 91304  
Telex: 698478

Rockwell  
International

4 March 1981

In reply refer to 81RC02364

MAR 12 1981

→ Regional Water Quality Control Board  
107 S. Broadway, Suite 4027  
Los Angeles, California 90012

Attention: Mr. Raymond M. Hertel, Executive Officer

Re: Inactive Burning and Disposal Site (File 81-18)

Gentlemen:

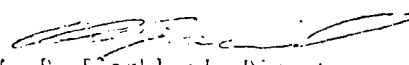
Rocketdyne is herewith submitting the historical data pertaining to the inactive disposal site known as the "Burn Pit" which is located at our Santa Susana Field Lab. This submittal is made in accordance with discussions with Mr. H. Yacoub and your letter dated February 19, 1981.

→ To assist in the assessment of the site, two information packages are being prepared; first, to provide historical background data for the site, and second, to provide a work plan delineating in detail how the site will be surveyed and analyzed. This package contains the historical background of the area. \*

General Site History

Very truly yours,

ROCKWELL INTERNATIONAL CORPORATION  
Rocketdyne Division

  
A. R. Bjorklund, Director  
Facilities & Industrial Engineering

ARB:pb

Enclosures: (3)

THE "BURN PIT  
PROPOSAL" GIVES  
THE WORK  
PLAN IF F&IE  
WANTS THE SSFL M&P  
LAB TO CONDUCT ALL  
THE CHEMICAL ANALYSES.

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BNA03472451

Solid Waste



# Test Methods for Evaluating Solid Waste

## Physical/Chemical Methods

EPA SW-846  
1980

SSFL - ANALYTICAL CHEMISTRY

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TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA-600/2-80-018	2.	3. RECIPIENT'S ACCESSION NO. 1050-135353
4. TITLE AND SUBTITLE Samplers and Sampling Procedures for Hazardous Waste Streams	5. REPORT DATE January 1980 (Issuance Date)	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Emil R. deVera, Bart P. Simmons, Robert D. Stephens, and David L. Storm.	8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Hazardous Materials Laboratory California Department of Health Services 2151 Berkeley Way Berkeley, CA 94704	10. PROGRAM ELEMENT NO. C73D1C, SOS #1, Task 32	11. CONTRACT GRANT NO. R 804692010
12. SPONSORING AGENCY NAME AND ADDRESS Cin., OH Municipal Environmental Research Laboratory-- Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268	13. TYPE OF REPORT AND PERIOD COVERED Final	14. SPONSORING AGENCY CODE EPA/600/14
15. SUPPLEMENTARY NOTES Richard A. Carnes, Project Officer (513/684-7871)		
16. ABSTRACT <p>The goal of this project was to develop simple but effective sampling equipment and procedures for collecting, handling, storing, and recording samples of hazardous wastes. The report describes a variety of sampling devices designed to meet the needs of those who regulate and manage hazardous wastes. Particular emphasis is given to the development of a composite liquid waste sampler, the Colivasa. This simple device is designed for use on liquid and semi-liquid wastes in a variety of containers, tanks, and ponds. Devices for sampling solids and soils are also described.</p> <p>In addition to the sampling devices, the report describes procedures for development of a sampling plan, sample handling, safety precautions, proper recordkeeping and chain of custody, and sample containment, preservation, and transport. Also discussed are certain limitations and potential sources of error that exist in the sampling equipment and the procedures. The statistics of sampling are covered briefly, and additional references in this area are given.</p>		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS Samplers Lagoons (ponds)--waste disposal Hazardous materials	b. IDENTIFIERS/OPEN ENDED TERMS Representative sampling Composite sampling Sampling plans Sampling procedures Hazardous waste Composite liquid waste sampler	c. COSATI Field/Group 68C
18. DISTRIBUTION STATEMENT Release unlimited	19. SECURITY CLASS (This Report) unclassified	20. SECURITY CLASS (This page) unclassified
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BIBLIOGRAPHIC DATA SHEET		1. Report No. EPA-670/2-73-053-a	2.	PB 224 580	
3. Title and Subtitle Recommended Methods of Reduction, Neutralization, Recovery, or Disposal of Hazardous Waste. Volume I, Summary Report			5. Report Date Issuing date - Aug. 1973		
7. Author(s) R. S. Ottinger, J. L. Blumenthal, D. F. Dal Porto, G. I. Gruber, M. J. Santy, and C. C. Shih			8. Performing Organization Rept. No. 21485-6013-RU-00-6-1		
9. Performing Organization Name and Address TRW Systems Group, One Space Park Redondo Beach, California 90278			10. Project/Task/Work Unit No.		
			11. Contract/Grant No. 68-03-0089		
12. Sponsoring Organization Name and Address National Environmental Research Center Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268			13. Type of Report & Period Covered Final		
15. Supplementary Notes Volume I of 16 volumes.			14.		
16. Abstracts A summary of the work performed on the hazardous waste research project is presented in the first volume of the 16 volume report. The report includes an updated listing of hazardous waste stream constituents, an evaluation of the adequacy of current waste management practices for these materials, and an identification of the research and development required to provide necessary information or develop adequate treatment methods. The results of this study clearly indicate the requirement for a system of National Disposal Sites to provide a repository for certain classes of hazardous waste stream constituent residues which must be stored and monitored permanently to avoid harm to the public and/or the environment. <					
17. Key Words and Document Analysis. 17a. Descriptors Hazardous Waste National Disposal Site Waste Management Treatment Methods					
17b. Identifiers/Open-Ended Terms					
<p style="text-align: center;">Reproduced by  <b>NATIONAL TECHNICAL  INFORMATION SERVICE</b>  U.S. Department of Commerce  Springfield, VA. 22151</p>					
17c. COSATI Field/Group 06F; 06T; 07B; 07C; 07E; 13B; 13H; 19A; 19B					
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BNA03472454

RECOMMENDED METHODS OF  
REDUCTION, NEUTRALIZATION, RECOVERY  
OR DISPOSAL OF HAZARDOUS WASTE  
Volume I. Summary Report

By

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Contract No. 68-03-0089  
Program Element No. 1D2311

Project Officers

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Solid and Hazardous Waste Research Laboratory  
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Cincinnati, Ohio 45268

Prepared for  
OFFICE OF RESEARCH AND DEVELOPMENT  
U.S. ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

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## REVIEW NOTICE

The Solid Waste Research Laboratory of the National Environmental Research Center - Cincinnati, U.S. Environmental Protection Agency has reviewed this report and approved its publication. Approval does not signify that the contents necessarily reflect the views and policies of this Laboratory or of the U.S. Environmental Protection Agency, nor does mention of trade names of commercial products constitute endorsement or recommendation for use.

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## FOREWORD

Man and his environment must be protected from the adverse effects of pesticides, radiation, noise and other forms of pollution, and the unwise management of solid waste. Efforts to protect the environment require a focus that recognizes the interplay between the components of our physical environment--air, water, and land. The National Environmental Research Centers provide this multidisciplinary focus through programs engaged in:

- studies on the effects of environmental contaminants on man and the biosphere, and
- a search for ways to prevent contamination and to recycle valuable resources.

Under Section 212 of Public Law 91-512, the Resource Recovery Act of 1970, the U.S. Environmental Protection Agency is charged with preparing a comprehensive report and plan for the creation of a system of National Disposal Sites for the storage and disposal of hazardous wastes. The overall program is being directed jointly by the Solid and Hazardous Waste Research Laboratory, Office of Research and Development, National Environmental Research Center, Cincinnati, and the Office of Solid Waste Management Programs, Office of Hazardous Materials Control. Section 212 mandates, in part, that recommended methods of reduction, neutralization, recovery, or disposal of the materials be determined. This determination effort has been completed and prepared into this 16-volume study. The 16 volumes consist of profile reports summarizing the definition of adequate waste management and evaluation of waste management practices for over 500 hazardous materials. In addition to summarizing the definition and evaluation efforts, these reports also serve to designate a material as a candidate for a National Disposal Site, if the material meets criteria based on quantity, degree of hazard, and difficulty of disposal. Those materials which are hazardous but not designated as candidates for National Disposal Sites, are then designated as candidates for the industrial or municipal disposal sites.

A. W. Breidenbach, Ph.D., Director  
National Environmental Research Center  
Cincinnati, Ohio



#### ACKNOWLEDGMENT

This program owes much to the program monitors and other staff of the Environmental Protection Agency who provided both advice and insight toward shaping this final report. Special thanks go to the program monitor, Mr. Henry Johnson, his predecessor, Dr. Lynn Wallace, and the staff of the Solid Waste Research Laboratory, National Environmental Research Center, Cincinnati, who have reviewed progress and provided information throughout the program. Thanks are also due to the staff of the Resource Recovery Division, Office of Solid Waste Management Programs, Washington, D.C., particularly Messrs. Sam Morekas, Don Marlow, Al Hayes, and Tom Gross, who also reviewed program progress, made constructive suggestions, and coordinated this project with the related projects sponsored by their organization.

This project relied very heavily on information obtained by personal communication and, therefore, much thanks is due to the individuals providing information. The industrial contacts are too numerous to mention specifically; however, certain individuals within the government sector were especially important in obtaining military and radioactive waste data. The collection of military hazardous waste data was coordinated through Col. Herbert Bell, Office of the Deputy Assistant Secretary of Defense for Environmental Quality, and Col. Walsh, Major Donald Rogers, and other members of the Department of Defense Environmental Pollution Control Committee. Information on radioactive wastes was obtained through Mr. Alex F. Perge, Assistant Director for Operations, Division of Waste Management and Transportation, Atomic Energy Commission, Washington, D. C., Mr. Lou Meyers, Office of Radiation Programs, Environmental Protection Agency, Rockville, and Mr. Charles Hardin of the Kentucky State Department of Health.

\* The important efforts of our major subcontractors, Hazelton Laboratories and Rollins Environmental Services, deserve appreciation as much information necessary to the successful completion of the project was obtained from



their programs. Finally, the contributions of our editor, Mrs. Marilyn Jennings, and of our secretarial staff have been extremely important to the preparation of our voluminous monthly reports and this final report. We appreciate their efforts.



# Maps organize hazardous materials spill data

**National Transportation Safety Board maps present time-sequenced data from past spills for researchers, emergency response teams**

"We need data," was the plea heard concerning hazardous materials transportation accidents.

There are models showing how hazardous materials will behave in a spill. But "one equation says you'll be burned to a cinder. Another says you'll be pleasantly warm."

That concern for data was expressed in support of a new program that had just been described at the 14th loss prevention symposium, held during the 88th National Meeting of the American Institute of Chemical

Engineers in Philadelphia early this month. The program involves development of hazardous materials accident spill maps by the National Transportation Safety Board.

The maps were devised by NTSB following a 1978 special investigation that indicated a need by researchers, mathematical modelers, emergency response personnel, and others for data to support predictions about how hazardous materials could be expected to behave in an accident. They are being developed under the office of Ludwig Benner Jr., chief of NTSB's hazardous materials division.

The idea of the maps, NTSB hazardous materials safety specialist Rebecca A. Rote told the symposium, is to report observed behavior of hazardous materials in an accident in a standardized format. NTSB considers its current standardized way of reporting the data as tentative and is

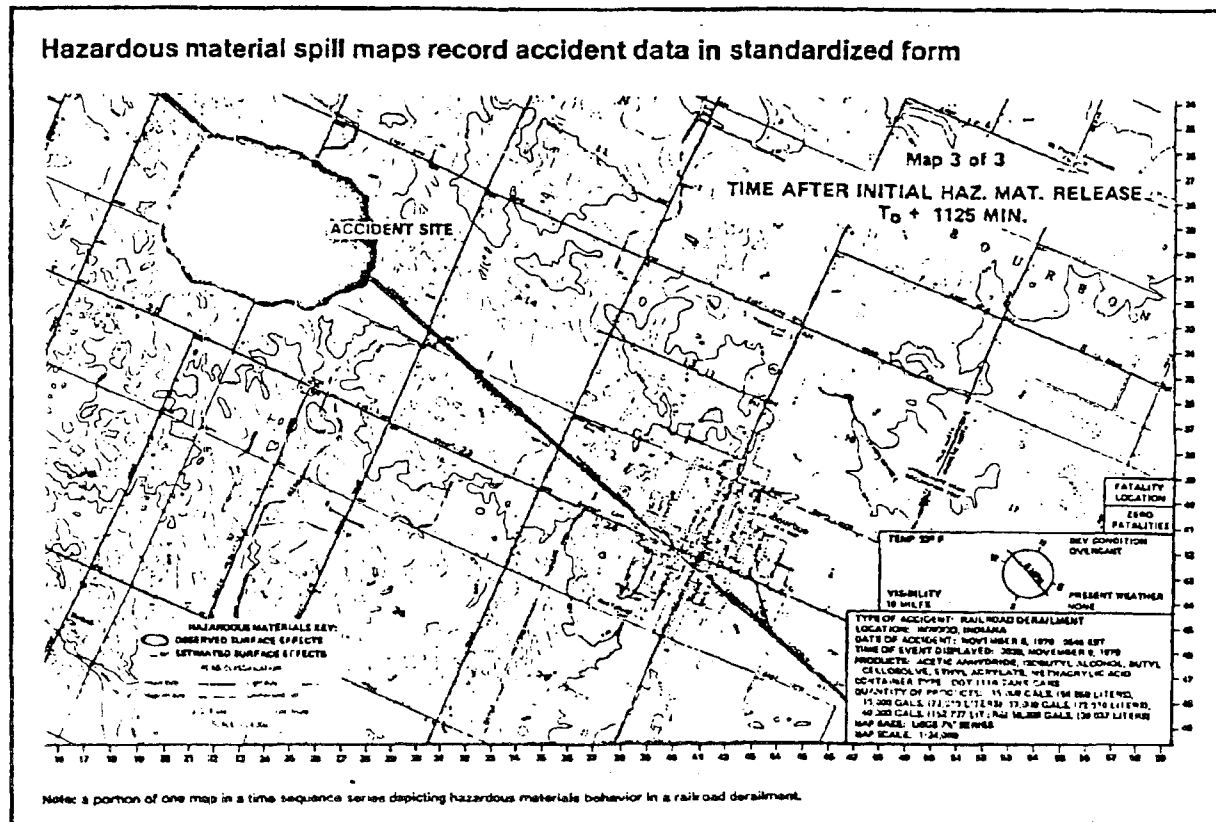
soliciting comments and suggestions from interested parties. It expects to propose a final standardized system by the end of this year.

The spill maps feature a time-sequenced display of dispersion patterns and ranges, weather at the times reported, injury/fatality exposure locations, and a synopsis of the accident scenario.

So far, NTSB has published maps for five accidents:

- Map 79-1: On Dec. 15, 1978, a railroad locomotive struck a tank semitrailer containing 7500 gal of liquefied anhydrous ammonia on a grade crossing near Boutte, La. The ammonia vaporized and formed a ground fog 30 to 40 feet high over a 1000-foot radius within 10 minutes. More than 18 tons of anhydrous ammonia escaped during this time, and ammonia continued to be vented for four hours after the collision. Three motorists within 200 feet of the

**Hazardous material spill maps record accident data in standardized form**



crossing died from ammonia inhalation, although the truck driver was not affected.

• Map 79-2: On April 8, 1979, a train derailment near Crestview, Fla., involved cars containing anhydrous ammonia, acetone, methanol, chlorine, phenol, carbon tetrachloride, sulfur, and urea. Flammable liquid and noxious gases were released through ruptures and punctures in the tank car shells, resulting in propulsive venting and fire. Flammable liquid flowed down an embankment toward a trestle and ignited. And an anhydrous ammonia car tank rocketed, injuring a motorist 450 feet from the tracks. By an hour and a half after the accident, winds had dispersed the escaping gas plume over a 15-square-mile area, extending 5 miles downwind.

• Map 79-3: On Oct. 24, 1978, a 30-inch pipeline transporting natural gas at 560 psi ruptured near Pearland, Tex. The gas was ignited by an unknown source, resulting in an explosion and fire. The fire's initiation was described as having been wide and low, gradually rising as a column of fire between 300 and 500 feet high. The blaze was estimated to have been up to 200 feet in diameter. Six persons were killed and 41 persons were hospitalized.

• Map 80-1: On Aug. 30, 1979, a freighter on the Mississippi River struck a docked butane tank barge loaded with about 283,500 gal of liquefied petroleum gas. The freighter ruptured at least one of the tanks, and escaping LPG formed a vapor cloud that engulfed the freighter and was ignited by an unknown source. The burning gas formed a fireball hundreds of feet high that lasted less than one minute and ignited combustibles on the freighter, the dock, a towboat, and the nearby shoreline. Of 34 persons hospitalized for burns, nine died. Three bodies were recovered from the river.

• Map 80-2: On Nov. 8, 1979, a train derailed near Inwood, Ind., and flammable and corrosive products leaked from eight breached tank cars. A small fire was noted later at the derailment site. The derailed cars contained acetic anhydride (leaked), butyl cellosolve (leaked), butyl methacrylate, ethyl acrylate (leaked), ethyl chloride, ethylene oxide, isobutyl alcohol (leaked), methacrylic acid (leaked), propylene naphtha, propylene oxide, sodium hydroxide, and vinyl acetate. Nearby residents reported symptoms of nausea, headache, dizziness, watering eyes, burning throat, nasal irritation, congestion, and tightness in the chest, in addition to an "obnoxious, acid-type odor." In addition to airborne and

surface effects the release led to subsurface effects as the chemicals leached into the soil.

In its 1978 investigation, NTSB heard from emergency response personnel, who reported problems encountered in developing pre-emergency plans and making tactical decisions during emergencies such as these. For preplanning or on-scene decision making, Rote explains, emergency response personnel need answers to five questions: Where is the hazardous material or container likely to go if released during the emergency? Why is the hazardous material likely to go there? When is the material likely to go there? How will the material get there? What harm will occur when the material gets there?

To meet users' needs, NTSB established some basic criteria for map base choice, information content, and layout. It considered essential a map base with a uniform scale, available nationwide, at low cost to all users. For this purpose, it chose the U.S. Geological Survey 7½-minute series, 1:24,000 scale, topographic map series as the standard mapping base. The standard also provides for scales of 1:12,000 or 1:6000 to permit reporting of small release patterns.

In mapping, Rote points out, time sequencing is important for emergency response personnel. Consequently, maps try to show the growth of the hazardous material dispersion pattern, changes in area affected due to environmental conditions such as wind direction, changes in number of people affected, or other changes in the hazardous material behavior that affect emergency response actions.

Both surface and airborne effects are displayed from observed data, supplemented by estimates suggested by comments of witnesses. A shaded area is used to show estimated surface effects, with solid lines enclosing observed surface effect patterns. A dotted line represents the boundary of airborne effects, and a dashed line the observed boundary.

Weather conditions at the times mapped are displayed in a block indicating wind direction and speed, sky condition, precipitation, visibility, and air temperature. An x,y coordinate grid system is used to pinpoint the locations of fatal exposures. And descriptive data about the accident are provided in a box containing type of accident, date and time of accident, time of event displayed, time after initial hazardous material release, product released, map base, and map scale.

NTSB expects the spill maps to find a number of applications—for example, model verification, release



## Chemical & Engineering

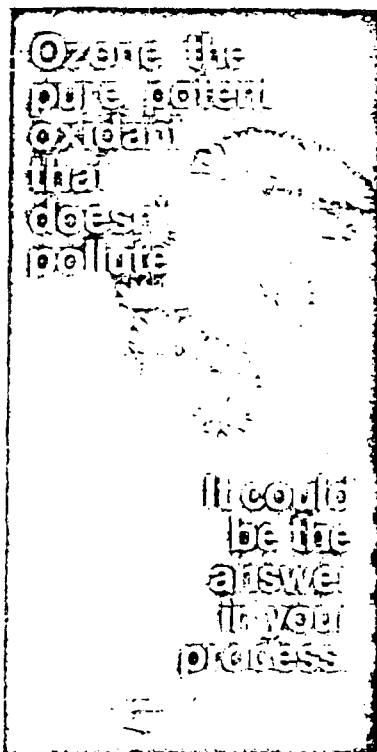
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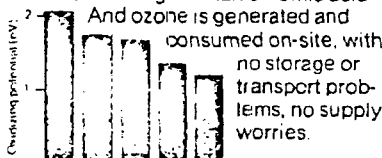


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comparisons, and accident simulations. Also, Rote points out, mapping may be expanded from recording releases due to transportation accidents to mapping other types of releases, such as at storage or manufacturing facilities. Regulatory agencies might also find the maps useful.

NTSB expects that in the future spill maps will aid on-scene response activities. Stored maps and associated data could be recalled at a one-call information center to help local

emergency personnel during an actual emergency.

Although NTSB is preparing the maps now, it expects that eventually it will be necessary to establish a clearinghouse for map publication and distribution. The Safety Board, Rote points out, isn't equipped to handle such a large project, which would likely include maps for non-transportation uses. Thus, public or private agencies may have to share the task. □

## Changing priorities may reshape oil refineries

Before crude oil prices soared in the mid-1970's, a popular technical exercise was depicting the petroleum refinery of the future. In addition to being a source for the usual mix of fuels, the future refinery was often viewed as a source of an ever greater number of feedstocks and even some consumer chemicals. The trend would be toward bigger and more complex refineries serving a greater variety of customers.

The tendency to depict the refinery of the future persists, but the objectives have changed.

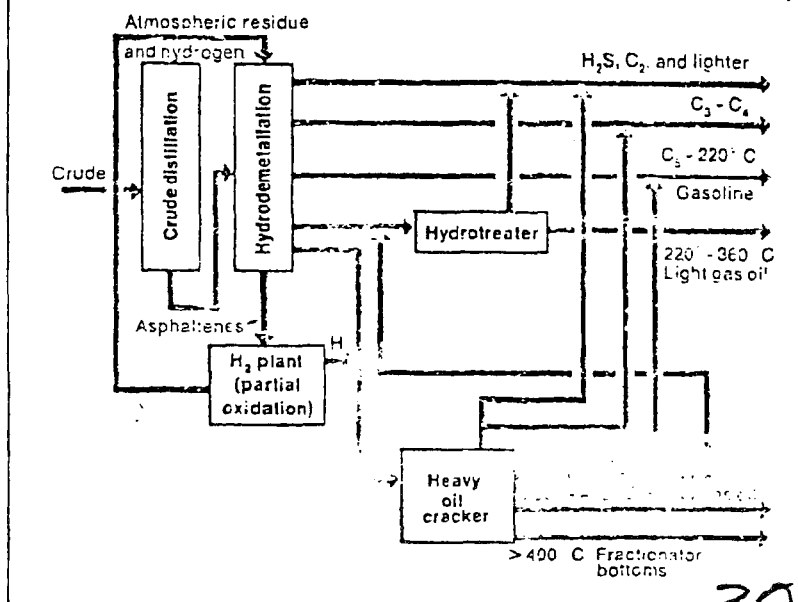
For example, James R. Murphy, manager of process technology for Pullman Kellogg, addressing Petrotech-80 in Amsterdam late last month, noted that petroleum refiners in the future will be processing heavier, more viscous crudes containing more contaminants. Some evolutionary changes in refinery configuration will be required, he says, but

there may be some minor revolutionary changes as well.

The high cost of crude oil, Murphy says, will require that a minimum amount of crude be processed for a given product output. That could pose some stringent technical requirements for designers. Future product demand will be almost entirely for transportation fuels with a minimum production of petrochemical feedstocks. That's the exact opposite of the usual assumptions a decade ago. There certainly will be no by-products with a market value less than that of the parent crude oil.

Residual fuel production will be discontinued altogether, he says. Future refineries will have considerable hydrogenation and desulfurization capacity, but the hydrogen to feed it no longer will come from steam reforming of naphtha or light hydrocarbons. Instead it will come from residual asphaltene or pitch.

### Refinery of future will process atmospheric residue to fuels



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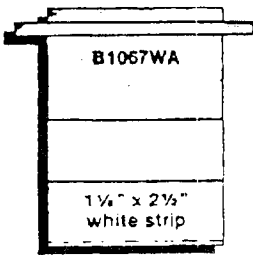
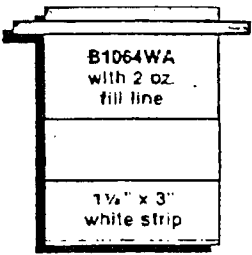
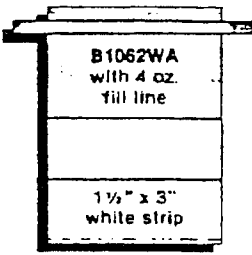
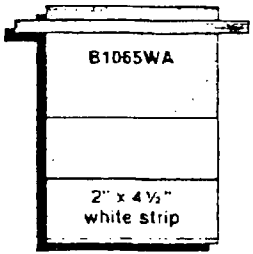


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1 1/2" x 2 1/2" white strip	1 1/2" x 3" white strip	1 1/2" x 3" white strip	2" x 4 1/2" white strip
milk samples for automated equipment	milk samples, packaging	milk samples, water samples, food samples	milk samples, food samples, powder samples

500 per box — 10M per master on 1, 2, and 6 oz.  
6M per master on 18 oz.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE MAR 13 1981

SUBJECT Nationwide Approval for the Use of NASCO Whirl-Pak Bags

FROM Victor J. Kimm, Deputy Assistant Administrator  
Office of Drinking Water (WH-550)

TO All Regional Administrators

Listed below is an alternate method of collecting potable water samples using a product which I have approved for nationwide use for "National Interim Primary Drinking Water Regulation" (NIPDWR) compliance monitoring, total coliform bacteria only.

Data provided to and statistically analyzed by the Environmental Monitoring and Support Laboratory (EMSL) in Cincinnati have shown that the product in question, when used in accordance with the manufacturer's instructions, will meet the container specifications contained in Standard Methods.

Measurement: Total Coliform Bacteria

Step: Sample Collection

Product:<sup>1</sup>NASCO Whirl-Pak Sterilized Water Sampling Bags  
containing sodium thiosulfate

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<sup>1</sup> This product is available from NASCO; 901 Janesville Avenue;  
Port Atkinson, Wisconsin; 53538

cc: Regional Water Supply Representatives  
Robert L. Booth, Acting Director, EMSL



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# THE HANDBOOK OF HAZARDOUS WASTE MANAGEMENT

by  
Amir A. Metry, Ph.D., P.E.

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NORMA S. FUJIKAWA  
Manager  
SSFL Analytical Chemistry

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CAPITAL EQUIPMENT REQUIREMENTS  
CURRENTLY PROJECTED FOR  
PHASE II

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TABLE 4 - CAPITAL EQUIPMENT REQUIREMENTS FOR PHASE II  
(PRELIMINARY ESTIMATE)

(Provided that the decision is made for the work to be  
done in-house by the SSFL Analytical Chemistry Unit)

<u>INSTRUMENT</u>	<u>APPROX. COST</u> <u>\$1981</u>	<u>PURPOSE</u>
Thermal Analysis Systems	\$32,000	Examine samples for reactivity according to the Federal Register - ASTM methods.
Ion Chromatograph	\$33,000	Excellent screening instrument for examining organic and inorganic ions more quickly than classical wet chemical techniques.
Inductively Coupled Plasma Atomic Emission Attachment for the Rocketdyne-owned Atomic Absorption Spectrophotometer	\$80,000	Rapid-fire analysis instrumentation suggested by EPA but not currently required because the whole package (aa+ICP) amounts to \$130,000.
Gas Chromatograph/ Mass Spectograph Computer Data + Tape Storage Systems	\$55,000	To provide the accessible data base of samples, standards, profiles already established at SSFL to use for all future cases as well as provide graphical representation of information gleaned in the event that litigation requires such declaration of technical data and performance of compliance.

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These highly reactive hazardous substances are substances which:

1. Autopolymerize
2. React vigorously with air or water
3. Are unstable with respect to heat or shock
4. Are strong oxidizing agents
5. React readily to give off toxic fumes
6. Are explosive

These categories are not discrete, but overlap. For instance, some peroxides would fit four of the above categories.

All these categories (except 4) usually require an external impetus to precipitate the reaction either in the form of energy as a "shock" or the addition of an initiating agent.

One common link among highly reactive substances, and an important reason for their hazardousness, is that their reactions can cause the formation of steep temperature or pressure gradients with time. There are standard methods of testing for and measuring these effects. Differential Thermal Analysis DTA (ASTM E475) is one procedure that can be used to identify wastes which give off large amounts of heat when reacting. The procedure consists of confining the sample in a specially designed vessel equipped with a shielded thermal-couple.

# THE HANDBOOK OF HAZARDOUS WASTE MANAGEMENT

by  
Amir A. Metry, Ph.D., P.E.

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1981  $\approx$  \$32,000

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Adhesives	Curing of Adhesives	Independent Research Labs	Contract Research
Aerospace	Carbon Fiber Laminates	Inorganic Chemical	Thermal Stability
Appliances	Analyze Plastic Housings	Instruments	Printed Circuit Boards
Automotive	Characterize Polypropylene Interior Panels	Medical Devices	Coatings on Implants
Biological	Phase Transition in Lipids	Metals	Melting Points, Phase Diagrams
Building Materials	Loss of Water in Cements, Hydration Forms	Non-Ferrous Metals	Protective Coatings
Chemicals	Phase Diagrams and Stability	Office Equipment	Curing of Toner Resins
Clay Minerals	Product Control, Composition	Organic Chemicals	Melting Points, Thermal Stability
Coal	Combustion Analysis and Coal Conversion Research	Packaging	Analyze Polyethylene
Communications	ABS in Telephones	Paint	Solvent Loss, Softening Point
Computers	Stability of Plastic Components	Petroleum	Cloud Point and Pour Point
Construction	Plastic Housing and Plumbing Materials	Pharmaceutical	Purity, Stability, Phase Diagrams
Containers	Epoxy Coating on Aluminum Cans	Photographic	Characterize Polyester Film Base
Cosmetics	Melting of Waxy Substrate	Plastics	Melting Points, Glass Transitions
Dairy	Melting Characteristics of Butter	Polymers	Effect of Additives and Fillers
Displays	Temperature Stability of Liquid Crystals	Power Tools	Magnet Wire Insulation
Education	Specific Laboratory Projects	Pulp and Paper	Free and Bound Water
Elastomers	Glass Transition Temperatures	Resins	Effect of Catalysts on Cure
Electrical	Oxidative Stability of Insulation	Rubber	Glass Transition Temperature
Electronics	Epoxy, Solder, Insulation	Semiconductors	Curing of Encapsulating Materials
Fertilizers	Decomposition of Fertilizers	Steel	Stress Relief
Films	Melting of Polyester Films	Sporting Equipment	Reliability of Nylon Tennis Strings
Food	Solid Fat Index of Fats	Textiles	Effect of Flame Retardants
Glass	Softening Point	Tires	Sulfur Cross-Linking of Rubber
		Waxes	Melting Profiles, Crystallinity
		Wire and Cable	Cross-Linking of Insulation

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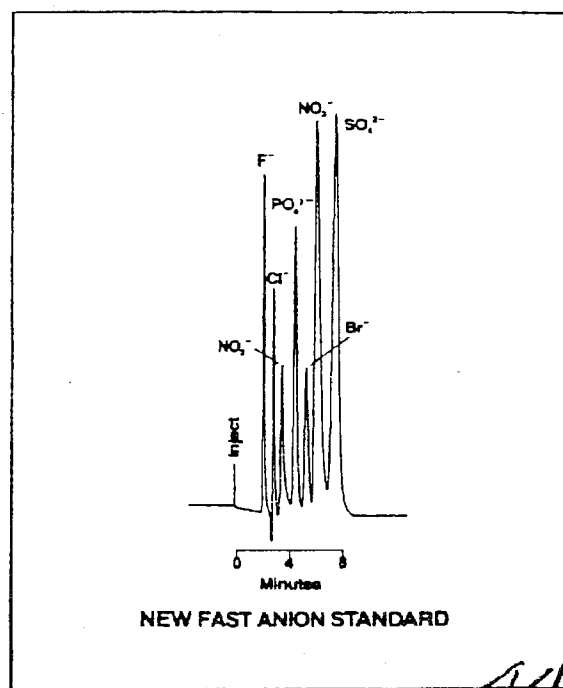
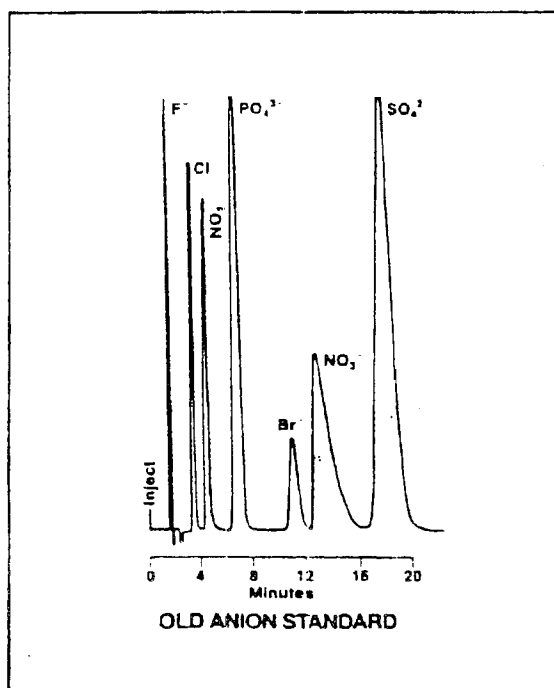
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FROM  
MARTY ROBERTSON

## Combining AA and ICP

①

IN RECENT YEARS there has been growing interest in inductively coupled plasma (ICP) atomic emission. Because ICP and atomic absorption spectroscopy (AAS) are complementary techniques, it was felt that a thorough examination of both techniques and their relationship to each other would prove useful. Such a study would have two purposes: to compare the advantages and disadvantages of each technique and to determine the feasibility of combining ICP and AAS in a single instrument. The results of this study and the development of an instrument for performing AAS and ICP are reported here.

### *Comparison of AAS and ICP*

Because many papers have been written on both AAS and ICP and excellent review papers are available on ICP emission,<sup>1-3</sup> this report will not go into the fundamental details of what a plasma is or how it works. Instead, it will examine closely the relationships between the two techniques and how they can be used to complement each other.

Atomic absorption is the older of the two techniques, dating back to 1955 when Sir Alan Walsh first reported on AAS as an analytical tool.<sup>4</sup> A consider-

able amount of material written since then has made AAS extremely well documented and easy to use on a routine basis. Detailed methodology exists for most kinds of applications. The development and growth of ICP emission have occurred more recently. The information available, particularly in terms of applications, is less comprehensive, but is increasing as more laboratories acquire ICPs. The review articles mentioned earlier include references to a large number of papers dealing with ICP emission and applications.

The greatest analytical capability of ICP emission is that refractory elements such as boron, phosphorus, tungsten, zirconium, niobium, and uranium are determined very easily. These elements can be determined by AAS only at high concentration levels. Even the development of the graphite furnace has not eliminated or changed this problem significantly. For most elements the detection limits for the ICP are somewhat better than for flame AA, but not nearly as good as for graphite furnace AA.

Because of the extremely high temperatures and long residence times associated with the plasma, ICP emission is noted for its lack of matrix interferences, known as chemical interferences in AAS. A classic illustration is the depression of a calcium signal by aluminum or phosphate in flame AAS. In ICP emission this depressive effect is not noticed until the con-

centrations of the interfering species are much higher. The interferences that are observed may actually be due to physical effects such as viscosity rather than to chemical effects. Another common flame AA interference is caused by ionization of easily ionized species such as the alkali metals. With ICP emission the degree of ionization is controlled, and ionization interferences do not appear to be a problem. With AAS, these interferences have been identified and in general they are very easy to control. The main advantage of ICP emission in this regard is that no special sample preparation is required to control chemical and ionization interferences.

Until recently most ICPs have been designed to perform simultaneous multielement analyses—as many as 60 elements simultaneously. For applications in which a large number of elements are to be determined in each sample, this is by far the quickest way to run samples. Because the plasma itself is an optically thin emission source, the linear working range associated with ICPs is around four to six orders of magnitude, which means that the determination of trace to major constituents can be performed simultaneously with the same sample preparation and dilution. For laboratories in which the same types of samples are always run, a system such as this can be useful.

However, for many laborator-

*Mr. Hanson is Senior Product Specialist, Atomic Spectroscopy, and Mr. Ediger is Manager, Plasma Emission Product Development, Perkin-Elmer Corporation.*

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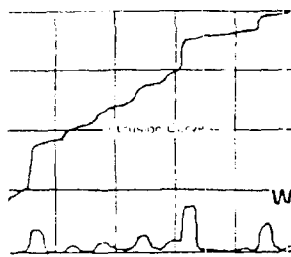
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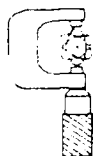


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ies new and different sample types must be run. Using a direct reading spectrometer, the analyst is limited to running elements and sample types that were identified at the time of purchase. A need has arisen for instruments that use the ICP as a source but have a scanning monochromator rather than a polychromator. Both Fassel<sup>1</sup> and Boumans<sup>2</sup> have recognized the need for and place of sequential ICPs. A direct-reading spectrometer is inflexible not only in terms of the elements it can determine but also the wavelength it uses for each element. The best emission line for boron in water is not the best one for boron in steel because of spectral interferences from iron. This is true for many other elements as well.

The problem of spectral interferences is one that generally has been ignored by most ICP users. However, several common spectral interferences have been identified.<sup>3</sup> Two are shown in Figure 1. This does not present a problem with a sequential ICP because other wavelengths, either ionic or atomic in nature, can be used. Atomic absorption spectroscopy, however, is relatively free of spectral interferences because the emission source is either the element of interest plus a fill gas or, at most, several elements, when multielement lamps are used. Therefore, it is easy to isolate a given resonance peak and perform quantitative analysis free from possible spectral interferences. Atomic absorption has always had the advantage of specificity.

An additional advantage of AAS has been the relatively low cost of the instrumentation in comparison to the costs of ICPs with multichannel capabilities; many laboratories unable to afford ICPs turned to AAS. If the number of elements to be deter-



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background correction measurements being made at different intervals on each side of the peak to determine baseline position accurately.

#### ICP 5000 system

It is apparent that one instrument may be used for both AAS and ICP emission, if the AA meets certain specifications. The basic components of an AA essentially are the same as those required for emission. The only difference is that AAS requires a light source and emission does not. Most AAs have the capacity to perform AA and flame emission. However, when an ICP is used as an emission source, some of the optical requirements are changed. For this reason, not all AAs can be used for AAS and ICP.

To perform the tests comparing AAS and ICP, an interface was built to transfer light from the ICP to a model 5000 spectrophotometer (Perkin-Elmer). The 5000 was designed to incorporate the features required for ICP emission. It has a high-dispersion monochromator with a reciprocal linear dispersion of 0.65 nm/mm in the first order and a resolution of  $\sim 0.03$  nm. With ICP it is important to have good resolution because of the large number of emission lines present. The fact that an ICP is such a good source creates problems in terms of being able to resolve the analytically useful emission lines from the other lines.

The instrument grating is driven by a digital stepper motor controlled by the built-in microcomputer. To perform ICP work satisfactorily it is important to have the control and accuracy that only a computer and digital stepper motor can provide. Because there are so many emission lines present with a typical

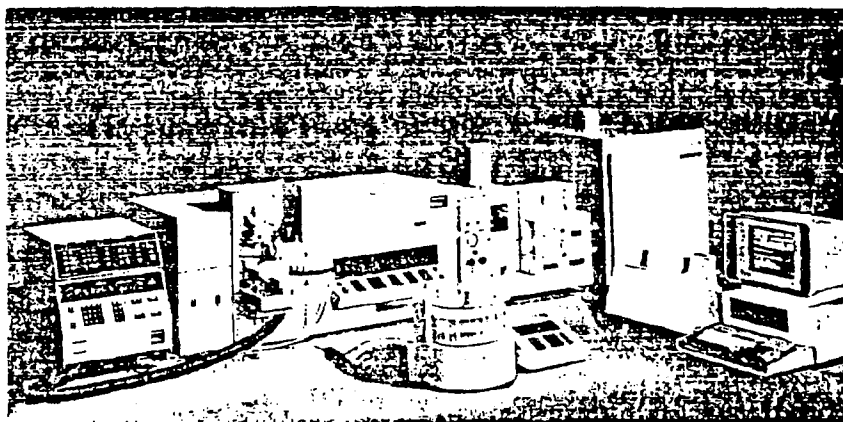


Figure 3 The ICP system, including the torch assembly and power supply, autosamplers, and data system.

sample, the wavelength setting must be very accurate in order to find the correct peak. This is true for any sequential ICP if it is to be operated in an automatic mode.

Stray light and the problems associated with it have been discussed in detail by Larsen et al.<sup>4</sup> A major source of stray light, known as Rowland ghost, is the imperfection is a ruled grating caused by periodic errors in grating groove spacing. These errors are a result of mechanical imperfections in the ruling engine used to make the master gratings. These imperfections and the Rowland ghost can be eliminated by using holographically recorded gratings. Holographic gratings are produced by using an interference phenomenon impinged on a glass plate with an optically flat surface coated with a photosensitive material. Gratings produced in this manner are free of periodic errors in groove spacing and also exhibit low levels of total scattered light.

To maintain optical efficiency for optimum AA performance, the holographic grating is blazed at 210 nm and designed for use

between 175 and 465 nm. In this wavelength region the optical efficiency is very close to that of a conventionally ruled grating blazed at 210 nm. Above 465 nm a ruled grating blazed at 580 nm is used to provide optimum performance in the visible region. Because very few elements are determined above 465 nm and stray light is not a significant problem, a holographic grating is not required.

For easy switchover from AA to ICP, the system (Figure 3) was designed with the ICP permanently mounted on one end. The graphite furnace or burner for flame AA is mounted in the normal position for AA. Changeover from AA to ICP is achieved by turning a knob. An optical interface to transfer emission from the ICP to the monochromator was installed between the ICP and the 5000. The viewing height of the plasma is controlled at the interface. With this particular torch and configuration the most common viewing height is approximately 15 mm above the coil, but this can be adjusted as needed.

The instrument is capable of having the entire optical path

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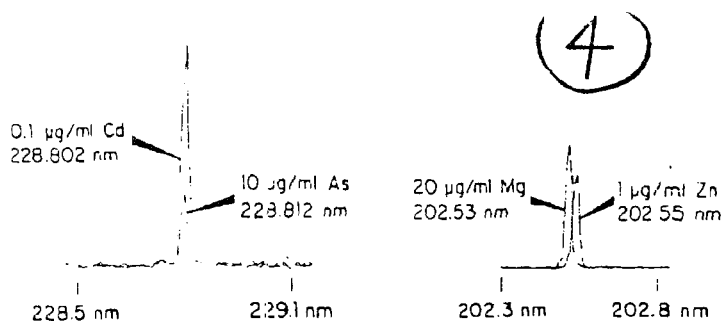


Figure 1 Two examples of spectral interferences with ICP. a) The direct line coincidence of cadmium at 228.802 nm and arsenic at 228.812 nm, and b) a near spectral overlap of magnesium at 202.53 nm and zinc at 202.55 nm.

mined in each sample is small, AAS is not only less expensive but faster.

Some analytical problems also can be solved more readily with AAS than with ICP. If high precision (CV <0.3%) is desired for an analysis, flame AAS is the method of choice. Although significant improvements have been made in sample introduction with ICPs, precision still remains poorer than with flame AAS (CV of 0.5 to 1.0% for ICP). As further progress is made in understanding the fundamentals of sample introduction and atomization processes with ICPs, this precision difference may become progressively smaller.

One of the biggest advantages of AAS is its ability to use other types of atomization sources, such as graphite furnaces and mercury/hydride systems. Both alternate sources have greatly lowered detection limits for elements that can be determined with them. With the graphite furnace, detection limits are as much as two orders of magnitude lower than with ICP emission. In addition, microliters of sample are used as opposed to the 1-2 milliliters normally used with an ICP. If desired, in some situations solid samples can be run directly in the graphite furnace.

In environmental chemistry there is a great deal of interest in determining mercury, arsenic, and selenium. These elements are best determined by using a mercury/hydride generator with an AA. The capability of AAS to be used with these alternate atomization systems gives it a flexibility not yet completely realized by ICP. Although hydride

generation has been applied to the ICP,<sup>9</sup> significant problems are caused by background shifts as hydrogen-containing gases pass through the plasma.

Background emission due to stray light is another problem in ICP instruments. The stray light can be caused by grating imperfections or by poor spectrometer design. In early polychromator systems, the problem of dealing with this background had been severe. Many systems now have an accessory to perform background correction, but this may limit their flexibility for dealing with different elements and samples. Properly designed sequential ICPs, however, have the capability to measure background on one or both sides of the peak at varying intervals, a versatile means of background correction. Stray light has been reduced in some instruments by a factor of 3-10, depending on conditions, with the use of holographic gratings. Figure 2 shows

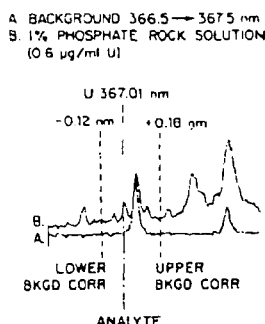


Figure 2 An example of uranium determination in phosphate rock. The background is measured at 0.12 nm below the analyte peak and 0.18 nm above.

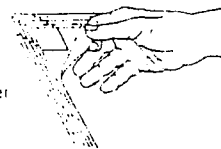
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BNA03472475

ICP/5000  
METALLURGICAL ANALYSIS

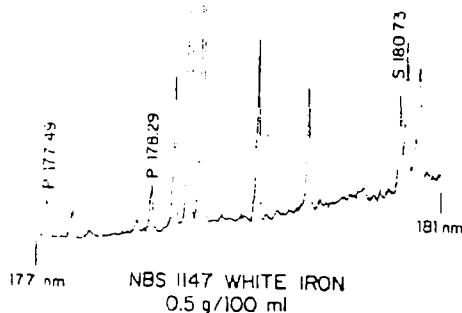


Figure 4 Spectrum of phosphorus and sulfur in an iron matrix. The spectral region shown is 177 to 181 nm.

purged with an inert gas such as argon or nitrogen, thus extending the working range of the instrument down to 175 nm. For sulfur, the most sensitive analytical lines, 180.73 nm and 182.04 nm, occur in the vacuum ultraviolet. The detection limit for sulfur at 180.73 nm is a factor of ~100 better than it is at 190.03 nm, the most sensitive wavelength outside the vacuum uv. For other elements, such as phosphorus and boron, the vacuum uv provides a wavelength region with few spectral interferences, particularly when iron is in the matrix being analyzed. Figure 4 shows a spectrum of phosphorus and sulfur in an iron matrix between 177 and 181 nm. Nitrogen was used as the purge gas.

For maximization of the system's capabilities a computer is needed for control and to collect the data. In this case a dedicated microcomputer with full ASCII keyboard and a CRT display is used. The computer has 64K of memory with dual floppy disk drive. The disks are used to store instrument operating parameters and the basic system software. In addition, the computer is programmable in BASIC for use as a laboratory computer. All

parameters for the 5000 during ICP operation are controlled by the computer. Because the operator is prompted by the computer, prior computer training is unnecessary.

#### Software

Software has been developed that controls all instrument parameters, peak finding, quantitation of results, and statistical analysis of the ICP/5000. The software has two operating modes, one for single-element and one for multielement analyses. Because the multielement mode is made up of a series of single element programs, the single-element program will be discussed first.

When the operator chooses the single-element mode by pressing the appropriate function key a form appears on the CRT. To set up the instrument to run the element of interest, the operator completes the form that appears on the screen by entering data through the keyboard. Once the form has been completed, the information, along with the file name and remarks, can be transferred to a library disk for long-term storage. The process of storing parameters or recalling them

is performed by pressing one of the labeled function keys above the keyboard. All commonly-used commands have a function key so that operators need not memorize them.

Once the program has been established and stored, the operator depresses the RUN MANUAL or RUN AUTO function key, depending on whether the analysis will be performed manually or in conjunction with the AS-50 autosampler. After the RUN MANUAL key is depressed, the operator is given the opportunity to retain an existing wavelength calibration. The operator then is asked to aspirate the first standard and press READ. When this step is completed the next instruction is to aspirate the blank and press READ. This same sequence continues for up to four more standards and for each sample to be analyzed. When the RUN AUTO mode is being used, the format is the same except that the CRT displays instructions for setting up the AS-50 autosampler. After it is set up, READ is pressed, and the data system assumes control.

If a multielement program is desired, it is first necessary to fill in a single-element parameter form for each element to be determined. The multielement program is designed so that up to 20 elements can be determined. After all single-element conditions have been entered along with a method file name, the entire program can be stored on a floppy disk. Once the conditions and parameters have been established, the analysis proceeds in the same way as the single-element analysis with the exception that each element is determined sequentially starting with the lowest wavelength and going in order to the highest.

Finally, the capability to perform background correction at varying intervals on one or both



6

sides of the analyte peak is an integral part of the software for the ICP/5000. The importance of being able to vary the intervals at which the background is measured has been shown.<sup>10</sup> An example of a situation in which this would arise is shown in Figure 2.

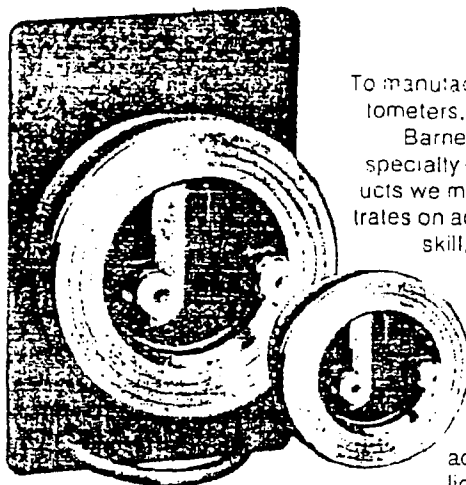
#### Conclusion

The authors' aim was to show the complementary nature of ICP emission and atomic absorption. The data demonstrated that both techniques have a place in the analytical laboratory and should be used in conjunction with each other. A second goal was to determine if an ICP could be successfully interfaced to an AA. This was proved feasible with an instrument that can be operated at optimal conditions for either technique.

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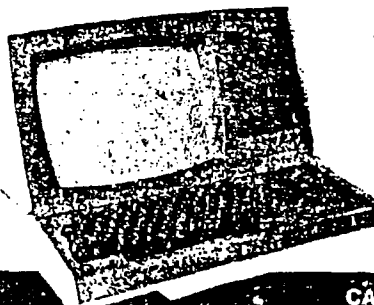
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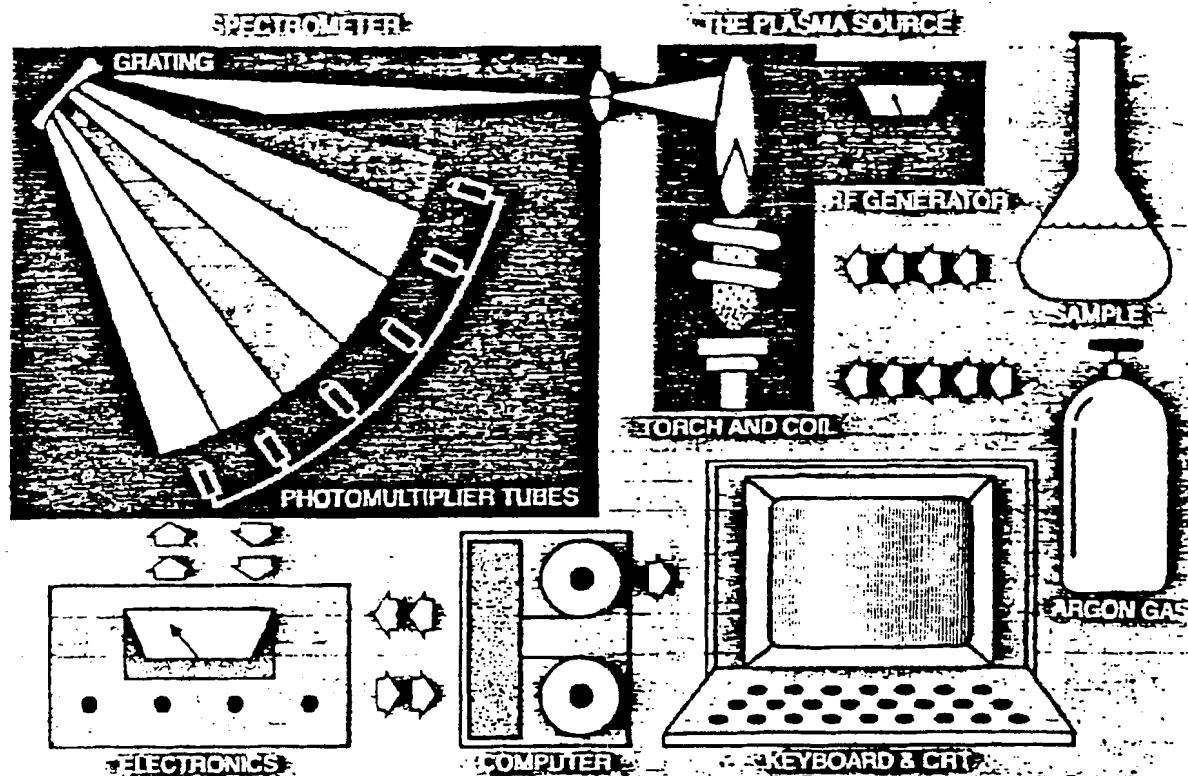
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BNA03472477

AA ATTACHMENT = 1981 = \$80,000

## principles of operation



The JY-48P Direct Reading Plasma Elemental Analyzer is designed to perform rapid simultaneous multi-element chemical analysis on a large variety of samples. Typical examples of materials that can be analyzed by the JY-48P include, water and waste water samples, oil samples (including additives and wear oils), sludges, biologicals, geologicals, metals, alloys, etc. The general principles of operation of the JY-48P are relatively simple. Radio frequency radiation is used to heat a flow of argon gas into a plasma by means of an induction coil. When a sample is introduced into this extremely hot (5000 to

10000 K) argon plasma, the sample is broken down into individual atoms, which are then further excited by the plasma. These excited atoms then will re-emit this energy as electromagnetic radiation (light) which is characteristic of their respective chemical elements. The emitted light is then passed into the spectrometer of the JY-48P. The spectrometer disperses the light across its focal curve, separating the various emission lines present in the radiation. At appropriate positions on the focal curve are positioned photomultiplier tubes, one for each analytical line desired on the system. These convert the light energy

emitted by the atoms into electrical currents. The current from each photomultiplier tube is integrated over a period of time (on the order of seconds), and then digitized so that the data may be fed into a computer for storage and calculations. Analytical results can then be printed out on the computer terminal or displayed on a video screen. The computer, besides collecting data and calculating results, also controls the overall functioning of the spectrometer, making the system reasonably "automatic" and removing from the system operator dependence.

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ICP



BNA03472478

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## Internal Letter



Rockwell International

Date . 21 June 1982

No . 82FE-212

TO : F. Feaster  
Rocketdyne-DeSoto  
553, 055-CA08

FROM : M. A. Francis  
Rocketdyne-DeSoto  
541, 055-FB12  
5726

Subject . Burn Pit Cleanup

It is requested that the bidding for the excavation, transportation, and disposal of the material from the burn pit be reopened. This request is being made because the original specification did not classify the material to be removed as "non-hazardous". This point may not have been clear to the bidders.

Attached is the revised specification for the work to be performed, blueprint of the burn pit, a discussion paper describing the soil sampling results, and letters from the California Department of Health Services and the Regional Water Quality Control Board.

Please include all of these documents as a part of the specification.

M. A. Francis  
Environmental Control Specialist  
Facilities Engineering

MAF:lh

Attachments - As Noted

APPROVED:

J. A. Bowman, Manager  
Facilities Engineering

cc w/o attachments:

W. J. Costas	540, 055-FB68
S. Gardner	553, 055-CA08
R. D. Schmued	541, 055-FB12



BNA03136096

Services To Be Performed:

1. Provide labor and equipment to excavate 2,000 tons (approximately 1,500 cubic yards) of non-hazardous soil, hardware, and burnt out propellant containers from the SSFL Burn Pit area. The actual tonnage removed + the 2,000 tons will be adjusted and reflected in the costs. The accounting of the tons of waste removed and disposed will be based on certified weight documents from the disposal facility.

The hardware, containers, and soil have been selectively sampled and analyzed. From the results of these analyses, it has been determined by the California Department of Health Services and the California Regional Water Quality Control Board that the material is non-hazardous. (Letters from above-mentioned agencies and lab results are enclosed.)

2. The area to be excavated is identified as "Buried Debris Area" and "Sediment Area" on the enclosed drawing labeled Plate 1. These areas are to be excavated to a depth of 4 feet from the existing surface.
3. All soil and debris excavated shall be transported in compliance with the Department of Transportation regulations by a registered hauler.
4. All soil and debris excavated shall be disposed of in a Class I landfill. This requirement is per the RWQCB.



BNA03136097



Rocketdyne Division  
6633 Canoga Avenue  
Canoga Park, California 91304

Rockwell  
International

Telex: 698478

22 April 1982

In reply refer to 82RC04548

Regional Water Quality Control Board  
107 S. Broadway  
Suite 4027  
Los Angeles, CA 90012

Attention: Mr. H. Yacoub

Gentlemen:

The soil samples taken at Rocketdyne's "Burn-Pit" located at the Santa Susana Field Lab have been analyzed, and the analyses are herewith being submitted to you for your review and evaluation. Samples were taken in two sets. The first set of eleven samples were taken on October 15, 1981. These were analyzed according to EPA methods. The sampling locations were selected on the basis of disposals, which consisted primarily of the combustion of the chemicals and the burial of residue and containers, in some instances.

The second sampling was performed on February 5, 1982 after a radar scan had been performed to identify locations of buried materials. A 40 ft. long and three foot deep trench was cut in the area, which was expected to represent the highest potential for contamination. The sides of this trench were sampled extensively (8 samples) in areas which showed physical evidence of contamination or odors. The second set as well as one split sample of the earlier set were analyzed according to the procedures outlined by the State Department of Health Services' California Assessment Manual.

The sampling results bear out Rocketdyne's belief that any contamination which may have occurred as a result of its disposal activities is very minimal. Sampling has been performed at the sites where contamination was expected to be at its worst, yet only isolated instances of marginally hazardous materials or concentrations have been found. Rocketdyne will remove 1400 cubic feet of the slightly contaminated soil as indicated on the plan of the Burn Pit site. It is requested that the Regional Water Quality Control Board and the State Department of Health Services approve the disposal of this soil at a Class 1 site as a non-hazardous waste. It is our belief that waste constituents which are now generally at or near limits of detection will be completely undetectable when mixed more homogeneously within the soil and spread at the landfill.



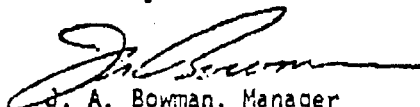
BNA03134552

Regional Water Quality Control Board  
Attention: Mr. H. Yacoub  
22 April 1982  
Page 2

For further information please telephone Mr. M. A. Francis, (213) 700-5726  
or Mr. R. D. Schmued, (213) 700-5814.

Very truly yours,

ROCKWELL INTERNATIONAL  
Rocketdyne Division



J. A. Bowman, Manager  
Facilities Engineering

JAB:ekv

Enclosure : Chemical analyses of contaminated soil samples



BNA03134553

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GROUNDWATER RESOURCES CONSULTANTS, INC.

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DATE: June 3, 1992TO: Dean Crippen 1 Rocketdyne  
(PERSON) (COMPANY)FROM: Dawn GarciaNumber of pages, including this page: 3

IF YOU DO NOT RECEIVE ALL PAGES, CALL:

(602) 326-1898

COMMENTS: In response to your questions on the Area I Thermal Treatment Unit: ① The reference on page 9 regarding disposal of 1400 cubic feet of soil came from a Rocketdyne letter (copy attached). It's possible that the 1600 cubic yards of soil were segregated and only 1400 cubic feet required Class I disposal. However, I don't know how to resolve the discrepancy. ② The reference on page 4 regarding the removal time came from a telephone conversation with you on December 5, 1991. The understanding at the time was that the features shown on the 1981 map were primarily removed in 1989 & maybe some in 1982.

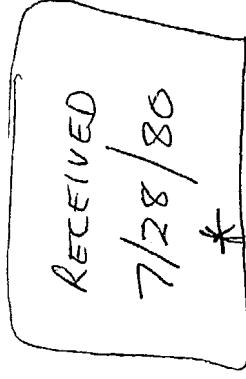
PROJECT NO.: 860  
OUR FAX NO.: (602) 325-0171I hope that this info helps!

• WATER SUPPLY DEVELOPMENT • GROUNDWATER CONTAMINATION INVESTIGATIONS •



BNA03134554

To: Norma Fujikawa  
From: Michael Francis  
Subject: Burn Pit Disposal Inventory



Enclosed is a copy of the disposal inventory in which I prepared. I would appreciate your review of the list and comments on possible troublesome residues.

Thank you

→ M.A. Francis

ENVIRONMENTAL CONTROL ENGINEER

# BURN PIT

\* INFORMED      MICHAEL THAT I WOULD  
HAVE TO HAVE FUNDING APPROVED  
FIRST.



BNA00377083

## BURN B. DIGITAL INVENTORY

YEAR	MATERIAL	QUANTITY	SOURCE	DISPOSAL METHOD
1961	ACETONE	110 gal	CANOGA	BURN
		110 gal	B LAB	
1961	AMMONIA	205 gal	PHOTO	DILUTION
1961	BORON FUEL	110 gal	CANOGA	BURN
1961	BORON TRIFLUORIDE	240 ft <sup>3</sup>	A I	DESTRUCTION
		5 lbs	A LAB	
1961	CARBON TETRACHLORIDE	110 gal	B LAB	BURN
1961	CESIUM	2 lbs	CANOGA	BURN
1961	DECON. SOLN.	110 gal	CANOGA	DESTRUCTION
1961	DITTO FLUID	110 gal	CANOGA	BURN
1961	ETHYLENE DIAMINE	55 gal	SPA	BURN
1961	FLUSHING OIL	385 gal	CANOGA	BURN
1961	GASOLINE	110 gal	CTL 3	BURN
1961	GEAR OIL	165 gal	DRUM STORAGE	BURN
1961	HEPTANE	500 gal	QUIK MIX	BURN
1961	HEXANES	1045 gal	CANOGA	BURN
		55 gal	DRUM STORAGE	
		55 gal	B LAB	
	TOTAL	1155 gal		
1961	HYDRAULIC OIL	55 gal	CTL 4	BURN
1961	HYDRAZINE	6845 gal	CANOGA	BURN
		55 gal	DELTA	
		55 gal	CTL 3	
	TOTAL	6955 gal		
1961	ISOPROPYL ALCOHOL	110 gal	CANOGA	BURN
1961	LACQUER DILUT.	55 gal	DRUM STORAGE	BURN
1961	LITHIUM CHLORIDE	825 gal	CANOGA	DISSIPATION IN H <sub>2</sub> O
1961	MAGNESIUM	820 gal	SPA	BURN
1961	METHYL ALCOHOL	110 gal	B LAB	BURN
1961	MISC. FLAMABLES	21865 gal	CANOGA	BURN
1961	MISC. LAB CHEMICALS	200 gal	CANOGA CHEM	BURN
1961	MIXED OXIDES	300 lbs	SPA	BURN
		300 lbs	155	
	TOTAL	600 lbs		
1961	MYOVINE	5000 gal	SPA	BURN
		420 gal	155	
	TOTAL	5620 gal		



BNA00377084

Rockwell International Corporation  
Rocketdyne Division

Santa Susana Field Laboratory  
Ventura County, California

Area I Thermal Treatment Facility  
CAD 093 365 435

Revised Closure Plan

2 January 1992



BN A01368701



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- 5.0 POST CLOSURE



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Attachments

I) DHS Letter regarding completion of excavation and removal of hazardous wastes, Burn Pit Area, Santa Susana Field Lab

II) VIII Operational Procedures

III) V-B Thermal Treatment Facility Ash Residue Typical Analysis Results

IV) Sampling and Analysis Plan, Area I Thermal Treatment Facility 8640-158

V) LIABILITY REQUIREMENTS

VI) CLOSURE SCHEDULE

VII) 100-year Flood Plain Map

VIII) ANNUAL SURFACE WIND ROSE - Santa Susana Field Laboratory



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## 1.0 INTRODUCTION

This document has been prepared in response to a letter received by Rockwell International Corporation, Rocketdyne Division on 3 September 1991 from Lester Kaufman, Chief, Permits Section, Hazardous Waste Management Division, U.S. Environmental Protection Agency. Its Purpose is to present a revised closure plan which addresses inadequacies of the closure plan submitted as part of the Part A Interim status permit application for Area I Thermal Treatment area located at the Rockwell International Corporation, Rocketdyne Division's Santa Susana Field Laboratory. The Santa Susana Field Laboratory is located in the Simi Hills, Ventura County, California. The procedures describe how the permitted facility will be closed in a manner that will protect human health and the environment.

The owner/operator of the facility is Rockwell International Corporation, Rocketdyne Division. The facility is located at the top of Woolsey Canyon Road, Simi Hills, California. The mailing address for the facility is: 6633 Canoga Avenue, Canoga Park, California, 91303

## 2.0 SITE DESCRIPTION

### 2.1 DESCRIPTION AND HISTORY OF FACILITY

The Santa Susana Field Laboratory (SSFL) is a 2700 acre complex situated at an elevation of 1850 feet in the Simi Hills on the border of Ventura County and Los Angeles County. A map noting the location of both the SSFL and the Area I Thermal Treatment Facility is given as Figure 1 of the attached Sampling and Analysis Plan. Rockwell International Incorporated, Rocketdyne Division (Rocketdyne) operates and maintains a number of rocket engine test facilities and research and development laboratories at the SSFL.

At one location at the SSFL, propellant waste is generated in small bench-scale quantities at the NAKA Research Laboratory. (The acronym NAKA stands for North American Kindleberger Atwood, a hybrid description of a laboratory derived from the previous name of Rockwell International and the founders of the laboratory.)

The NAKA Research Laboratory is located approximately nine tenths of a mile from the Thermal Treatment Facility and is not a part of the permitted unit.

Research conducted at the NAKA Research Laboratory on solid rocket and gun propellants generates waste products and cleaning materials of which the hazardous constituent is explosive, reactive or ignitable. At the Component Test Laboratory III hypergolic rocket engine ignitors were both



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produced and experimented with. Thus, a number of hypergolic ignitors required disposal. The Area I Thermal Treatment Facility was an area used for the small scale destruction of explosive wastes by open burning.

Open burning and open detonation was chosen as an alternative to transporting potentially dangerous wastes through the community. It was felt that the explosive, reactive and ignitable wastes generated at the research laboratories could be safely and efficiently treated at a remote location at the SSFL.

Strong oxidizer compressed gases are also utilized at the SSFL in a variety of experiments and processes ranging from laser research to rocket propellant preparation. Occasionally, a compressed gas cylinder that could no longer be safely transported on public roads would be destroyed at the Area I Thermal Treatment Facility.

The Area I Thermal Treatment Facility is located in a cleared area on the south side of the facilities active portion of SSFL. See Figure 1 of the attached Sampling and Analysis Plan. Access to the Area I Thermal Treatment Facility is along the Area I Road and to the west of the Perimeter Pond. The area consists of a mostly unpaved area of reasonably flat terrain which is routinely graded to eliminate vegetation.

The western portion of the facility has been used for demonstrations and training activities by Santa Susana Fire Protection. It is flat and mostly vegetation free. There are several tables, buckets, and stands that were used for the training and demonstration purposes.

On the eastern portion of the Area I Thermal Treatment Facility there are two bermed area, and old control center wall and several hundred square feet of asphalt.

One berm is located on the south side of the facility and is approximately 8 feet in height and is "L" shaped. Within the berm is a 19.5 feet by 20 feet concrete pad which was built concave to prevent any liquids from running off. Two pipe bollards that have been modified to hold cylinders are attached to this pad. The berm surrounds the southern and eastern sides of the pad.

The second concrete pad is 6.5 feet by 6.5 feet and is surrounded on all sides by an 8-foot high soil berm. A burn cage measuring six feet by six feet by six feet covered with thick, densely woven steel mesh is housed on this pad. A longitudinally split 55 gallon steel drum was housed within the cage. Explosive materials and paper, the compounds TEA and TEB, etc. were loaded into a the split drum and ignited. The steel cage eliminated the possibility of waste materials escaping the facility while treatment was in progress. The



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cage also acted to control wind dispersal of the ash residue.

#### Facility operation 1958 to 1982

The Area I Thermal Treatment Unit was intermittently operated from 1958 to 1982. To provide permitting coverage for the facility it was initially permitted as a waste pile in 1980. The area was cleaned in 1982 under Department of Health Services authority (see letter dated 3 September 1982, Attachment 1-A). The Interim Status Document was amended to include the facility as a "Thermal Treatment" facility on 15 January 1990.

#### Facility operation 1982 to 1990

The wastes handled at the facility since 1982 are EPA characteristic wastes, D001 (ignitable) and D003 (reactive). These wastes include strong oxidizers and hypergolic propellants such as chlorine pentafluoride (a.k.a "Compound A"), Tetrafluorohydrazine, and solid propellant and reactive/ignitable scraps from R&D operations including HMX, RDX, ammonium perchlorate, nitrocellulose, and nitroglycerine. Associated with these wastes were limited quantities of solvents and kerosine used in the clean up and safe storage of the explosives.

## 2.2 GEOLOGY

Refer to the attached Sampling and Analysis Plan for a description of the geologic and hydrologic conditions.

### 2.2.1 RELATIONSHIP OF THE FACILITY TO THE 100-YEAR FLOODPLAIN

#### A. Floodplain Location

The Santa Susana Field Laboratory, which includes the Area I Thermal Treatment Facility, does not lie within the 100-year floodplain.

#### 1. Source of Data:

Federal Insurance Administration  
Department of Housing and Urban Development  
Flood Hazard Boundary Map  
Ventura County, California

Map No. 46, Revision Date - 10/18/77

#### 2. A Copy of the flood map is given in attachment VII.

#### 3. 100 - Year Flood Level:



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The SSFL Area I Thermal Treatment Facility is located along the top of a ridge in the Simi Hills. The SSFL is located at an approximate average elevation of 1,800 feet above sea level. The highest 100-year flood level projected for the valley areas on either side of the SSFL site is an elevation of approximately 1,200 feet.

No flood protection devices or procedures since the Santa Susana Field Laboratory lies above the 100 - year flood plain.

## 2.3 HYDROGEOLOGY

### 2.3.1 SURFACE WATER

Surface water from rainfall at the Area I Thermal Treatment Facility which does not infiltrate into the ground runs off to the Perimeter Pond which is sampled on a weekly basis for chlorides, nitrates, fluorides, arsenic, and volatile organic compounds. Historical data suggest the rainfall runoff from the area has not resulted in contamination at the sampling location.

The Perimeter Pond is part of the SSFL reclaimed water system. The reclaimed water system, during normal operation and rainfall events, eventually becomes full. The water from this system is then discharged to Bell Canyon Creek. Analysis of the discharge waters is performed as specified in the NPDES permit number CA0001309.

### 2.3.2 GROUND WATER

A discussion of the groundwater at the facility is provided in the attached Sample and Analysis Plan.

## 2.4 METEOROLOGY

A Annual Surface Wind Rose is given as attachment VIII. As can be seen there are predominantly north westerly winds with a significant amount of south easterly flow. Only a very small percentage of the flow is in a north easterly or south westerly direction.

## 2.5 PREVIOUS INVESTIGATION AND REMEDIATION

In early 1982, during the process of removing debris and waste from the Area I Thermal Treatment Facility, Rocketdyne notified the California Department of Health Services and the Regional Water Quality Control Board that significant concentrations of contamination were located. A map noting the locations of the previous excavation is included as Figure 6 of the attached Sampling and Analysis Plan.

The contaminants were excavated and disposed of in accordance with the California regulations under the



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oversight of Department of Health Services staff. Laboratory analysis of the soil samples following removal confirmed that the significant contamination was removed. Copies of the correspondence confirming contamination removal are found in attachment I.

## 2.6 QUANTITIES OF HAZARDOUS WASTE TREATED AT THE FACILITY

During a typical treatment event between .5 and one pound of waste explosive materials were treated. The estimated monthly quantity of wastes that were generated (and therefore disposed of) was approximately 30 pounds, dependent on the activity level, with an estimated average of 7 to 8 pounds per month. This quantity represents the total amount of waste generated by the NAKA Laboratory and includes the slurry waste generated.

The waste consisted primarily of paper towels and cotton swabs used for cleaning, explosive material and limited quantities of liquids. The amount of the wastes treated at the Area I Thermal Treatment Facility is listed in Table 1.

Table 1. Estimated quantities of hazardous wastes treated at the Area I Thermal Treatment Facility. These estimates are based on area treatment logs that were kept as part of the normal operation. The monthly values were derived from the average annual values from the treatment logs.

Increment	NAKA Propellents	TEA/TEB	Gas Cyl's
Per month (lb.)	24.72	1.92	1.28
Months per year	10	10	10
Years in operation	8	8	8
Estimated lbs treated	1977.36	153.6	102.4

## 2.7 PRE TREATMENT WASTE HANDLING

The explosive waste was accumulated near the generating area in an explosive test cell in velostat bags placed in an approved non-sparking aluminum container. Hazardous wastes were not stored at the Area I Thermal Treatment Facility.



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The handling processes for the explosive waste are discussed in detail in Operations Plan, Section VIII.

## 2.8 HAZARDOUS WASTE CHARACTERISTICS

### 2.8.1 PROPELLENTS

This section discusses the characteristics of the hazardous wastes handled at the Area I Thermal Treatment Facility.

Each bag of waste generated contained a small quantity of explosive material. The composition of the energetic material was placed on the bag label.

Each bag contained 0.5% to 5% (by weight) of the energetic material with the balance consisting of various cleaning materials such as paper towels and cotton tipped applicators, etc.

Some of the waste was generated in the cleaning of processing equipment. This waste consisted of oxygenated solvents, such as acetone, ethanol, isopropyl alcohol, and water containing trace amounts (less than five percent) of binders, oxidizers, plasticizers, and metals. For safety and handling purposes, this liquid slurry was mixed with an absorbent material to isolate potential explosive components and prevent any free liquids.

The monthly quantity of wastes generated from the NAKA Laboratory was between one and 50 pounds, depending on the activity, with an estimated average of 25 pounds per month.

### 2.8.2 PYROPHORIC WASTES

Each container of waste generated contained no more than 1/3 of a gallon of hypergol. The hypergol was covered with a layer of RP-1 to fill the container. This prevented spontaneous ignition during accumulation of the waste.

Small quantities of the surplus hypergolic compounds Triethylaluminum (TEA), and Triethylboron (TEB) were placed into a 55 gallon split steel drum located on the concrete pad and ignited. The waste materials were contained within the split drum to eliminate the possibility of soil contamination.

### 2.8.3 COMPRESSED GAS CYLINDERS

The contents of the occasional oxidizer compressed gas cylinder destined for detonation at the facility varied. All of the cylinders treated at the facility contained gases. Records indicate that the leaking or damaged cylinders containing such various gases as argon, hydrogen, fluorine, etc. were strapped to a metal pipe and pierced with a high-



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powered bullet. The piercing was performed following notification of the local Air Quality Management District.

## 2.9 TREATMENT RESIDUE MANAGEMENT

The composition of the waste propellant material treated was similar. It is therefore reasonable to assume that the treatment residues are similar. The products of treating the propellant wastes are carbon monoxide, carbon dioxide, water, nitrogen, nitrogen oxides, hydrogen chloride, potassium chloride, aluminum oxides, magnesium oxides, and carbon.

Following treatment of the propellant waste, the residue or ash was placed in a plastic container and a representative sample submitted to the Analytical Chemistry Laboratory for analysis of Title 22 metals. An example of a typical ash residue is attached as Attachment III. Based upon the results of the analysis, the ash residue was disposed properly.

The residues from the treatment of the TEA and TEB wastes are aluminum oxides and a boron salt. The containers were disposed of as non-hazardous waste since there were no remaining hazardous residues following combustion.

Debris following the detonation of the compressed gas cylinders were collected and disposed of as a non-hazardous waste.

## 3.0 CLOSURE

### 3.1 CLOSURE PLAN ORGANIZATION

A phased approach will be used for the implementation of the closure activities set forth in this closure plan. Figure 1 gives the management structure that will be used to monitor and control the implementation of this closure plan.

### 3.2 CLOSURE REQUIREMENTS

#### 3.2.1 PERSONEL QUALIFICATIONS

All personnel working on closure activities at the Area I Thermal Treatment Facility will have the appropriate training to work in a hazardous waste facility as specified in 29 CFR 1910.1200.

#### 3.2.2 HEALTH AND SAFETY PLAN

A health and safety plan will be created before the closure activities begin. In general, the plan will consist of a monitoring procedure that insure that the appropriate level of personal protection is maintained by all site personnel, an identification of the hazards that may exist at the



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