U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service
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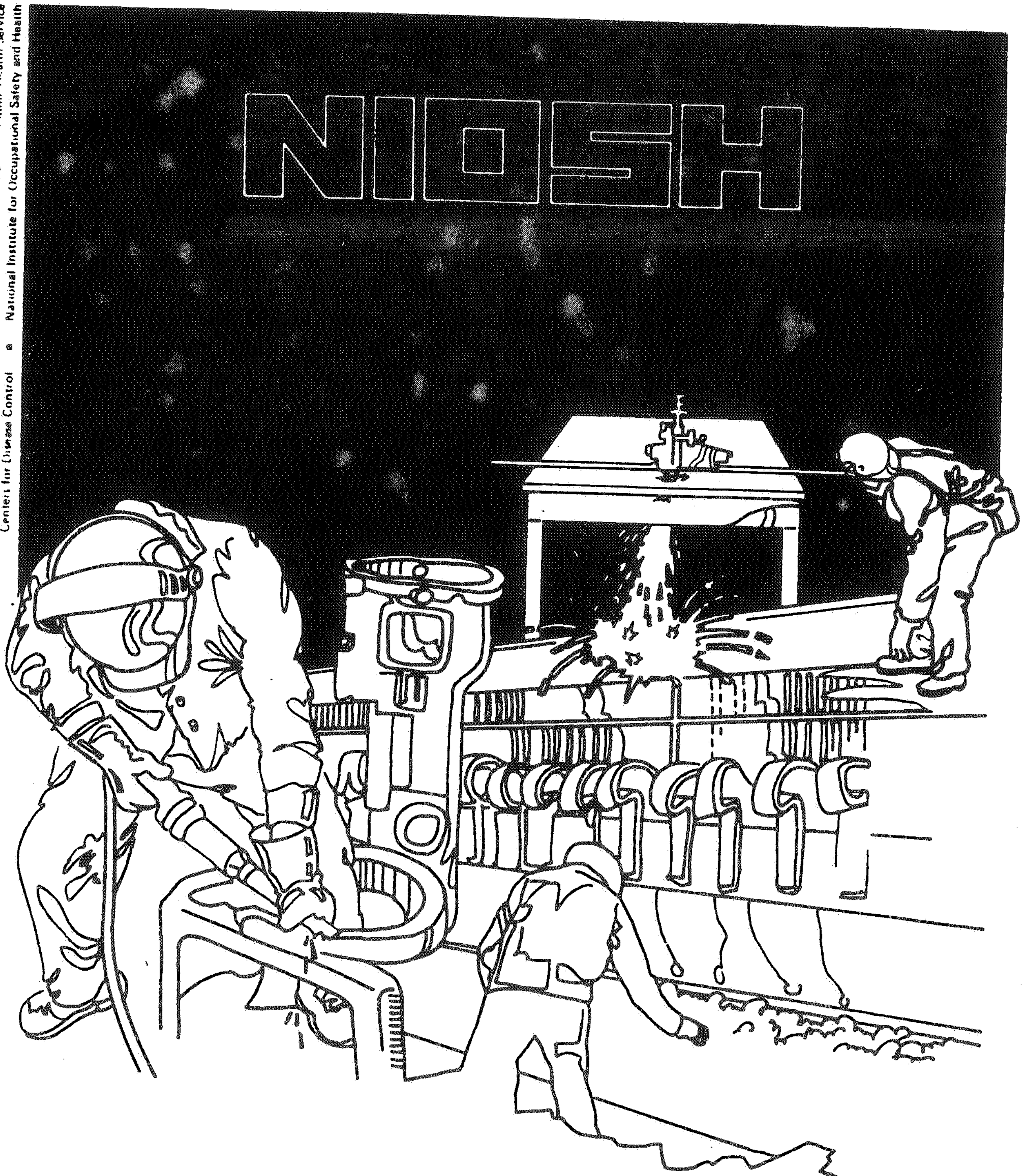

Health Hazard Evaluation Report

HETA 80-232-1055
ALLIED CHEMICAL
BATON ROUGE, LOUISIANA

HETA 81-037-1055
ROLLINS ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 80-232-1055
FEBRUARY 1982
ALLIED CHEMICAL
BATON ROUGE, LOUISIANA

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I. SUMMARY

In August 1980, NIOSH received an employee request from the Allied Chemical polyolefin plant in Baton Rouge, Louisiana, to investigate health problems attributed to chemical waste migrating from the neighboring Rollins Environmental Services chemical waste disposal facility. In October 1980, NIOSH conducted a walk-through inspection of the facility, administered medical questionnaires to 109 Allied employees, reviewed the plant emission inventory and state and Federal air sampling data collected near Allied and the Rollins facilities, and conducted a related questionnaire and industrial hygiene survey at Rollins (HETA 81-37).

The medical questionnaire was analyzed after dividing the Allied workers into three groups: Group A included 38 persons who worked predominantly indoors, Group B included 16 persons who worked both indoors and outdoors, and Group C included 55 persons who worked predominantly outdoors. Outdoor workers reported a significantly higher frequency of several symptoms, including watery, burning eyes; dry mouth; sore throat; cough; chest tightness; chest pain; suffocating feeling; headache; weakness; and nausea. However, no chronic medical problems were significantly elevated in this group.

It is not possible from our evaluations to attribute the symptoms of mucous membrane and respiratory irritation experienced by Allied workers to a specific chemical or source. The cyclohexane-soluble fraction of total airborne particulate matter, which contained some PNA materials, was suspected of producing the same effects among Rollins employees. Occasional episodic exposures to irritant chemicals may account for some of the symptoms among Allied workers.

NIOSH concluded that any airborne chemical waste which may migrate to the Allied plant from Rollins does not constitute a serious occupational health hazard. This conclusion is based on the low ambient air concentrations of volatile organic substances measured by two different governmental agencies at the Rollins fenceline throughout 1980, on the generally low levels of chemical exposure to Rollins personnel, and on the intermittent exposure episodes. However, occasional episodic exposures to irritant chemicals may account for the high rate of symptoms reported by the Allied workers. Recommendations are detailed in Section VII of this report.

KEYWORDS: SIC 2821 (Plastics Materials, Synthetic Resins, and Nonvulcanizable Elastomers), hazardous waste treatment plants, hazardous waste disposal, environmental contamination.

II. BACKGROUND

In August 1980, NIOSH received a written request from 10 employees of the Allied Chemical polyethylene manufacturing facility in Baton Rouge, Louisiana, to investigate working conditions at the plant. The plant manufactures high density polyethylene by the Phillips particle form process and solution process. It employees approximately 400 workers on three shifts. The requestors attributed health problems to migrating airborne contaminants from the Rollins Environmental Services chemical waste disposal facility, which was located immediately north of the Allied plant (Figure 1).[1] NIOSH administered medical questionnaires to 109 Allied employees on October 1 and October 2, 1980, and an industrial hygienist made a walk-through inspection of the facility.

Residents of the neighboring community of Alsen were very concerned about acute and chronic health effects from exposure to irritant fumes from the Rollins' site. A community health study performed by the Louisiana State Department of Health in November 1980 indicated higher proportions of headache and eye irritation among Alsen residents when compared to residents from other areas of Baton Rouge.[2]

III. METHODS

A. Industrial Hygiene

No industrial hygiene samples were collected. This decision was based on the plant-wide complaints which could not be attributed to traditional industrial exposures, which tend to be process- or operation-related, or related to materials used throughout the workplace. NIOSH and Allied industrial hygienists conducted a walk-through inspection of the facility. Air pollution discharge permits were reviewed to determine the major chemicals utilized at the plant and released into the environment. The available results of environmental sampling along the Rollins' fence line and the NIOSH study at Rollins were reviewed.

B. Medical

A questionnaire was administered to 109 of the 233 workers employed at the Baton Rouge facility. These workers were divided into three groups:

1. Indoor workers (i.e., senior operators, laboratory technicians) N = 38

2. Workers spending time both indoors and outdoors (operators) N = 16

3. Outdoor workers (maintenance, shipping, truckdrivers, service) N = 55

Those interviewed were chosen on the basis of availability at the time of the interview and desire to participate. The questionnaire was designed to obtain information on work history, medical history, and symptoms.

IV. EVALUATION CRITERIA

A. Multiple Low-Level Exposures

The health effects of the wide variety of substances typically present at or near hazardous wastes sites are neither well documented nor well understood.[3] There is no good way to evaluate chronic occupational low-level exposure to a variety of substances even when they can be measured. A recent study by the National Research Council[4] suggests that the "state of the art" is to assume additivity of exposure and follow the guidelines recommended by the American Conference of Governmental Industrial Hygienists. That organization recommends assuming additivity when two or more hazardous substances are present that act upon the same organ. Exceptions are made "when there is a good reason to believe that the chief effects of the different harmful substances are not in fact additive, but independent as when purely local effects on different organs of the body are produced by the various components of the mixture."[5]

B. Occupational Health Standards

The OSHA standards and the NIOSH-recommended single substance exposure levels for benzene and toluene, two air contaminants frequently detected near the Rollins fence line, are reported in Appendix I. These are occupational standards designed to protect the health of workers for a 40-hour workweek over a working lifetime. They are not environmental or community health standards. Chemically induced disease would be an unlikely result of exposures to single substances at or below these levels. The eye and lung irritant effects of the substances on the Air Control Commission Emission Inventory Questionnaire for Allied Chemical in Baton Rouge are given in Appendix II.

C. Eye Irritation Effects of Substances Measured at the Rollins Fence Line

Toluene has been reported to produce eye irritation in human subjects at 1,500,000 ug/M^3. While there are no human data for benzene, rabbits displayed only mild eye irritation upon application of 0.1 ml of benzene into the eye.[6]

D. PNAs and Cyclohexane Solubles

In the absence of other exposures, the cyclohexane-soluble fraction of total airborne particulate matter from coal tar products has been reported to cause burning and watering of the eyes, photophobia, conjunctivitis, coughing, sneezing, and swollen nasal mucosa and sinuses. Long-term dermal exposure has been associated with skin cancer. Fishermen who mended coal tar-treated nets and held tar smeared needles between their teeth developed lip cancer.[7]

In 1975, NIOSH conducted a Health Hazard Evaluation of roofers exposed to cyclohexane solubles evolved from a material which contained 4.89% particulate polycyclic organic matter (PPOM) by weight, of which 1.9-13% were PNAs. The workers experienced short-term eye and skin disorders. Of 34 roofers exposed to concentrations of 20-490 ug/M^3 (mean 100 ug/M^3), 50% reported eye irritation which disappeared within 72 hours after exposure. Four of six workers showed clinical signs of conjunctivitis after exposure to 210-490 ug/M^3.[8]

In 1976, NIOSH conducted a Health Hazard Evaluation in a plant producing asphalt shingles and rolled roofing products.[9] Three of nine workers exposed to a mixture of cyclohexane solubles at concentrations of 100-6,840 ug/M^3 (mean: 1,000 ug/M^3), benzene (mean: 100 ug/M^3), dust, and low levels of other organic vapors reported eye irritation. There was observable redness of the conjunctiva in seven of the nine workers exposed.

V. RESULTS

A. Industrial Hygiene

1. NIOSH Study at Rollins Environmental Services

In October 1980, NIOSH received a request from employees at the Rollins Environmental Services chemical waste disposal facility in Baton Rouge, Louisiana, to evaluate their working conditions and health status. NIOSH visited the plant in November 1980 and administered 45 employee health status questionnaires.

Forty-nine fixed-location screening samples were collected near the unloading pump pad, the landfill, the landfarm, the biosystem, the oil/water separators, and the barrel crusher. Eighty-seven additional personal air samples were collected in the breathing-zone of operations, maintenance, laboratory, and transportation personnel in March 1981.

In March 1981, 32 personal breathing-zone samples had measurable benzene (mean 698 ug/M^3). Toluene and xylene were frequently present at very low levels. This result is consistent with the fence line samples. The measured solvent exposures did not exceed recognized health standards either singly or when identical target organs and additivity of effect was assumed.

Twenty-nine filter samples contained particulates soluble in cyclohexane at concentrations up to 919 ug/M^3 (mean 280 ug/M^3). Vapors of one or more of the substances naphthalene, indan, indene, and anthracene were measured in 13 samples. The cyclohexane-soluble fraction of total airborne particulate matter collected on the filter element of the sampling train exceeded NIOSH and OSHA standards in 28 of the 36 samples, although these standards may be be directly applicable to this exposure. There was excess respiratory and eye irritation among Rollins employees, significantly higher frequencies of eye and lung complaints among the Allied Chemical workers who spent most of their time outdoors, and excess eye irritation among citizens of Alsen.

The only ubiquitous material identified in this study that is known to produce eye irritation at the concentrations measured is the cyclohexane-soluble fraction of airborne particulate matter. The health effects reported by the questionnaire responses at Rollins, although nonspecific, are similar to those demonstrated in NIOSH Health Hazard Evaluations in comparable environments where cyclohexane solubles are present.

2. NIOSH Actions at Allied Chemical

The information submitted by the company on the Louisiana Air Control Commission Emission Inventory Questionnaire dated March 1980 was reviewed.[10] The materials used in this plant include ethylene, isobutane, hydrogen, cyclohexane, hexene, butene, hexane, natural gas, process gas, No. 5 fuel oil, gasoline, and diesel fuel. Emissions include hexane, isobutane, cyclohexane, ethylene, acetic acid, ketones, alkenes, hydrocarbons, sulfur dioxide, carbon monoxide, nitrogen oxides, and carbon dioxide.

State and Federal environmental monitoring reports were reviewed. Fence line strategies in which air monitors were positioned near the Rollins' property line both upwind and downwind had been employed.

a. State

In a report to the Environmental Control Commission by the Louisiana Department of Natural Resources Office of Environmental Affairs, dated April 22, 1980 (Appendix

III)[11], ambient air samples of 3-hour duration collected on charcoal and chromasorb during late March and early April 1980 are described. Apparently, sampling was continued both on the Rollins site and in surrounding locations until June 6,1980. Further results were reported to the Louisiana Department Natural Resources by Enviro-Med Laboratories May 27, 1980 (Appendix IV).[12] Additional results are included in a letter from the Louisiana Department of Natural Resources to the U.S. Environmental Protection Agency dated September 16, 1980 (Appendix V).[13] A number of organic vapors were detected. However, the measured concentrations did not approach an occupational health standard either singly or in combination.

b. Federal

Ambient air monitoring was also conducted by the U.S. Environmental Protection Agency in November 1980. The Phase I contractor report concludes that toluene and benzene were the major species identified in air (Appendix VI).[14] The data contained in the Phase II contractor report to the EPA indicated that a number of organic vapors were detected. However, the measured concentrations did not approach an occupational health standard either singly or in combination (Appendix VII).[15,16]

While a large number of organic compounds, including benzene, chloroform, cyclohexane, dichloroethane, dichloromethane, ethylbenzene, Freon 113, methylene chloride, tetrachloroethylene, toluene, trichloroethylene, and xylene, among others, were identified in air samples collected near the Rollins fence line. The most frequently quantified substances were benzene and toluene.

Benzene was quantitated in 41 of 78 samples. The arithmetic mean concentration was 0.12 ppm (standard deviation: 0.7, range: 0.003-6.1 ppm). Toluene was quantitated in 31 of 62 samples. The arithmethic mean concentration was 0.15 ppm (standard deviation: 0.47, range: 0.001-2.4 ppm). Samples were collected both upwind and downwind of Rollins, the suspected source of the organic vapors. While the upwind results appear to be somewhat lower than the downwind results, the grand means calculated here disregard the sample location. The occupational health evaluation criteria for these substances are presented in Appendix I.

B. NIOSH Medical

Although the workers in Group A, who worked exclusively indoors, tended to be older and to have more seniority than the workers in Group B, who worked outdoors about 50% of the time, and who in turn were slightly older and more senior than workers in Group C, who worked 100% outdoors, the three groups were similar enough to allow comparison (Table 1).

There was no significant difference in the history of respiratory disease, heart disease, and hypertension. Smoking patterns did not differ (Group A: 12%; Group B: 15%; Group C: 10%).

Forty-two of the 109 workers (38.5%) felt that they were exposed to irritant fumes. All groups thought the fumes were migrating airborne chemicals that came from the Rollins facility (Group A: 89.5%; Group B: 93.8%; Group C: 100.0%). All groups felt "bothered" by these fumes (Group A: 76%; Group B: 88%; Group C: 93%). The two groups with outdoor exposure complained significantly more about various upper and lower respiratory symptoms and possibly CNS-related symptoms. Group B members, who spent only part of their work time outdoors, reported more symptoms than did members of Group C, who worked exclusively outdoors (Table 2).

Some workers also reported exposure to fumes and dust from their jobs, but agreed that these were very much less irritating than the those perceived to have originated at Rollins. A few workers felt so sick that they missed work on several occasions.

The fumes were perceived to be worse during periods of humid weather, hot temperatures, and northern winds, and to have increased during recent years. Some workers reported that the worst irritation occured during night shifts and the weekends. Whitish particles were reported to accompany these episodes. Perceived odors varied widely.

An incidental finding was three cases, all male employees, with in-plant employment histories more than 10 years, who had developed systemic lupus erythematosus (SLE). SLE is a rare condition, especially among men, which has recently been tentatively associated with chemicals such as aromatic amines and hydrazines[17].

VI. DISCUSSION AND CONCLUSIONS

Eye irritation was the common denominator of symptoms reported on questionnaires administered at Rollins, Allied Chemical, and Alsen. Both Rollins and Allied workers reported respiratory irritation. At Rollins, these symptoms may have been due to the cyclohexane-soluble fraction of total airborne particulate matter which contained some PNA materials. There is no occupational health standard directly applicable to this exposure, and it is unlikely that Allied Chemical workers are exposed to levels equal to or higher than Rollins workers. This is because atmospheric mixing effects occur when particulates are transported.

It is not possible to attribute the symptoms of mucous membrane and respiratory irritation demonstrated by the questionnaire survey to a specific chemical or source at Allied Chemical. The process materials, which are used in large quantities, would not normally produce the effects noted in this study except at very high concentrations.

It is clear from the State of Louisiana and U.S. EPA ambient air monitoring data that any volatile organic material which may migrate to the Allied plant from Rollins does not constitute a serious occupational health hazard. This conclusion is based on the low ambient air concentrations measured by two different governmental agencies throughout 1980, on the generally low levels of chemcial exposure to Rollins personnel, and on the intermittent exposure episodes reported by Allied employees. Occasional episodic exposures to irritant chemicals may account for the high rate of symptoms reported by the Allied workers.

VII. RECOMMENDATIONS

1. The possible cluster of SLE cases at the Allied plant should be investigated.

2. While process changes at Rollins may have already eliminated the possibility of episodic exposures, outdoor activities should be minimized when widespread symptoms of eye and respiratory irritations exist.

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IX. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report have been sent to:

1. Individual Requestor
2. Allied Chemical, P.O. Box 52006, Baton Rouge, Louisinia 70005
3. Local 216, International Union of Operating Engineers, 6150 Hooper Road, Baton Rouge, Louisiana 70811
4. State of Louisiana, Department of Health, P.O. Box 60630, New Orleans, Louisiana 70160
5. Regional Administrator, U.S. Environmental Protection Agency, 1201 Elm Street, Dallas, Texas 20460
6. NIOSH, Region VI
7. OSHA, Region VI

Copies of this Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22151. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address.

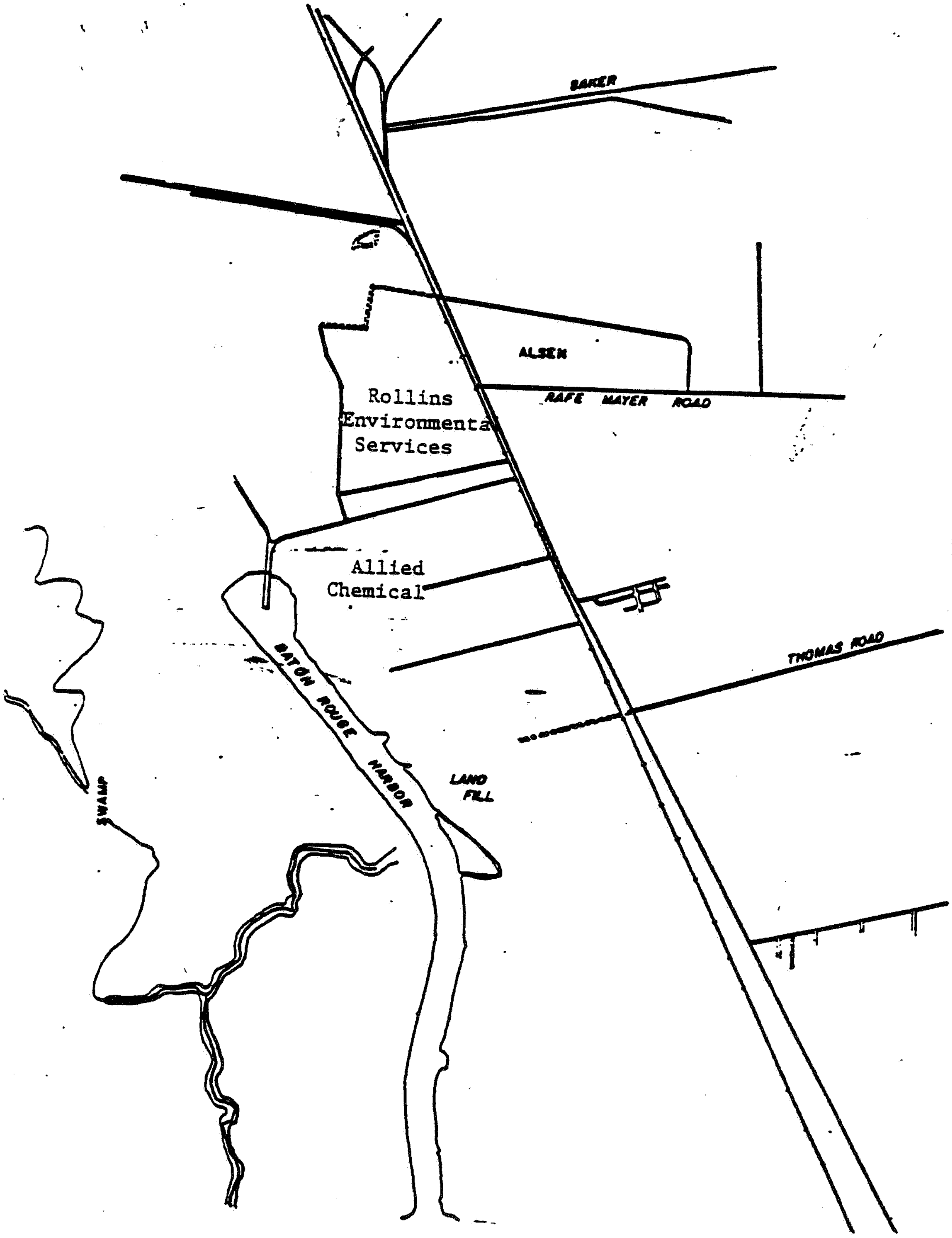

Figure 1. Area Map Rollins Environmental Services Baton Rouge, Louisiana (Adapted from Reference 1).

TABLE 1

Age and Seniority Among Groups

Allied Chemical
Baton Rouge, Louisiana
October 1-2, 1980

	Group 1 N=38 Indoors	Group 2 N=16 Indoors/Outdoors	Group 3 N=55 Outdoors
Mean Age (Years)	42	40	39
Standard Deviation	8.3	13.0	10.6
Range	21-53	21-64	20-63
Mean Seniority (Years)	15	11	10
Standard Deviation	8.3	9.4	7.8
Range	1-24	1-23	1-23

Table 2

Reported Symptoms Among Workers

Allied Chemical
Baton Rouge, Louisiana
October 1-2, 1980

Symptom	Group 1 (N=38) Indoors		Group 2 (N=16) Indoors/Outdoors		Group 3 (N=55) Outdoors	
	#	%	#	%	#	%
Watery Buring Eyes[1,2]	19	50	14	87.5	47	85.5
Burning Nose	19	50	12	75	36	65.5
Dry Mouth[1,2]	5	13.2	8	50	21	38.2
Sore Throat[1,2]	11	28.9	11	68.6	31	56.4
Hoarseness[2]	5	13.2	6	37.5	17	30.9
Cough[1,2]	9	23.7	11	68.8	26	47.3
Chest Tightness[1,2]	1	2.6	9	56.3	14	25.5
Chest Pain[1,2]	1	2.6	6	37.5	7	12.7
Suffocating Feeling[1,2]	7	18.4	9	56.3	25	45.5
Headache[1,2]	11	28.9	11	68.8	30	54.4
Dizziness[1]	2	5.3	6	37.5	5	9.1
Lightheadness[1]	4	10.5	7	43.8	9	16.4
Weakness[1,2]	0	0.0	3	18.8	7	12.7
Numbness[1]	0	0.0	4	25.0	3	5.5
Sleepiness	1	2.6	2	12.5	4	7.3
Nausea[1,2]	7	18.4	8	50.0	22	40.0

Table 2 (Continued)

Reported Symptoms Among Workers

Allied Chemical
Baton Rouge, Louisiana
October 1-2, 1980

Symptom	Group 1 (N=38) Indoors		Group 2 (N=16) Indoors/Outdoors		Group 3 (N=55) Outdoors	
	#	%	#	%	#	%
Vomiting	1	2.6	2	12.5	5	9.1
Abdominal Pain	1	2.6	3	18.8	5	9.1
Diarrheal	0	0.0	4	25.0	2	3.6

NOTES:

1 p 0.05 by Chi square for all three groups.
2 p 0.05 by Chi Square for Group 1 vs Groups 2 and 3.

APPENDIX I

Environmental Evaluation Criteria

Allied Chemical
Baton Rouge, Louisiana
October 1-2, 1980

Substance	NIOSH Recommended Standard		Reference	OSHA Standard		Reference
	8-Hour TWA ug/M3	Ceiling ug/M3		8-Hour TWA ug/M3	Ceiling ug/M3	
Benzene	3,000 (1 ppm)	15,000 (5 ppm) 10 Minutes	24	30,000 (10 ppm)	80,000 (25 ppm)	25
Toluene	375,000 (100 ppm)	750,000 (200 ppm) 10 Minutes	26	750,000 (200 ppm)	1,125,000 (300 ppm)	25

APPENDIX II

EYE AND LUNG IRRITATION EFFECTS
SUBSTANCES
LISTED ON THE AIR CONTROL COMMISSION
EMISSION INVENTORY QUESTIONNAIRE

Allied Chemical
Baton Rouge, Louisiana
October 1-2, 1980

Substance	OSHA Workplace Standard Reference 18	NIOSH Recommended Reference 18	ACGIH TLV Reference 19	NIOSH/OSHA Occupational Health Guidelines For Hazardous Chemicals Reference 18	Patty References 9, 21, and 22	Documentation of TLVs Reference 18	CHRIS Reference 23
Ethylene	N.S.	N.S.	E	Not Listed	Physiologically inert below lower flammable limit (27,500 ppm).	Simple asphyxiant Flammable	Not irritating to eyes or throat.
Isobutane	N.S.	N.S.	N.S.	Not Listed	No effect on skin or eyes, except in direct contact.	Not listed	Flammable
Cyclohexane	300 ppm 1,015,000 ug/M3	N.S.	300 ppm	Short term overexposure may cause irritation to the eyes, nose, and throat	Vapor may be irritant to skin, eyes, and respiratoy tract.	300 ppm is somewhat irritating to the eyes and mucous membranes.	Irritating to eyes, nose, and throat; Flammable.
Hexane	500 ppm 1,800,000 ug/M3	100 ppm	50 ppm	May cause irritation of eyes and nose	Exposure to 800 ppm for 15 minutes can cause eye and upper respiratory tract irritation in humans.	Slight nausea, headache, eye, and throat irritation at 2400-1500 ppm. No irritation at 500 ppm.	Irritating to nose and throat. Will cause coughing; Flammable.
Butene	N.S.	N.S.	N.S.	Not Listed	Low eye irritant.	Not Listed	Flammable
Hexene	N.S.	N.S.	N.S,	Not Listed	Low to moderate eye irritant.	Not Listed	Flammable

APPENDIX II
(Continued)

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Natural Gas	N.S.	N.S.	N.S.	Not Listed	Practically non-toxic below explosive limits; Flammable.	Not listed	Not Listed
No. 5 Fuel Oil	N.S.	N.S.	N.S.	Not Listed	Not Listed	Not Listed	Irritating to skin and eyes.
Gasoline	N.S.	N.S.	300 ppm 1,500,000 ug/M3	Not Listed	Eye irritant	160-270 ppm causes eye and throat irritation in several hours.	Irritating to eyes, nose, and throat; Flammable.
Diesel Fuel	N.S.	N.S.	N.S.	Not Listed	Not an eye irritant	Not Listed	Not listed
Acetic Acid	10 ppm 2,500 ug/M3	N.S.	10 ppm	Short term exposure causes irritation of the eyes, nose, throat, and lungs.	Eye, nose, and throat irritation in excessive quantities.	10 ppm is non-irritating. 60 ppm is slightly irritating.	Vapor irriting to the nose and throat.
Sulfur Dioxide	5 ppm 13,000 ug/M3	0.5 ppm	2 ppm	Irritating to the eyes and respiratory tract. Can cause coughing and chest tightness.	20 ppm is the least amount irritating to the eyes. Irritant to respiratory tract and wet skin.	Respiratory irritation at 20-30 ppm.	Vapor poisonous.

APPENDIX II
(Continued)

EYE AND LUNG IRRITATION EFFECTS
SUBSTANCES
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EMISSION INVENTORY QUESTIONNAIRE

Allied Chemical
Baton Rouge, Louisiana
October 1-2, 1980

Substance	OSHA Workplace Standard Reference 18	NIOSH Recommended Reference 18	ACGIH TLV Reference 19	NIOSH/OSHA Occupational Health Guidelines For Hazardous Chemicals Reference 18	Patty References 9, 21, and 22	Documentation of TLV s Reference 18	CHRIS Reference 23
Carbon Monoxide	50 ppm 55,000 ug/M3	35 ppm	50 ppm	No listing of eye or lung irritation.	No eye or lung effects listed.	No eye effects listed.	Vapor poisonous; Flammable.
Nitrogen (Di)oxide	5 ppm 9,000 ug/M3	1 ppm	3 ppm	Irritation of the eyes, nose, throat, and wet skin may occur with acute exposure.	10-20 ppm is mildly irritant to the eyes, nose, and upper respiratory tract.	10-20 ppm is mildly irritant to the eyes, nose, and upper respiratory tract.	Not listed
Carbon Dioxide	5,000ppm 9,000,000 ug/M3	10,000	5,000 ppm	No listing of eye or lung irritation.	No listing of eye or lung irritation.	No listing of eye or lung irritation.	Poisonous if Inhaled; Flammable.

NOTES:

1. N.S. means no standard, recommended standard, or threshold limit value (TLV).
2. E means simple asphyxiant.
3. Hydrocarbons and ketones are not specific substances and their effects are not given.

APPENDIX III[11]

Table 13
ORGANIC VAPOR ANALYTICAL DATA
ROLLINS ENVIRONMENTAL SERVICES, INC.

Charcoal Tube No.	Date Sampled	Location	1,2 Dichloroethane	Benzene	Toluene	Ethylbenzene
			Parameter (ppm/v)			
1C	4-18-80	SW corner	ND	ND	0.01	ND
2C	4-18-80	Church	ND	ND	ND	ND
3C	4-18-80	SW corner	2.8	6.1	0.19	0.03
4C	4-18-80	Church	ND	ND	0.01	ND
5C	4-18-80	L.F.8-Sign	ND	ND	ND	ND

Notes:

1. ND = not detected
2. ppm/v = parts per million on a volume volume basis (ul/liter).
3. Additional peaks were detected and further analyses is in progress by GC and GC/MS.
4. Above four organic compounds are on the U. S. Environmental Protection Agency priority pollutant list.

APPENDIX IV[12]

TABLE V. ROLLINS SITE DATA 3/80 — 4/80 AIR SAMPLES
Charcoal Tubes

Date	Location	Volume Air Sample	Concentration (ppm, V/V): Dichloro-methane	1,2-Dichloro-ethane	1,1,1-Trichloro-ethylene	Trichloro-ethylene	Benzene	Tetrachloro-ethylene*	Toluene	1,1,2-Tri-chloro ethane	Ethyl benzene	Freon 113
3/24	Allied N. fence S.E. of Rollins stack	6.6	0.5	---	0.04	0.03	0.19	0.03	0.03	---	0.03	---
3/24	Ewell residence N. of home	5.0	0.6	0.08	0.06	0.05	0.34	0.08	0.03	---	0.04	---
3/31	Road sign on Rollins Rd.	82.	---	---	---	---	0.02	---	0.01	---	0.005	---
/3	Brooklawn Dr. 1.2 mi. W. of U.S. 61	5.3	0.2	---	0.05	0.01	0.06	0.04	0.05	---	<0.01	---
/3	Barge Terminal Road at Hy-Purle pit	4.4	0.3	0.11	0.7	0.06	0.21	0.02	0.19	---	0.04	---
/8	N. Side Land Farm Plot 8	2.3	0.1	---	0.03	0.02	0.22	0.03	0.03	0.07	<0.01	---
/8	S.E. Corner Land Farm Plot 8	3.2	0.2	---	0.04	0.02	0.10	**	**	---	**	---
/10	Ewell residence fence 50 ft. E. of home	5.3	>2.7	---	0.07	0.01	0.06	0.01	0.01	0.02	<0.01	---
/10	Barge Terminal Road S. of stack	7.3	0.6	---	0.06	0.02	0.05	0.02	0.02	0.01	<0.01	---
/15	Rollins office	4.2	0.3	---	0.01	0.10	0.49	0.3	0.68	---	0.04	---
/15	S. side Land Farm Plot 9	3.4	0.4	---	0.02	0.15	0.24	0.5	---	---	0.11	---
15	Barge Road S.W. corner of Land Farm Plot 1	123.	0.01	---	---	0.002	0.002	---	---	---	---	---
18	S.W. corner	5.19	---	---	---	---	---	---	0.01	---	---	---
18	Church	4.72	---	---	---	---	---	---	---	---	---	---
18	S.W. corner	12.11	4.4	2.8	---	3.1	6.1	0.41/0.13***	0.19	---	0.03	1.9
18	Church	7.87	---	---	---	---	---	0.27/0.01***	0.01	---	---	---
8	Land Farm 8 sign	7.61	---	---	---	---	---	---	---	---	---	---

ies tetrachloroethane

lost due to instrument malfunction.

a A is ppm tetrachloroethylene and B is ppm tetrachloroethane

APPENDIX IV (Continued)[12]

TABLE VI. ROLLINS SITE DATA 3/80-4/80 AIR SAMPLES

POROUS POLYMER TUBES

Sample Number	Location	Date	PPM Benzene
1	Allied N. Fence S.E. of Rollins Stack	3/24	<0.01
2	S.W. Corner	3/31	<0.01
5	Brooklawn Dr. 1.2 mi. W. of U.S. 61	4/3	0.01
6	Barge Terminal Rd. at Hy-Purle Pit	4/3	0.02
17	N. Side Land Farm Plot 8	4/8	< 0.01
24	S.E. Corner Land Farm Plot 8	4/8	0.02
8	Ewell Residence Fence 50 ft. E. of Home	4/10	<0.01
9	Hy-Purle Pit	4/10	<0.01
10	S. Side Land Farm Plot 9	4/15	0.04
11	Barge Rd. S.W. Corner of Land Farm Plot 1	4/15	0.02
1T	S.W. Corner		----
2T	Church		----
3T	Land Farm 7 Sign		----

APPENDIX IV (Continued)[12]

TABLE VII

ROLLINS SITE DATA 3/80 -- 4/80 AIR SAMPLES

Sample Number	Date	Location	Sample Tubes: Volume of Air Sampled	Benzene (ppm)	Toluene	EthylBenzene
R1C	4-23-80	?	5.9ℓ*	0.06	<0.04	<0.01
R2C	4-23-80	Barge Terminal Rd. Downwind	2.4ℓ*	<0.01	<0.01	<0.01
R3C	4-23-80	Upwind of LF-8 and LF-9	86.0ℓ*	0.002	<0.001	<0.001
R4T			85.0ℓ	No detectable levels of charcoal compound observed		
R5T			66.0ℓ			

*No other compounds found on charcoal at or above limits of detection

TABLE V. ROLLINS SITE DATA 3/80 — 4/80 AIR SAMPLES
Charcoal Tubes

ate	Location	Volume Air Sample	Dichloro-methane	1,2-Dichloro-ethane	1,1,1-Trichloro-ethylene	Trichloro ethylene	Benzene	Tetrachloro ethylene*	Toluene	1,1,2-Tri-chloro ethane	Ethyl benzene	Freon 113
			Concentration (ppm, V/V)									
/24	Allied N. fence S.E. of Rollins stack	6.6	0.5	---	0.04	0.03	0.19	0.03	0.03	---	0.03	---
/24	Ewell residence N. of home	5.0	0.6	0.08	0.06	0.05	0.34	0.08	0.03	---	0.04	---
/31	Road sign on Rollins Rd.	82.	---	---	---	---	0.02	---	0.01	---	0.005	---
/3	Brooklawn Dr. 1.2 mi. N. of U.S. 61	5.3	0.2	---	0.05	0.01	0.06	0.04	0.05	---	<0.01	---
/3	Barge Terminal Road at Hy-Purio pit	4.4	0.3	0.11	0.7	0.06	0.21	0.02	0.19	---	0.04	---
8	N. Side Land Farm Plot 8	2.3	0.1	---	0.03	0.02	0.22	0.03	0.03	0.07	<0.01	---
8	S.E. Corner Land Farm Plot 8	3.2	0.2	---	0.04	0.02	0.10	**	**	---	**	---
10	Ewell residence fence 50 ft. E. of home	5.3	>2.7	---	0.07	0.01	0.06	0.01	0.01	0.02	<0.01	---
10	Barge Terminal Road S. of stack	7.3	0.6	---	0.06	0.02	0.05	0.02	0.02	0.01	<0.01	---
15	Rollins office	4.2	0.3	---	0.01	0.10	0.49	0.3	0.68	---	0.04	---
15	S. side Land Farm Plot 9	3.4	0.4	---	0.02	0.15	0.24	0.5	---	---	0.11	---
5	Barge Road S.W. corner of Land Farm Plot 1	123.	0.01	---	---	0.002	0.002	---	---	---	---	---
8	S.W. corner	5.19	---	---	---	---	---	---	0.01	---	---	---
8	Church	4.72	---	---	---	---	---	---	---	---	---	---
8	S.W. corner	12.11	4.4	2.8	---	3.1	6.1	0.41/0.13***	0.19	---	0.03	1.9
8	Church	7.87	---	---	---	---	---	0.27/0.01***	0.01	---	---	---
8	Land Farm 8 sign	7.61	---	---	---	---	---	---	---	---	---	---

...ra tetrachloroethane

...set due to instrument malfunction.

... A is ppm tetrachloroethylene and B is ppm tetrachloroethane.

APPENDIX V13

TABLE II. ROLLINS AIR SAMPLING DATA 3/80 -- 6/80
POROUS POLYMER TUBES (Tenax and Chromasorb)

Sample Number	Location	Date	PPM Benzene
1	Allidd N. Fence S.E. of Rollins Stack	3/24	< 0.01
2	S. W. Corner	3/31	< 0.01
5	Brooklawn Dr. 1.2 mi W. of U.S. 61	4/3	0.01
6	Barge Terminal Rd. at Hy-Purle Pit	4/3	0.02
17	N. Side Land Farm Plot 8	4/8	< 0.01
24	S.E. Corner Land Farm Plot 8	4/8	0.02
8	Ewell Residence Fence 50 ft. E. of Home	4/10	< 0.01
9	Hy-Purle Pit	4/10	< 0.01
10	S. Side Land Farm Plot 9	4/15	0.04
11	Barge Rd. S.W. Corner of Land Farm Plot 1	4/15	0.02
1T	S. W. Corner	4/18	----
2T	Church	4/18	----
3T	Land Farm 7 Sign	4/18	----
4T	S. W. Corner	4/23	----
5T	N. Side Land Farm Plot #9	4/23	----

TABLE 6.

CONCENTRATIONS OF BENZENE AND TOLUENE IN AIR AS CALCULATED FROM THE CHARCOAL TUBE EXTRACTS

SITE	FIELD NO.	LABORATORY SAMPLE NUMBER	BENZENE (PPM)	TOLUENE (PPM)
1B	1	6171	0.05	2.3
1B	2	6172	0.05	2.4
2B	9	6175	0.03	1.4
2B	10	6176	0.02	1.0
4B	33	6203	0.004	0.02
5B	36	6206	0.007	0.05
			TLV=10	TLV=200

Figures associated with the GC/MS analysis are presented in Apprendix D.

APPENDIX VI (Continued)[14]

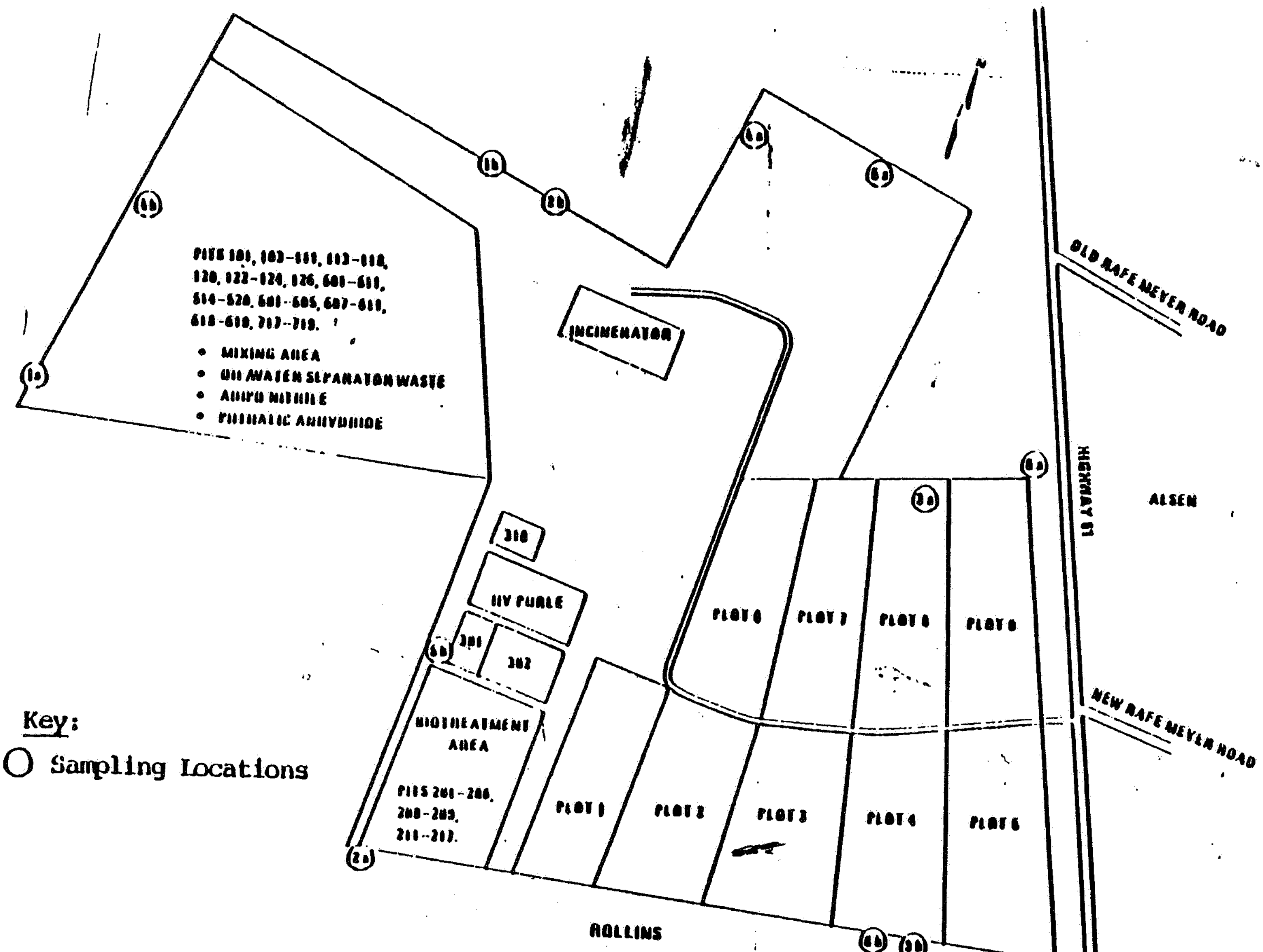

FIGURE 1 AIR SAMPLE LOCATIONS–PHASE I

Key:
O Sampling Locations

APPENDIX VII[15]

TABLE 5. GC RESULT SUMMARY (Concentrations in ppb)*

Sample #	Site #	Benzene	Toluene	Ethyl Benzene	1,1,1 Tri-chloroethane	Methylene Chloride	Tetrachloro-ethylene	Chloro-form	Meta-xylene	Comments
1	1	6	6							GC Run Onsite
2	2	56	21		84	19		241		GC Run Onsite
3	3	(UPWIND SAMPLE)								No significant peaks
4	1	3	8							GC Run Onsite
5	2									No significant peaks GC Run Onsite
6	4	(UPWIND SAMPLE)								No significant peaks GC Run Onsite
7	6									Early peak GC Run Onsite
8	7	4								GC Run Onsite
10	4	(UPWIND SAMPLE)								No significant peaks
11	8	89	240						11	GC Run Onsite
12										No significant peaks
13	6	60	63	55	59	64				
14	9	12	34						20	GC Run Onsite
15	7	57	52		132	42	138			

* Blanks indicate that pollutant concentrations are below detection limits.

APPENDIX VII (Continued)[15]

TABLE 5. GC RESULT SUMMARY (Concentrations in ppb)* (Continued)

Sample #	Site #	Benzene	Toluene	Ethyl Benzene	1,1,1 Tri-chloroethane	Methylene Chloride	Tetrachloro-ethylene	Chloro-form	Meta-xylene	Comments
16	8	215	428						26	GC Run Onsite
17	8									No significant peaks GC Run Onsite
18	10	31	108							GC Run Onsite
20	11		(UPWIND SAMPLE)							No significant peaks
21	4		(UPWIND SAMPLE)							No significant peaks
22	11		(UPWIND SAMPLE)							No significant peaks
23	5									No significant peaks GC Run Onsite
31	12									No significant peaks
33	5	16	30	22	26	15	39			
37	12									No significant peaks GC Run Onsite
39	13									Some small peaks
40	11		(UPWIND SAMPLE)							No significant peaks

* Blanks indicate that pollutant concentrations are below detection limits.

Versar inc.

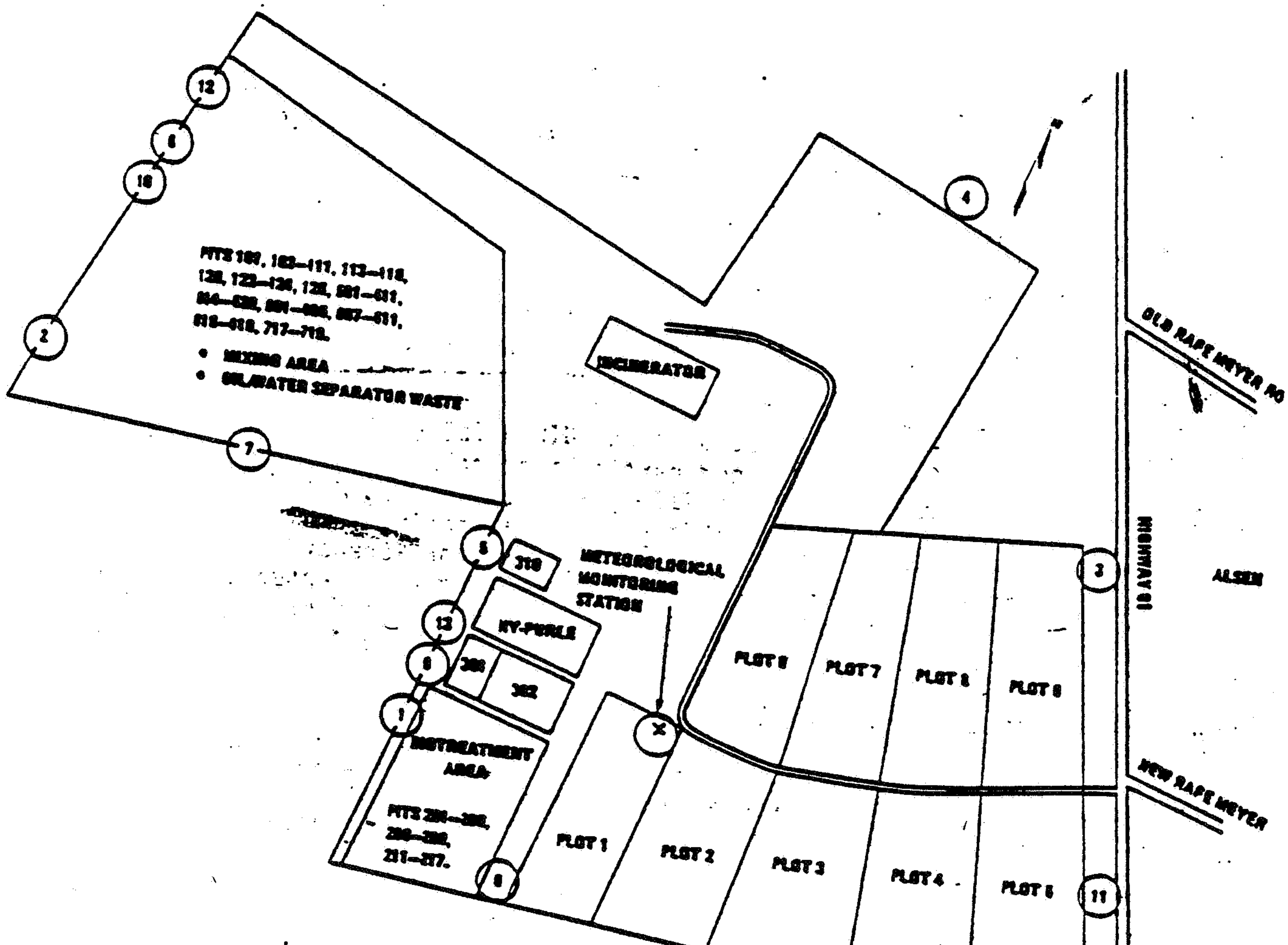

FIGURE 1 RES PHASE II AIR SAMPLING LOCATIONS
(ALL SAMPLING SITES WERE WITHIN FENCELINE)

HETA 81-037-1055
FEBRUARY 1982
ROLLINS ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

NIOSH INVESTIGATORS:
Richard Costello, I.H.
Brigette Froneberg, M.D.
James Melius, M.D.

I. SUMMARY

In October 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from employees at the Rollins Environmental Services chemical waste disposal facility in Baton Rouge, Louisiana, to evaluate their working conditions and health status. NIOSH visited the plant in November 1980 and administered 45 employee health status questionnaires. Forty-nine fixed-location screening samples were collected near the unloading pump pad, the landfill, the landfarm, the biosystem, the oil/water separators, and the barrel crusher. Eighty-seven additional personal air samples were collected in the breathing zone of operations, maintenance, laboratory, and transportation personnel in March 1981.

Two respirable dust samples (52 micrograms per cubic meter (ug/M^3) and 206 ug/M^3) analyzed for crystalline silica exceeded the NIOSH-recommended standard of 50 ug/M^3 based on a 10-hour time-weighted average (TWA). The noise exposure of one heavy equipment operator tending the landfarm (100.7 dBA average for a 5 1/2 hour period) exceeded both the OSHA (93 dBA) and NIOSH (88 dBA) criteria. Twenty-nine filter samples contained particulates soluble in cyclohexane at concentrations up to 919 ug/M^3 (mean 280 ug/M^3). Specific multi-ring compounds identified in the screening samples were quantitated in the personal samples. Vapors of one or more of the substances naphthalene, indan, indene, and anthracene were measured in 13 samples. Thirty-two samples had measurable benzene (mean 698 ug/M^3). The NIOSH-recommended standard is a ceiling concentration of less than 3000 ug/M^3 for this substance. Toluene and xylene were frequently present at very low levels.

Workers reported a high frequency of symptoms of eye irritation (71.8%) and chronic cough (56.2%). These effects may be attributable to polynuclear aromatic hydrocarbons (PNAs) and to the cyclohexane-soluble fraction of total airborne particulate matter. When compared to workers at a neighboring chemical plant (HE 80-232), the Rollins workers also reported a significantly higher prevalence of central nervous system symptoms including lightheadedness and occassional weakness which are probably attributable to solvent exposures.

Several deficiencies were noted in work practices and the personal protective equipment program. The past medical surveillance program was inadequate.

NIOSH concluded that Rollins employees were overexposed to noise and crystalline silica, experienced a high incidence of respiratory and eye irritation, and reported significantly more central nervous system symptoms than workers at a neighboring chemical plant. Recommendations to improve work practices, personal protective equipment programs, and medical monitoring are detailed in Section VII. NIOSH also recommended that monitoring to measure noise and silica exposure be conducted on site for contractor personnel.

KEYWORDS: SIC 4953 (Refuse Systems), hazardous waste treatment plants,

II. BACKGROUND

In October 1980, NIOSH received a written request from 34 employees of the Rollins hazardous waste disposal facility to evaluate their working conditions and health status. The facility is located on approximately 160 acres in an industrial area of East Baton Rouge Parish (Figure 1)[1]. Rollins clients include many petroleum and petrochemical firms in Louisiana.[2] Unit operations at this site include incineration, biological stabilization and treatment, landfilling, and landfarming (Figure 2). The plant has approximately 50 employees on three shifts and a nominal disposal capacity of 193,000 tons per year.[2]

NIOSH medical and industrial hygiene personnel visited the Rollins facility on November 5-6, 1980, conducted 45 medical interviews, and collected 49 screening air samples. An interim report describing the results of the industrial hygiene sampling was distributed to interested parties in February 1981. Additional industrial hygiene samples were collected during a follow-up visit March 17-20, 1981.

Residents of the neighboring community of Alsen were also very concerned about acute and chronic health effects from exposure to irritant fumes from the Rollins site. A community health study was performed by the Louisiana State Department of Health in November 1980. Alsen citizens reported a higher incidence of headaches and eye irritation than residents from other areas of Baton Rouge.[3]

The strategy of this study was to collect, analyze, and evaluate screening air samples which could detect the presence or absence of various classes of chemical substances; to identify the ubiquitous substances and evaluate the magnitude of employee exposure to them by means of personal air samples; and to correlate the measured contaminants with known health effects and the health effects reported in medical interviews and questionnaires.

III. METHODS

A. Industrial Hygiene

The selection of compounds, or classes of compounds, to be evaluated at a hazardous waste treatment facility is not an exact science. A recent paper argued, "[The] 'tried and true' industrial hygiene practices applicable to commercial chemical processing are available . . . . [However] such practices are not well established for chemical waste processing." Significant differences between hazardous chemical commodities and hazardous chemical wastes include the ill-defined composition, chemical, and physical nature of hazardous chemical waste; the heterogeneity of chemical waste; and the lack of quality control procedures in waste "production."[4] In short, the nature of the "raw material," the waste, at a hazardous waste chemical treatment facility is poorly defined and may vary from day to day. From an occupational health air sampling viewpoint, it was not clear whether waste streams presently being treated at Rollins or the materials historically deposited in the landfill, injected into the soil in the landfarm, or held in large, open-surface ponds were the materials of potential health interest. In addition, most of the workers did not have a fixed job location, as on an assembly line, and most worked around multiple unit operations at various site locations throughout the day.

Because of these uncertainties, the industrial hygiene strategy of this study was to collect, analyze, and evaluate screening air samples which could detect the presence or absence of broad classes of chemical substances reported to have been received for disposal at the site; to identify the ubiquitous substances; to consider the potential toxic effects of the detected substances; and to evaluate the magnitude of employee exposure to the ubiquitous substances by means of personal air samples. While this method does not guarantee that every potential inhalation exposure will be identified and quantitated, it does provide information useful in assessing potential chronic health effects.

Volatile organic vapors, metals, and pesticides were selected for analysis because they are common constituents of waste materials. PCBs were selected because of their persistence and bioaccumulative characteristics. Hydrogen sulfide was selected because of persistent reports of odors. The acid anions were monitored as a possible indicator of combustion by-products.

During the November visit, fixed-location screening samples were collected near major unit operations which included the unloading pump pad, landfill, landfarm, biosystem, oil/water separator ponds, and the barrel crusher. A grab sample of the liquid pumped from the landfarm holding pit was collected. The organic samples were analyzed qualitatively for volatile organic vapors and pesticides. Metals, polychlorinated biphenyls (PCBs), hydrogen sulfide (H_2S), and acid anions were analyzed quantitatively (Tables 1-6). Benzene was detected in 3 of 7 samples, naphthalene in 9 of 12, styrene in 3 of 7, toluene in 5 of 7, xylene in 3 of 7, indenes in 5 of 5, aluminum in 5 of 7, calcium in 7 of 7, iron in 6 of 7, and sodium in 7 of 7. No PCBs, hydrogen sulfide, or pesticides were detected, although PNAs and the arenes indan and indene were identified in the pesticide scan. The cement flue dust used widely on the site contained 2.5% quartz. The incinerator was not in operation during this visit. The sampling and analytical methods used are presented in Appendix I.

Worker exposure to the most frequently detected volatile organic vapors and the specific PNAs and arenes that were identified in the November visit were quantitated in personal breathing-zone samples collected in March. These substances had been found throughout the plant and in the bulk sample from the landfarm holding pit. This plan allowed collection of two samples in the breathing zone of each worker for both classes of analytes. This would tend to decrease the statistical variability of the results. Other considerations included time limitations, the need for different sampling media to evaluate other compounds, and the laboratory workload induced.

The screening air samples collected in November 1980 and a qualitative analysis of one of the organic vapor samples collected in March both indicated that all detectable organics were well below the levels of hygienic significance for the individual substances. Therefore, the organic vapor samples (charcoal tubes) were analyzed only for the three most abundant materials: benzene, toluene, and xylene. No attempt was made to detect or quantitate additional PNAs.

Silica and noise monitoring were conducted because of the earth moving operations. No samples for phthallates, which were present in three of five screening samples, were collected because of the relatively low toxicity of this class of substances and the possibility of sample contamination by non-fixed phthallates found in industrial hygiene equipment.

Personal air samples were obtained by drawing air from the worker's breathing zone through sorbent and filter media using small battery-operated pumps attached to the worker's belt. Initially, 19 workers, 100% of each job category, which included local truck drivers, laboratory, operations, and maintenance personnel, participated.

Samples for volatile organic vapors and PNAs, arenes, and cyclohexane solubles were collected on alternate days. Each worker provided two samples for organic vapor analysis and two samples for PNA analysis. One individual refused to wear the sampling device after the first day and two individuals were not sampled on the last day for administrative reasons. Of the 19 employees sampled, 12 had completed medical interviews in November 1980. At that time, three had been placed in the "high exposure group," and nine were in the "low-exposure group" (See Section III. C). Office workers and contractor personnel engaged in landfill activities were not sampled. The site incinerator was not in operation during this visit.

Because personal breathing-zone samples measure the substances present in the air where a mobile worker is located, wind direction and velocity are irrelevant to this study. Breathing-zone samples integrate variable exposures as a function of time at whatever location the worker occupies.

A Metrologger noise dosimeter was attached to the shirt collar of one worker who operated a truck used for local waste pickups and on other workers who operated heavy equipment on the landfarm.

Filter samplers and filter collectors in series behind cutting cyclones were attached to landfarm equipment near the operator's seat both inside and outside the enclosed cabs. The filter sampler collected total dust and the cutting cyclone/filter sampling train collected respirable dust. Both dust samples were analyzed for crystalline free silica. Bulk samples of the landfarm soil, cement flue dust, and landfill cover soil were collected and analyzed for silica.

The sampling trains for PNAs and arenes consisted of a 13-millimeter glass-fiber silver membrane filter and a porous polymer tube in series. The sample flow rate was 0.2 liters per minute. The inlet orifice of the filter was restricted to provide a cassette inlet velocity and filter face velocity equivalent to a 37-mm filter operated at a flow rate of 2 liters per minute after the method of Hill and Arnold.[5]

The sampling and analytical methods used are detailed in Appendix II. The frequency distributions for cyclohexane solubles, benzene, toluene, and xylene were tested to determine whether they fit either normal or log normal distributions. Duncan's Multiple Range Test was used to evaluate the significance of differences between the mean contaminant concentration among the four job categories: laboratory, operations, maintenance, and transportation, and the categories smoker and nonsmoker, which included previous smokers who no longer smoked. Students' t-Test was used to test for significant differences between the "high" and "low" exposure groups. These tests were repeated using nonparametric statistics.

B. <u>Work Practices</u>

Site health and safety procedures were reviewed.

C. <u>Medical</u>

During the 2-day visit in November 1980, 45 questionnaires, which included sections identical to those used at the neighboring Allied Chemical plant (HE 80-232), were administered to 35 of 39 Rollins "production" employees (89.7%), 6 office workers, and 4 contractors. This questionnaire was designed to obtain information about job history, medical history, and current symptoms. Workers were questioned in detail about work-related symptoms, including mucous membrane, upper respiratory, lower respiratory, central nervous system, and gastrointestinal effects.

The job categories at Rollins were divided into high- and low-exposure groups based on estimated exposure (Table 7). For statistical analysis, contractors were analyzed as a separate group; clerical workers were considered "unexposed" controls (Table 8).

IV. EVALUATION CRITERIA

A. Multiple Low-Level Exposures

The health effects of the wide variety of substances typically present at hazardous wastes sites are neither well documented nor well understood.[6] There is no good way to evaluate chronic low-level exposure to a variety of substances even when they can be measured. A recent study by the National Research Council[7] suggests that the "state of the art" is to assume additivity of exposure and follow the guidelines recommended by the American Conference of Governmental Industrial Hygienists. That organization recommends assuming additivity when two or more hazardous substances are present that act upon the same organ. Exceptions are made "when there is a good reason to believe that the chief effects of the different harmful substances are not, in fact, additive, but independent as when purely local effects on different organs of the body are produced by the various components of the mixture."[8]

B. Occupational Health Standards

The OSHA standards and the NIOSH-recommended single substance exposure levels, as well as occupational standards for noise exposure, are reported in Appendix III. These are occupational standards designed to protect the health of workers for a 40-hour workweek over a working lifetime. They are not environmental or community health standards. Chemically induced disease would be an unlikely result of exposures to single substances at or below these levels.

C. PNAs and Cyclohexane Solubles

1. Coal-Based Materials

There are occupational health standards, based on measuring the benzene or cyclohexane-soluble fraction of total airborne particulate material, for coal tar products and coke oven emissions. They were developed to deal with health effects of coal-based materials and addressed the presumed effects of carcinogenic PNAs.[9] The NIOSH-recommended standard for coal tar pitch is 100 ug/M^3 evaluated as a 10-hour time-weighted average (TWA).[10] The OSHA workplace standard for coking operations is 150 ug/M^3 evaluated as a 10-hour TWA.[11] The

NIOSH-recommended standard for coke ovens prescribes work practices only.[12]

Tars and pitches are black or brown liquid or semisolid products derived from coal, petroleum, wood, shale oil, or other organic materials. The principal source of coal tar is condensation of gases and vapors produced during the conversion of coal to coke. This is why the standards and health effects of coal tar products and coke ovens are discussed jointly. Tars derived from a variety of organic materials have similar properties.[10]

> "The pitch of coal tar is the black or dark brown amorphous residue that remains after the redistillation [of coal tar]. The [coal tar pitch] volatiles contain a large quantity of lower molecular weight polycyclic hydrocarbons.(1-3) As these hydrocarbons (napthalene, fluorene, anthracene, acridine, phenanthrene) sublime into the air there is an increase of benzo(a)pyrene (BaP or 3,4-benzpyrene) and other higher weight polycyclic hydrocarbons in the tar and in the fumes."[13]
>
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In 1967, the American Conference of Governmental Industrial Hygienists (ACGIH) adopted a threshold limit value (TLV) of 0.2 mg/M^3 for coal tar pitch volatiles (CTPV), described as a 'benzene-soluble' fraction, and listed certain carcinogenic components of CTPV. The TLV was established to minimize exposure to the listed substances believed to be carcinogens, viz, anthracene, BaP [Benzo(a)pyrene], phenanthrene, acridine, chrysene, and pyrene. This TLV was promulgated as a federal standard under the Occupational Safety and Health Act of 1970 (29 CFR 1910.1000).[10]

2. Petroleum-Based Materials

In 1972, the Federal Register (37:24749, November 21, 1972) contained an

> interpretative rule of the term 'coal tar pitch volatiles': ". . . coal tar pitch volatiles include the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum, wood, and other organic matter." This has been reprinted as 29 CFR 1910.1002. The general philosophy behind this interpretation was that "all of these volatiles have the same basic composition and . . . present the same dangers to a person's health." The interpretation has been reinforced more recently in the Federal Register (41: 46752, October 22, 1976) by the statement: "The existing standard will continue to apply to employee exposures to coal tar pitch volatiles outside of coke plants, such as the petroleum asphalt industry . . . ."[14]

The current OSHA standard for the benzene-soluble fraction of total airborne particulate matter from coal tar pitch is 200 ug/M^3 evaluated as an 8-hour TWA.[15]

Many wastes handled at Rollins are petroleum based.[2] A recent book, Health Impacts of Polynuclear Aromatic Hydrocarbons[16], states "There is no conclusive evidence that the extraction and transportation of petroleum crude oils are accompanied by a major polycyclic aromatic hydrocarbon (PAH)-related cancer risk. The PAH content of crude oils is of interest in occupational carcinogenesis primarily through its possible influence on subsequent refining operations and the composition of process streams. PAH content of crudes is of interest in environmental carcinogenesis as it may affect the composition of refinery waste streams and of emissions from end-use (e.g., combustion) of final products." The expressions PAH and PNA are essentially interchangable.

3. Health Effects

In the absence of other exposures, the cyclohexane-soluble fraction of total airborne particulate matter from coal tar products has been reported to cause burning and watering of the eyes, photophobia, conjunctivitis, coughing, sneezing, and swollen nasal mucosa and sinuses. Long-term dermal exposure has been associated with skin cancer. Fishermen who mended coal tar treated nets and held tar smeared needles between their teeth developed lip cancer.[10]

In 1975, NIOSH conducted a Health Hazard Evaluation of roofers exposed to cyclohexane solubles evolved from a material which contained 4.89% particulate polycyclic organic matter (PPOM) by weight of which 1.9-13% were PNAs. The workers experienced short-term eye and skin disorders. Of 34 roofers exposed to concentrations of 20-490 ug/M^3 (mean 100 ug/M^3), 50% reported eye irritation which disappeared within 72 hours after exposure. Four of six workers showed clinical signs of conjunctivitis after exposure to 210-490 ug/M^3.[17]

In 1976, NIOSH conducted a Health Hazard Evaluation in a plant producing asphalt shingles and rolled roofing products.[18] Three of nine workers exposed to a mixture of cyclohexane solubles at concentrations of 100-6840 ug/M^3 (mean: 1000 ug/M^3), benzene (mean: 100 ug/M^3), dust, and low levels of other organic vapors reported eye irritation. There was observable redness of the conjunctiva in seven of the nine workers exposed.

Although confounded by the presence of combustion gases, exposure to coke oven emissions, measured by benzene or cyclohexane extracts of total particulate matter, has been associated with excess cancer of the skin, lungs, bladder, and kidney.[12]

There is no formal standard for anthracene. However, it is phototoxic and photoallergenic on human skin[19] and exerts carcinogenic and neoplastic effects in animals.[20]

D. Asphalt

Asphalt is a dark-brown to black cementitious material, solid or semisolid in consistency, in which the predominating constituents are bitumens. It is a residual in petroleum refining.[21] (The source and primary chemical constituents are two reasons why the health effects of asphalt are considered independently of coal tar and coal tar pitch.) "The literature on the biological effects of exposure to asphalt fumes is often confusing and contradictory. Some of the problems arise from failure to distinguish between asphalt . . . tar . . . and pitch. However, the toxicity of asphalt and asphalt fumes is substantially lower than that of coal tar, coal tar pitch, and their fumes."[14] Irritation of the serous membranes of the conjunctivae and the mucous membranes of the respiratory tract are the principal adverse effects on the health of those exposed to asphalt fumes. NIOSH recommends that exposure to asphalt be limited by a ceiling concentration of 5000 ug/M^3, based on a 15-minute measurement of total airborne particulate matter.[13]

E. Indene and Indan

Quantitative indene vapor inhalation exposure of human subjects has not been reported. However, it can be expected to cause irritation of the mucous membranes based on the analogy between the chemical structure and toxicological effects of related monoaromatic hydrocarbons. Animal experiments indicate that indene is an irritant to mucous membranes and lungs, but not to the skin.[13] The American Conference of Governmental Industrial Hygienists suggests that exposure be limited to 45000 ug/M^3 measured as an 8-hour TWA.[8] Indan is analogous to indene.

F. Eye Irritation

Comparison of eye irritation characteristics indicate that cyclohexane-soluble materials exert effects at concentrations as low as 210 ug/M^3.[17] Asphalt fumes by themselves are potential eye and respiratory irritants in animals at concentrations above 4000 ug/M^3.[14] Xylene has been reported to produce eye irritation in human subjects at 1980000 ug/M^3 and toluene at 1500000 ug/M^3. While there is no human data for benzene, rabbits displayed only mild eye irritation upon application of 0.1 ml of benzene into the eye.[19]

G. Skin Effects

Benzene, toluene, and xylene are each skin defatting agents and prolonged contact with these liquids may cause dermatitis. Xylene is readily absorbed through the intact skin. Clayton and Clayton state "Immersion of both hands in m-xylene for 15 min equals an estimated pulmonary retention at 100 ppm . . . . Percutaneous exposure to 600 ppm xylene vapor for 3.5 hours corresponded to an equally long inhalation exposure of less than 10 ppm."[19]

V. RESULTS

A. Industrial Hygiene

Eighty-seven air samples were collected during the March visit. Thirty-six personal air samples were analyzed for cyclohexane solubles as well as for anthracene, fluorene, naphthalene, indan, and indene. Cyclohexane solubles were detected on 29 of 36 samples. In calculating the descriptive statistics, a value equal to one-half of the detection limit divided by the modal sample volume (111 ug/M^3) was included for samples which were below the limit of detection. The mean concentration was 280 ug/M^3 and the standard deviation was 211. Because the frequency distributions for the substances cyclohexane solubles, benzene, toluene, and xylene did not fit either normal or log-normal distributions, the arithmetic mean and standard deviation were arbitrarily selected for reporting results. All job categories were exposed to cyclohexane solubles. However, their arithmetic mean exposures did not differ (Table 9). There were no significant differences in the exposures of the four job categories when nonparametric statistics were used.

Operations personnel were exposed to naphthalene, indan, indene, and anthracene. Maintenance personnel were exposed only to anthracene. Transportation workers had mixed naphthalene and indan exposure. Laboratory personnel were not exposed to the specific PNAs measured. Anthracene, the most frequently quantitated PNA, was measured in 5 of 36 personal samples. Because only the PNAs anthracene and napthalene were quantitated in these samples, it is not possible, to state what fraction of the cyclohexane solubles collected on the filter was composed of PNAs.

The specific PNAs and the arenes indan and indene were collected on the porous polymer tube element of the sampling train. This implies that these species were in a vapor state. It is generally believed, however, that because of their characteristic high melting points and low vapor pressures, most atmospheric PNAs are associated with particulate matter, either as a pure material or adsorbed on other kinds of particulates.[16] This would account for the cyclohexane-soluble fractions collected on the prefilters.

There was measurable benzene on all of the charcoal tube samples. The mean of the 32 samples was 698 ug/M^3, and the standard deviation was 574. The range was 17.9--2405 ug/M^3. The current OSHA standard is 30000 ug/M^3 expressed as an 8-hour time-weighted average. The NIOSH-recommended standard is a ceiling concentration of less than 3000 ug/M^3 for this substance. Again, the mean exposures of the four job categories was not significantly different (Table 10).

Toluene and xylene were present in most samples at very low levels. All job categories were exposed to these substances. In calculating the descriptive statistics for these substances, a value equal to one-half of the detection limit divided by the modal sample volume (11 ug/M^3) was included for samples that were below the limit of detection, which was 2 ug/sample. Again, the mean exposures did not differ significantly between jobs (Table 10).

The mean exposures of Group 1 (the "high-exposure group") and Group 2 (the "low-exposure group") (See Section III. C.) did not differ significantly for benzene, toluene, or xylene. Group 1 had higher cyclohexane-solubles exposure than Group 2. This difference existed whether parametric or nonparametric statistics were used. The mean exposure to smokers and nonsmokers did not differ for any of the four substances.

Eighteen area samples for total and respirable dust were collected on the terrigator and grader. One personal respirable dust sample was obtained. Two samples exceeded the OSHA total dust standard for the amount of silica present. Two samples exceeded the 10-hour NIOSH-recommended TWA for respirable free silica, which is 50 ug/M^3. All respirable samples exceeded 50 ug/M^3 before allowing for nonexposure during the unsampled portion of the day. The native top soil in both the landfarm and landfill areas contained more than 30% quartz (Table 11).

Eight noise dosimeter measurements were made for periods of 1.5 to 6.5 hours. High noise exposure occurred during the grading operations on the landfarm. One 5.5-hour measurement of 100.7 dBA exceeded both OSHA and NIOSH noise level criteria (Table 12).

B. Health and Safety Procedures:

There was no physician, nurse, or medical facility at the plant. There were two first aid kits, one in the lab and one with the security guard. Should an accident occur, it would take about 15 minutes to reach the nearest physician's office and about 30 minutes to reach the nearest hospital emergency room.

Employees received a pre-employment physical which included a chest X-ray. Blood, urine, and pulmonary function tests are not presently being done. In 1976, a contract for annual medical surveillance, consisting of a basic multiphasic medical screen without a physical examination, but including work history questionnaire, chest X-ray, pulmonary function tests, ECG, a battery of blood tests, and audiometry was begun. This program apparently did not work too well in the past. In several instances there were results to tests that had never been done. Neilson Associates, consultants in occupational health, are presently taking over this program.

Employees were supplied with hard hats, safety glasses, rain suits, rubber gloves, and safety boots. During the November visit, it was observed that because employee lockers were too small to hold these items, they usually remained with the supervisors. One bathroom containing two showers, two lavatories, and two toilets was supplied. The facility was poorly maintained. Virtually nobody showered there. During the March 1981 visit, a modified mobile home was being installed to upgrade locker, shower, and eating facilities.

Work practices were observed or reported during the November visit which unnecessarily increased chemical exposure.

(1) In the drum crushing procedure, the barrels were not completely emptied, exposing the crusher operator to residues and their vapors.

(2) In the chemistry laboratory, there were numerous spills on the workcounter, and the two exhaust systems were out of order.

(3) It was reported that water taken from the open waste pits was used for flue dust control.

(4) Material labeling was inadequate. Workers did not know what substances were being handled, although the tanks and barrels were coded with a number.

C. Medical Questionnaire

The results of the medical questionnaire for the four groups ("high exposure," "low exposure," clerical worker, and outside contractors) showed that the nonclerical Rollins workers had an average seniority of 6.2 years (Table 13). There was no difference in the prevalence of cigarette smoking among the groups (p = 0.16). The history of upper and lower respiratory disease and heart disease was infrequent and did not differ.

Work-related symptoms were divided into mucous membrane, upper respiratory, lower respiratory, central nervous system, and gastrointestinal effects. The prevalence of symptoms of respiratory irritation was quite high in the exposed groups. Of the nonclerical workers, 71.8% reported occasional eye irritation, and 56.2% repeated cough (Table 14). Many other symptoms prevailed at far higher rates among the exposed, but these differences were not statistically significant when compared to the nonexposed group. When the three exposed groups were pooled and compared with the six controls, the exposed group experienced burning eyes (p = 0.0086), burning nose (p = 0.0507), and sore throat (p = 0.0403) significantly more often (Table 14).

An identical symptom catalog was contained in the questionnaire administered at Allied Chemical. A comparison was made between exposed Rollins workers and Allied workers with outdoor exposure. Rollins employees who spent part of their time indoors and part outdoors reported more symptoms than workers who performed tasks exclusively outdoors. Neglecting "unexposed" controls, the results showed a comparable percentage of symptoms among the two work forces. Mucous membrane and respiratory symptoms were more prevalent among Allied employees. Rollins workers showed more lightheadness and weakness (Table 15).

When investigating Allied Chemicals workers, it became apparent that workers who spent part of their time indoors and part outdoors reported far more symptoms than did workers who worked exclusively outdoors. Both groups are combined in Table 15. There is a similar pattern in the rates of reported respiratory symptoms.

Rollins workers were directly exposed to chemicals on the site. Allied Chemical workers were exposed, if at all, to diluted airborne chemical contaminants from Rollins. Individuals continuously exposed may adapt to an irritant material and not necessarily develop acute or chronic disease. The higher rate of CNS-related symptoms among Rollins employees probably reflects more direct exposure to solvents such as benzene, toluene, and xylene.

VI. DISCUSSION AND CONCLUSIONS

Rollins personnel are exposed to solvents, PNAs, and arenes. The chemicals measured in the air were very similar to those in the analysis of the bulk sample taken from the landfarm holding pit. The exposure is fairly uniform among occupational groups. This similarity is consistent with the observed practice of transporting waste from the landfarm holding pit to the landfill area, mixing it with fly ash and burying the resulting product.

The measured solvent exposures did not exceed recognized health standards either singly or when identical target organs and additivity of effect was assumed. The persistent widespread exposures to benzene, toluene, and xylene vapors imply that there are liquid sources of these materials at this site. The skin defatting properties of the liquids benzene, xylene, and toluene, and the ability of xylene to exert a toxic effect by penetration into the body through the intact skin, point to the need to select and wear gloves made of materials that are impermeable to these liquids. Because of the complex mixtures of chemicals at this site, laboratory testing of glove materials[23] in the context of current research[23,24,25] is recommended.

The cyclohexane-soluble fraction of total airborne particulate matter collected on the filter element of the Hill/Arnold sampling train exceeded OSHA standards for coal tar pitch volatiles and and NIOSH recommendations for occupational exposure to coal tar products in 28 of the 36 samples. There was excess respiratory and eye irritation among Rollins employees, significantly higher frequencies of eye and lung complaints among the Allied Chemical workers who spent most of their time outdoors (See HETA 80-232), and excess eye irritation among citizens of Alsen. The only ubiquitous material identified in this study that is known to produce eye irritation at the concentrations measured is the cyclohexane-soluble fraction of airborne particulate matter. The health effects reported by the questionnaire responses, although nonspecific, are similar to those demonstrated in NIOSH Health Hazard Evaluations in comparable environments where cyclohexane solubles are present (See Section IV).

Widespread PNA and cyclohexane-solubles exposures at the time of the NIOSH study are consistent with the analysis of the waste sludge applied to the landfarm which was a 90:10 mixture of two waste streams. In early 1980, 2600-3000 tons (30 pounds of wet sludge per square foot) were applied to the 55-60 acres of landfarm plots at 6-month intervals.[2] Data furnished to the Louisiana Department of Natural Resources[26] indicate that the PNA content of these waste streams was 1876 and 13.3 ppm, primarily phenanthrene, pyrene, fluoranthrene, benz(a)anthracene, benzo(a)pyrene, chrysene, and benzo(ghi)perylene. Anthrancene was present at 1.31 ppm in the minor (10%) waste stream. A draft report furnished by Rollins to the State of Louisiana states "The extent and mechanisms involved in the adsorption of PNAs and other organic compounds by soil clay minerals is not known . . . . Excessive accumulation of slowly degrading compounds may prove toxic . . . . Given the available data from a single collection and analysis of runoff . . . , it appears that the concentration of certain PNAs (e.g., pyrene, fluroanthene, chrysene) is above background levels (when compared to 'virgin' plot LF 6) and the PNAs may possibly be accumulating in RES landfarm plots."[27] This finding is consistent with an independent report to the Louisiana Department of Natural Resources. Anthracene was quantitated in three landfarm and one boring sample, napthalene in one landfarm and two sludge pit samples, and pyrene and fluoranthrene in landfarm samples.[28]

Landfarm soil is tilled with agriculutral equipment and may be disturbed by the wind. Particulate matter, especially small particles with low terminal settling velocities, can remain airborne for long periods of time. Dust, bearing PNA materials, may well be transported throughout the Rollins site, remain in the air as suspended particulates, and be inhaled or impacted on the eyes of workers.

The applicability of the coal tar products and coke oven standards (which are based on health effects exerted by coal products) to the results of this study is uncertain. The asphalt standard, which was derived for a petroleum material, is not applicable because the PNAs and arenes measured are not characteristic of this substance; in fact, they are more closely related to the constituents of coal tar pitch (See Section IV. C.). The pattern of eye irritation reported at Rollins, Allied Chemical, and Alsen and the respiratory symptoms reported at Rollins and Allied are consistent with the effects of low-level exposure to materials similar to coal tar pitch volatiles.

It cannot be determined, based on this study, whether any of the chemical exposures measured at this site have or will exert carcinogenic effects on Rollins personnel. The study does suggest that PNAs and arenes are related to the widespread symptoms of eye and respiratory irritation reported. The measured exposure of Rollins employees to such materials strongly reinforces the need for a well planned and documented medical surveillance program. The health effect of chronic exposure to volatile organics, such as benzene, toluene, and xylene, in the presence of cyclohexane soluble particulate matter is not known. It would be reasonable to carefully consider the target organs and health effects experienced by coke oven, coal tar pitch, asphalt, and aromatic solvent workers when devising the medical surveillance program for this site.

There is measured overexposure to noise and silica in the landfarm operation. It is not known whether contractor personnel operating the landfill have similar exposures. However, the comparable heavy equipment used and the silica content of the soil strongly suggests the need for industrial hygiene evaluation.

VII. RECOMMENDATIONS

1. Because cyclohexane-soluble fractions of airborne particulate matter and PNAs are associated with skin cancer and the solvents quantitated are associated with skin defatting, basic hygiene must be improved by the installation of sufficient, well-maintained showers, and adequate change and eating facilities.

2. Storage facilities for protective equipment should be improved. Gloves, aprons, and other skin protective devices should be selected to protect against carcinogenic skin hazards.

3. Operations likely to induce unnecessary inhalation or dermal exposure should be discontinued or modified. If crushing drums with residual contents is necessary, the process should be done remotely to remove the operator from exposure. The use of pit water for dust control should be evaluated with industrial hygiene sampling or discontinued.

4. The safety program should include labeling of waste in a manner understandable to workers and indicate its hazardous properties and the protective equipment needed when it is handled. First aid training for supervisors should be provided.

5. The personnel operating the landfill should be monitored for silica and noise exposure. If consistent high exposures are found, measures should be taken to reduce the exposure and appropriate medical monitoring (audiograms, chest X-rays, etc.) should be instituted.

6. Medical surveillance should be established, including pre-employment and periodic follow-up examination of workers including physical examination, blood, and urine tests, as appropriate to the various exposures.

7. Hygiene and worker health programs at this site should be modeled after those recommended for coke oven, asphalt, and coal tar pitch workers.

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report have been sent to:

1. Individual Requestor
2. Rollins Environmental Services, P.O. Box 73887, Baton Rouge, Louisiana 70807
3. State of Louisiana, Department of Health, P.O. Box 60630, New Orleans, Louisiana 70160
4. Regional Administrator, U.S. Environmental Protection Agency, 1201 Elm Street, Dallas, Texas 20460
5. NIOSH, Region VI
6. Individual Requestor, Route 1, Box 165A, Pride, Louisiana 70770
7. Allied Chemical, P.O. Box 52006, Baton Rouge, Louisinia 70005
8. Local 216, International Union of Operating Engineers, 6150 Hooper Road, Baton Rouge, Louisiana 70811
9. OSHA, Region VI

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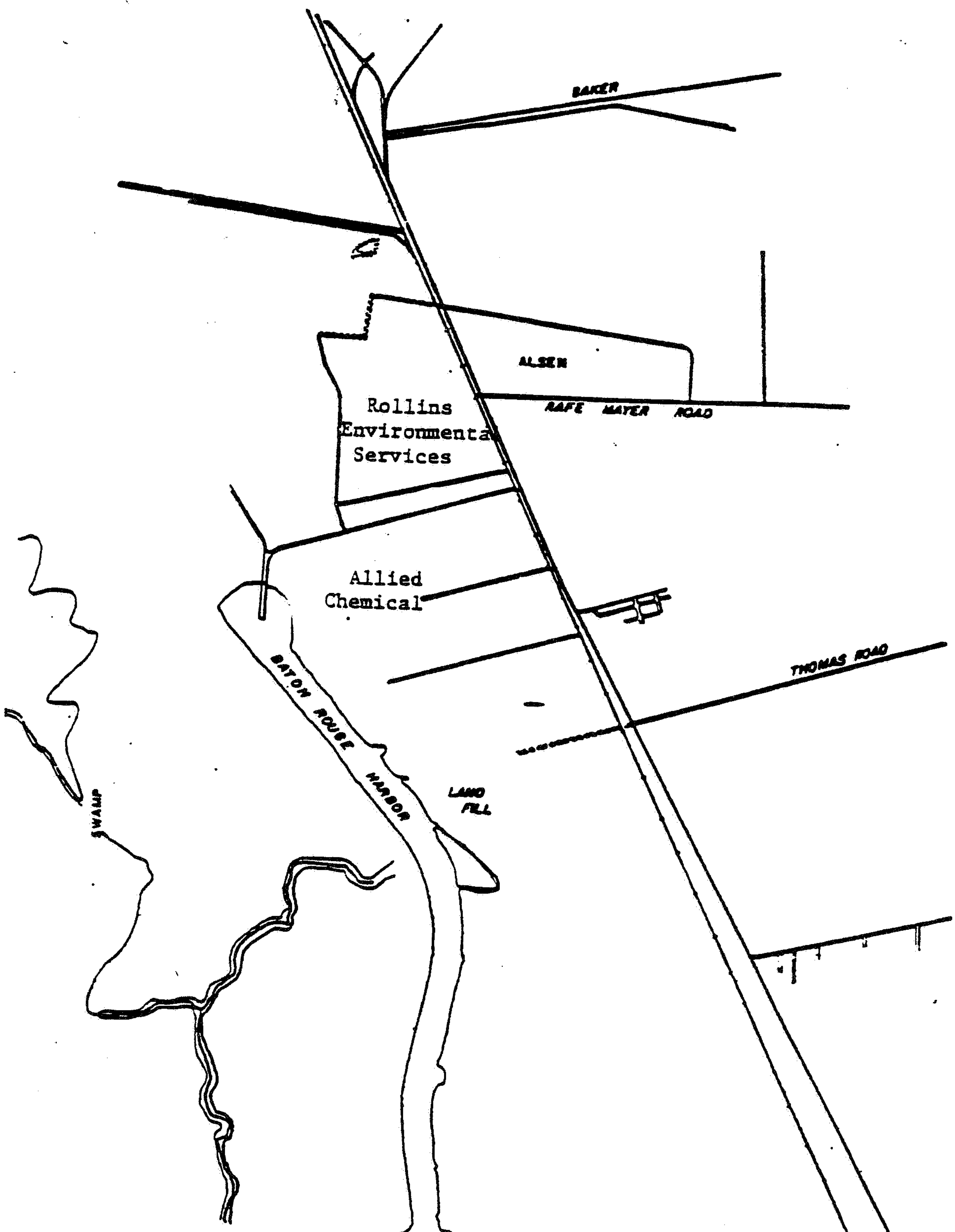

Figure 1. Area Map Rollins Environmental Services Baton Rouge, Louisiana
(Adapted from Reference 1).

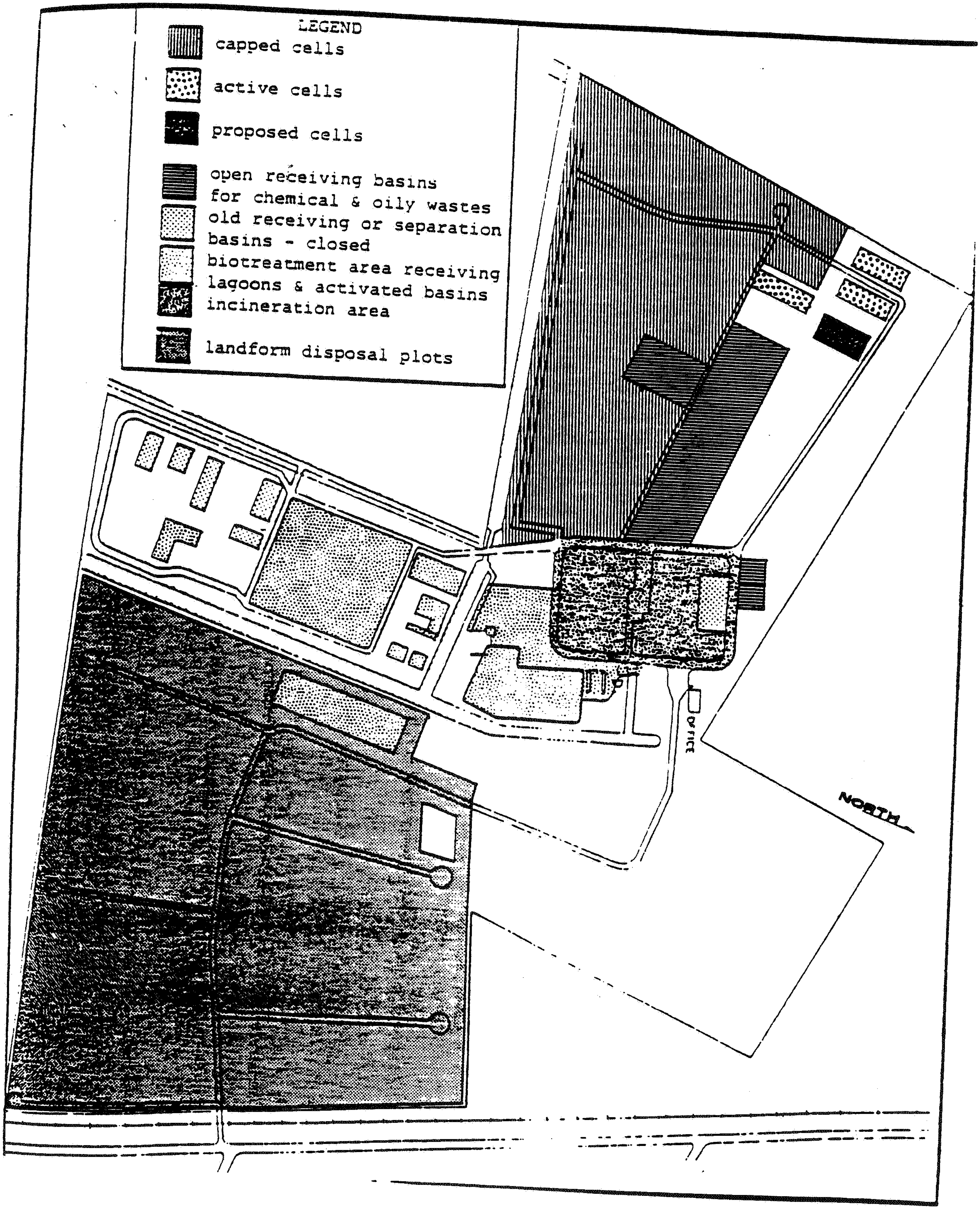

Figure 2. Site Plan Rollins Environmental Services, Baton Rouge, Louisiana (Adapted from Reference 2).

TABLE 1

Area Samples

Unloading Pump Pad

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

All Concentrations Are Expressed in ug/M3

PCBs	H_2S	Pest**	Al	Ca	Cr	Co	Fe	Mg	Mn	Na	Ni	P	Pb	Ti	Zn
N.D.	N.D.	N.D.	1.7	14.3	N.D.	N.D.	3.5	N.D.	N.D.	11.4	N.D.	N.D.	N.D.	N.D.	N.D.

All Concentrations Are Expressed in ug/M3

Chloride	Nitrate	Bromide	Fluoride	Sulfate	Phosphate
43	N.D.	N.D.	N.D.	N.D.	N.D.

NOTES:

1. Ag, As, Be, Cd, Co, Li, Mo, Pt, Se, Sn, Te, Tl, V, W, Y, and Zr were included in the analysis, but were less than 0.5 ug/filter.
2. Pest** reports the results of a pesticide scan.
3. This table presents the qualitative and quantatative results of a single fixed position air sample collected using the sampling media and methods for the analytes metals, pesticides, PCBs, acid anions, and H_2S detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection. N.D. means not detected.

TABLE 1 (Continued)

Area Samples

Unloading Pump Pad

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

DETECTED ORGANICS
Qualitative Analysis

Substance	Abundance
N-Butanol	M
Toluene	M
Acetone	I
Benzyl Chloride and/or Chlorobenzenes	I
Methyl Cellosolve Acetate	I
N-Propanol	I
Naphthalene	I
Trichloroethylene	I

Substance	Chemical Class
1,1-Dimethyl Indene	Indene
Methyl Indene	Indene
1 or 2 Methyl Naphthalene*	Naphthalene
2-Methyl-1,2-Dihydro Naphthalene	Naphthalene
Naphthalene*	Naphthalene
2-Methyl-1,2,3,4-Tetrahydro Napthalene	Naphthalene
Benzyl Butyl Phthalate	Phthalate
Dibutyl Phthalate*	Phthalate
Diethyl Phthalate*	Phthalate
Unknown Phthalate	Phthalate

NOTES:

1. "M" is a major contaminant. "I" is an identified contaminant. Within the sample set identified with "M"s and "I"s, the highest concentration of benzene was estimated to be 50-100 ug/M3. The concentration of toluene was estimated be 200-400 ug/M3. The concentration of perchloroethylene was estimated to be 200-400 ug/M3 and most of the other compounds were estimated at less than 100-200 ug/M3.
2. *Indicates identifications confirmed by GC retention times or by distinctive mass spectra.
3. This table presents the qualitative results of a single fixed position air sample collected using a charcoal tube for the sample set identified with "M"s and "I"s, and a sampling train consisting of a 13-mm glass fiber filter and Chromosorb 102 tube in series for the sample set identified with the descriptor "Chemical Class." The sampling methods are detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection.

TABLE 2

Area Samples

Landfill

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

All Concentrations Are Expressed in ug/M3

PCBs	H_2S	Pest**	Al	Ca	Cr	Co	Fe	Mg	Mn	Na	Ni	P	Pb	Ti	Zn
N.D.	N.D.	N.D.	22.7	328	N.D.	N.D.	21.6	N.D.	N.D.	13.7	N.D.	N.D.	N.D.	1.4	N.D.

All Concentrations Are Expressed in ug/M3

Chloride	Nitrate	Bromide	Fluoride	Sulfate	Phosphate
N.D.	N.D.	N.D.	N.D.	52	N.D.

NOTES:

1. Ag, As, Be, Cd, Co, Li, Mo, Pt, Se, Sn, Te, Tl, V, W, Y, and Zr were included in the analysis, but were less than 0.5 ug/filter.
2. Pest** reports the results of a pesticide scan.
3. This table presents the qualitative and quantatative results of a single fixed position air sample collected using the sampling media and methods for the analytes metals, pesticides, PCBs, acid anions, and H_2S detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection. N.D. means not detected.

TABLE 2 (Continued)

Area Samples

Landfill

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

DETECTED ORGANICS
Qualitative Analysis

Substance	Abundance
Benzene	M
Cyclohexane	M
Toluene	M
Naphthalene	I
Styrene	I
Xylene(s)	I

Substance	Chemical Class
1,1-Dimethyl Indene	Indene
Methyl Indene	Indene
1 or 2 Methyl Naphthalene*	Naphthalene
2-Methyl-1,2-Dihydro Naphthalene	Naphthalene
Naphthalene*	Naphthalene
2-Methyl-1,2,3,4-Tetrahydro Naphthalene	Naphthalene
Benzyl Butyl Phthalate	Phthalate
Dibutyl Phthalate*	Phthalate
Diethyl Phthalate*	Phthalate
Unknown Phthalate	Phthalate

NOTES:

1. "M" is a major contaminant. "I" is an identified contaminant. Within the sample set identified with "M"s and "I"s, the highest concentration of benzene was estimated to be 50-100 ug/M3. The concentration of toluene was estimated be 200-400 ug/M3. The concentration of perchloroethylene was estimated to be 200-400 ug/M3 and most of the other compounds were estimated at less than 100-200 ug/M3.
2. *Indicates identifications confirmed by GC retention times or by distinctive mass spectra.
3. The landfarm operator hauled liquid from the landfarm pit to a burial area where it was covered with "cement flue dust" during the entire sampling period.
4. This table presents the qualitative results of a single fixed position air sample collected using a charcoal tube for the sample set identified with "M"s and "I"s, and a sampling train consisting of a 13-mm glass fiber filter and Chromosorb 102 tube in series for the sample set identified with the descriptor "Chemical Class". The sampling methods are detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection.

TABLE 3

Area Samples

Landfarm

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

All Concentrations Are Expressed in Units of ug/M3

	PCBs	H_2S	Pest**	Al	Ca	Cr	Co	Fe	Mg	Mn	Na	Ni	P	Pb	Ti	Zn
Landfarm	N.D.	N.D.	N.D.	101	404	N.D.	0.7	7.5	7.6	2.5	27.5	1.6	3.8	1.0	1.2	3.2

All Concentrations Are Expressed in ug/M3

	Chloride	Nitrate	Bromide	Fluoride	Sulfate	Phosphate
Landfarm	55	N.D.	N.D.	N.D.	66	N.D.

NOTES:

1. *Percent by Weight. Ag, As, Be, Cd, Co, Li, Mo, Pt, Se, Sn, Te, Tl, V, W, Y, and Zr were included in the analysis, but were less than 0.001% for the Landfarm Holding Pit Sample.
2. Pest** reports the results of a pesticide scan.
3. This table presents the qualitative and quantatative results of a single fixed position air sample collected using the sampling media and methods for the analytes metals, pesticides, PCBs, acid anions, and H_2S detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection. N.D. means not detected.

TABLE 3 (Continued)

Area Samples

Landfarm

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

DETECTED ORGANICS
Qualitative Analysis

Substance	Abundance
Benzene	M
Naphthalene	M
Styrene	M
Toluene	M
Xylene(s)	M

Substance	Chemical Class
Alkane	Alkane
Alkane	Alkane
Anthracene	Anthracene
2-Methyl-1-Propenyl Benzene	Benzene
2-Methyl-1-Propyl Benzene	Benzene
Fluorene*	Fluorene
1,1-Dimethyl Indan	Indan
Indene	Indene
Methyl Indene	Indene
1,1-Dimethyl Indene	Indene

NOTES:

1. "M" is a major contaminant. "I" is an identified contaminant. Within the sample set identified with "M"s and "I"s, the highest concentration of benzene was estimated at 10 ug per sample, toluene was estimated at 40 ug per sample, perchloroethylene was estimated at 40 ug per sample, and most of the other compounds were estimated at less than 20 ug per sample.
2. *Indicates identifications confirmed by GC retention times or by distinctive mass spectra.
3. This table presents the qualitative results of a single fixed position air sample collected using a charcoal tube for the sample set identified with "M"s and "I"s, and a sampling train consisting of a 13-mm glass fiber filter and Chromosorb 102 tube in series for the sample set identified with the descriptor "Chemical Class". The sampling methods are detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection.

TABLE 3 (Continued)

Area Samples

Landfarm

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

Substance	Chemical Class
Naphthalene*	Naphthalene
2-Methyl-1,2-Dihydro Naphthalene	Naphthalene
1 or 2 Methyl Naphthalene*	Naphthalene
Propenyl or methyl-ethenyl Naphthalene	Naphthalene
Biphenyl or Ethenyl Naphthalene	Naphthalene
Ethyl or Dimethyl Naphthalene	Naphthalene
2-Methyl-1,2,3,4-Tetrahydro Naphthalene	Naphthalene
Methoxy Butyl Phenol (BHA)*	Phenol
Diethyl Phthalate*	Phthalate
Dibutyl Phthalate*	Phthalate

NOTES:

1. This table presents the continuation of the the qualitative results of a single fixed position air sample collected using a 13-mm glass fiber filter and Chromosorb 102 tube in series for the sample set identified with the descriptor "Chemical Class". The sampling methods are detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection.

TABLE 3 (Continued)

Bulk Sample
from Landfarm Holding Pit

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

	PCBs	H_2S	Pest**	Al	Ca	Cr	Co	Fe	Mg	Mn	Na	Ni	P	Pb	Ti	Zn
	All Concentrations Are Expressed in Units of ug/M^3															
Landfarm Pit				N.D.	18.6	N.D.	N.D.	3.2	N.D.	N.D.	4.2	N.D.	N.D.	N.D.	N.D.	N.D.

Benzene, Toluene, Xylene, Styrene, Methyl Styrene, Indenes, Naphthalene, Methyl Naphthalenes, Lower molecular weight PNAs no larger than 3-member rings were detected.

Al (0.698), Ca (0.28), Cu (0.006), Fe (0.065)
Mg (0.022), Mn (0.001), Mo (0.001), Na (0.043)
Ni (0.001), P (0.073), Pb (0.003), Ti (0.003),
Zn (0.015), Zr (0.006)*

NOTE:
1. This table presents the qualitative and quantative results of a bulk sample. Organics were eluted from the bulk material with carbon disulfide and analyzed by gas chromatography and mass spectrometry. The metals were analyzed by inductively coupled plasma atomic emission spectrometry.

TABLE 4

Area Samples

Biosystem

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

PCBs	H_2S	Pest**	Al	Ca	Cr	Co	Fe	Mg	Mn	Na	Ni	P	Pb	Ti	Zn
				All Concentrations Are Expressed in ug/M3											
N.D.	N.D.	N.D.	N.D.	5.7	N.D.	N.D.	N.D.	N.D.	N.D.	2.3	N.D.	N.D.	N.D.	N.D.	N.D.

TABLE 4 (Continued)

Area Samples

Biosystem

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

DETECTED ORGANICS
Qualitative Analysis

Substance	Abundance
Ethanol	M
Isopropanol	M
Toluene	M
Perchloroethylene	M
Ethyl Acetate	I
Heptane	I

Substance	Chemical Class
Naphthalene*	Naphthalene
1 or 2 Methyl Naphthalene*	Naphthalene
Dibutyl Phthalate*	Phthalate

NOTES:

1. "M" is a major contaminant. "I" is an identified contaminant. Within the sample set identified with "M"s and "I"s, the highest concentration of benzene was estimated at 10 ug per sample, toluene was estimated at 40 ug per sample, perchloroethylene was estimated at 40 ug per sample, and most of the other compounds were estimated at less than 20 ug per sample.
2. *Indicates identifications confirmed by GC retention times or by distinctive mass spectra.
3. This table presents the qualitative results of a single fixed position air sample collected using a charcoal tube for the sample set identified with "M"s and "I"s, and a sampling train consisting of a 13-mm glass fiber filter and Chromosorb 102 tube in series for the sample set identified with the descriptor "Chemical Class". The sampling methods are detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection. N.D. means not detected.

TABLE 5

Area Samples

Oil Water Separator

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

All Concentrations Are Expressed in ug/M3

PCBs	H_2S	Pest**	Al	Ca	Cr	Co	Fe	Mg	Mn	Na	Ni	P	Pb	Ti	Zn
	N.D.	N.D.	18.4	229	N.D.	N.D.	19.3	N.D.	N.D.	4.6	N.D.	N.D.	N.D.	1.8	N.D.

All Concentrations Are Expressed in ug/M3

Chloride	Nitrate	Bromide	Fluoride	Sulfate	Phosphate
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

NOTES:

1. Ag, As, Be, Cd, Co, Li, Mo, Pt, Se, Sn, Te, Tl, V, W, Y, and Zr were included in the analysis, but were less than 0.5 ug/filter.
2. Pest** reports the results of a pesticide scan.
3. This table presents the qualitative and quantatative results of a single fixed position air sample collected using the sampling media and methods for the analytes metals, pesticides, PCBs, azcid anions, and H_2S detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection. N.D. means not detected.

TABLE 5 (Continued)

Area Samples

Oil-Water Separator

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

DETECTED ORGANICS
Qualitative Analysis

Substance	Abundance
Naphthalene	M
Styrene	M
Xylene(s)	M
Benzene	M
Toluene	M
Indenes	I
Methyl Naphthalenes	I
Methyl Styrenes	I

Substance	Chemical Class
1,1-Dimethyl Indan	Indan
Indene	Indene
Methyl Indene	Indene
Naphthalene*	Naphthalene
2-Methyl-1,2-Dihydro Naphthalene	Naphthalene
1 or 2 Methyl Naphthalene*	Naphthalene
2-Methyl-1,2,3,4-Tetrahydro Naphthalene	Naphthalene

NOTES:

1. "M" is a major contaminant. "I" is an identified contaminant. Within the sample set identified with "M"s and"I"s, the highest concentration of benzene was estimated to be 50-100 ug/M^3. The concentration of toluene was estimated to be 200-400 ug/M^3. The concentration of perchloroethylene was estimated to be 200-400 ug/M^3 and most of the other compounds were estimated at less than 100-200 ug/M^3.
2. *Indicates identifications confirmed by GC retention times or by distinctive mass spectra.
3. This table presents the qualitative results of a single fixed position air sample collected using a charcoal tube for the sample set identified with "M"s and "I"s, and a sampling train consisting of a 13-mm glass fiber filter and Chromosorb 102 tube in series for the sample set identified with the descriptor "Chemical Class". The sampling methods are detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection. N.D. means not detected.

TABLE 6

Area Samples

Barrel Crusher

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

All Concentrations Are Expressed in ug/M3

Al	Ca	Cr	Co	Fe	Mg	Mn	Na	Ni	P	Pb	Ti	Zn
8.1	52	1.4	N.D.	14.9	1.4	N.D.	6.2	N.D.	N.D.	N.D.	N.D.	1.6

DETECTED ORGANICS
Qualitative Analysis

Substance	Abundance
Ethanol	M
Isopropanol	M
Toluene	M
Perchloroethylene	M
Ethyl Acetate	I
Heptane	I

NOTES:

1. Ag, As, Be, Cd, Co, Li, Mo, Pt, Se, Sn, Te, Tl, V, W, Y, and Zr were included in the analysis, but were less than 0.5 ug/filter.
2. "M" is a major contaminant. "I" is an identified contaminant. Within the sample set identified with "M"s and "I"s, the highest concentration of benzene was estimated at 10 ug per sample, toluene was estimated at 40 ug per sample, perchloroethylene was estimated at 40 ug per sample, and most of the other compounds were estimated at less than 20 ug per sample.
3. This table presents the qualitative and quantatative results of a single fixed position air sample collected using the sampling media and methods for the analytes metals and organics collected on charcoal tubes detailed in Appendix I. Appendix I also states the analytical methods and the limits of detection.

TABLE 7

Employee Rating of Exposure
to Chemical Waste
by Job Category

Rollins Environmental Services
Baton Rouge, Louisiana
November 5-6, 1980

Job Category	Exposure Rating
Biotreatment Operator	High
Equipment Operator	High
Incinerator Operator	High
Shift Helper	High
Treatment Operator	High
Day Helper	Low
Laboratory Technician	Low
Maintainance Mechanic	Low
Operation Superintendent	Low
Truck Driver	Low

TABLE 8

Group Size

Rollins Environmental Services
Baton Rouge, Louisiana
November 5-6, 1980

GROUP 1	Rollins workers with "high" exposure	14
GROUP 2	Rollins workers with "low" exposure	21
GROUP 3	Clerical worker	6
GROUP 4	Outside contractors	4
		45

TABLE 9

Cyclohexane Solubles

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Frequency Distribution

N = 36

Not Detected	100-199 ug/M3	200-299 ug/M3	300-399 ug/M3	400-499 ug/M3	500-599 ug/M3	600-699 ug/M3	700-799 ug/M3	800-899 ug/M3	900+ ug/M3
7	1	19	1	3	2	0	0	2	1

Arithmetic Mean* ug/M3	Standard Deviation	Range ug/M3
280	211	111 - 919

Exposure By Job Category

	Number of Samples	Arithmetic Mean* ug/M3	Standard Deviation	Range ug/M3
Laboratory	4	196	57	111-235
Maintenance	15	248	120	111-536
Operations	13	314	266	111-919
Transportation	4	374	364	111-883

Identified Cyclohexane Solubles

Substance	Incidence By Group Lab	Maint	Ops	Trans	Total Incidence	Mean ug/M3	Standard Deviation	Range ug/M3
Naphthalene	0	0	2	1	3	27	31	6 - 63
Indan	0	0	2	1	3	47	39	18 - 92
Indene	0	0	2	0	2	29	35	4 - 54
Anthracene	0	4	1	0	5	5	7	1 - 18

NOTE:

1. *In calculating the descriptive statistics, a value equal to one half of the detection limit divided by the modal sample volume (111 ug/M3) was included for samples which were below the limit of detection.
2. The limits of detection for cyclohexane solubles, napthalene, indan, indene, and anthracene are given in Appendix III. Cyclohexane solubles were quantitated on the filter samples only.

TABLE 10

Organic Vapors

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Benzene

Frequency Distribution

N = 32

18-500 ug/M3	501-1000 ug/M3	1001-1500 ug/M3	1501-2000 ug/M3	2001-2500 ug/M3
16	10	2	2	2

Arithmetic Mean ug/M3	Standard Deviation	Range ug/M3
698	574	17.9-2405

Exposure By Job Category

	Number of Samples	Arithmetic Mean ug/M3	Standard Deviation	Range ug/M3
Laboratory	4	365	97	248 - 484
Maintenance	12	576	256	230 - 1094
Operations	13	939	768	18 - 2405
Transportation	3	586	696	76 - 1379

NOTE:

1. Benzene was quantitated on all 32 samples.
2. Benzene and cyclohexane appeared together on the chromatogram and it was not always possible to separate them during the data processing. The values given should be taken as the maximum amount present.

TABLE 10 (Continued)

Organic Vapors

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Toluene

Frequency Distribution

N = 32

N.D.-500 ug/M^3	501-1000 ug/M^3	1001-1500 ug/M^3	1501-2000 ug/M^3	2001-2500+ ug/M^3
22	4	5	0	1

Arithmetic Mean ug/M^3	Standard Deviation	Range ug/M^3
574	518	11-2575

Exposure By Job Category

	Number of Samples	Arithmetic Mean ug/M^3	Standard Deviation	Range ug/M^3
Laboratory	4	998	1076	274 - 2575
Maintenance	12	505	365	202 - 1464
Operations	13	591	424	11 - 1465
Transportation	3	209	129	71 - 327

NOTE:

1. In calculating the descriptive statistics, a value equal to one half of the detection limit divided by the modal sample volume (11 ug/M^3) was included for samples that were below the limit of detection which was 2 ug/sample.

TABLE 10 (Continued)

Organic Vapors

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Xylene

Frequency Distribution

N = 32

N.D.-100 ug/M^3	101-200 ug/M^3	201-300 ug/M^3	301-400 ug/M^3	401-500+ ug/M^3
12	6	7	2	5

Arithmetic Mean ug/M^3	Standard Deviation	Range ug/M^3
200	170	11-734

Exposure By Job Category

	Number of Samples	Arithmetic Mean ug/M^3	Standard Deviation	Range ug/M^3
Laboratory	4	283	333	11 - 734
Maintenance	12	212	164	11 - 436
Operations	13	173	131	11 - 460
Transportation	3	160	94	63 - 251

NOTE:

1. In calculating the descriptive statistics, a value equal to one half of the detection limit divided by the modal sample volume (11 ug/M^3) was included for samples that were below the limit of detection which was 2 ug/sample.
2. The values used in these calculations represent o-xylene only. However, all isomers of xylene were present.

TABLE 11

Silica Samples

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Date	Location		Type of Sample		Sample Volume	Sample Duration	% Quartz	OSHA TLV	Quartz	10-Hour TWA Respirable	Total Dust
					M^3	Hr + Min		ug/M^3	ug/M^3	ug/M^3	ug/M^3
3-17-81	Dozer	Inside	Personal	Respirable	0.54	5+15	25	370	77	40	298
3-17-81	Terragotor	Inside	Area	Respirable	0.65	6+25	--	--	321	205	--
3-17-81	Terragator	Inside	Area	Respirable	3.38	6+15	13	667	56	35	432
3-18-81	Terragator	Inside	Area	Respirable	0.35	3+55	--	--	--		287
3-18-81	Terragator	Inside	Area	Respirable	1.76	3+15	14	625	68	22	479
3-20-81	Terragator	Inside	Area	Respirable	0.61	5+59	--	--	--	--	410
3-20-81	Terragator	Inside	Area	Respirable	3.23	5+59	11	769	87	52	823
3-17-81	Terragator	Inside	Area	Total	0.65	6+25	--	--	--	--	--
3-17-81	Terragator	Inside	Area	Total	3.38	6+15	08	3000	21		248
3-18-81	Terragator	Inside	Area	Total	0.35	3+55	19	1428	115		574
3-18-81	Terragator	Inside	Area	Total	1.76	3+15	12	2142	125		1054
3-20-81	Terragator	Inside	Area	Total	0.61	5+59	15	1765	131		836
3-20-81	Terragator	Inside	Area	Total	3.23	5+59	10	2500	127		1241
3-17-81	Terragator	Outside	Area	Respirable	0.63	6+10	15	588	63	39	413
3-18-81	Terragator	Outside	Area	Respirable	0.31	3+05	--	--	--	--	159
3-20-81	Terragator	Outside	Area	Respirable	0.61	5+59	07	1111	66	39	885
3-17-81	Terragator	Outside	Area	Total	0.63	6+10	15	1764	95		652
3-18-81	Terragator	Outside	Area	Total	0.31	3+05	15	1764	159		1049
3-20-21	Terragator	Outside	Area	Total	0.61	5+59	16	1666	1060		6032

NOTE:
1. % Quartz is the weight of quartz divided by the weight of total dust multipled by 100.
2. A terragator is an agricultural machine used to inject sludge from the landfarm holding pit into the landfarm soil.

TABLE 11 (Continued)

Silica Samples (Continued)

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

Cement Flue Dust Bulk Sample	Quartz 2.5% Cristobalite Less Than 1.5%, The Detection Limit for This Analysis. Al (1.35), Ca (11.7), Cr (0.005), Fe (1.37) Li (0.007), Mg (0.458), Mn (0.023), Mo (0.003), Na (0.482), P (0.073), Pb (0.032), Pb (0.009), Ti (0.041), Zn (0.010), Zr (0.003)*

NOTE:

1. *Percent by Weight. Ag, As, Be, Cd, Co, Li, Mo, Pt, Se, Sn, Te, Tl, V, W, Y, and Zr were included in the analysis, but were less than 0.003% for the "Cement Flue Dust" Sample.

Bulk Samples
March 17-20, 1981

Location	Quartz	Cristobalite
Landfill Cap	37%	Less Than 1.5%
Cement Flue Dust 175 Yards West of Barrel Crusher	4%	Less Than 1.5%
Landfarm Soil 150 Feet East of Sludge Pit	33%	Less Than 1.5%

TABLE 12

Noise Dosimeter Results

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Date	Job Description	Sample Duration Hours	Cumulative dBA
3-17-81	Dozer and Tractor Operator	5+29	100.7
3-17-81	Truck Driver	3+23	83.4
3-17-81	Terragator Operator	1+34	78.8
3-18-81	Terragator Operator	2+44	85.2
3-19-81	Terragator Operator	7+34	86.8
3-19-81	Terragator Operator	6+20	85.7
3-20-81	Terragator Operator	6+36	84.3
3-20-81	Terragator Operator	3+36	86.3

TABLE 13

Demographic Characteristics
of
Workers Interviewed

Rollins Environmental Services
Baton Rouge, Louisiana
October 1-2, 1980

	Group 1 High Exposure (14 workers)	Group 2 Low Exposure (21 workers)	Group 3 Clerical (6 workers)	Group 4 Contractors (4 workers)
Age (Years)				
Mean:	35.9	40.4	35.0	34.5
Range:	25-46	20-59	20-52	23-57
Seniority (Years)				
Mean:	7.9	5.6	1.7	1.9
Range:	3-10	1-10	1-10	1-4
Race				
Black	7	10	0	0
White	7	11	6	4
Sex				
Male:	14	20	3	4
Female:	0	1	3	0

TABLE 14

Symptoms Related to Work Exposure

Rollins Environmental Services
Baton Rouge, Louisiana
November 5-6, 1980

Group / Symptoms	1 High Exposure (n=14)		2 Low Exposure (n=21)		3 Clerical (n=6)		4 Contractors (n=4)		Total (n=45)	
	n	%	n	%	n	%	n	%	n	%
1. Watery, burning eyes	12	85.7	14	66.7	1	16.7	2	50.0	29	64.4
2. Burning nose	6	42.9	7	33.3	0	0.0	3	75.0	16	35.6
3. Dry mouth	6	42.9	9	42.9	1	16.7	0	0.0	16	35.6
4. Sore throat	8	57.1	7	33.3	0	0.0	2	50.0	17	37.8
5. Hoarseness	2	14.3	2	9.5	0	0.0	1	25.0	5	11.1
6. Cough	12	85.7	9	42.9	2	33.3	1	25.0	24	53.3
7. Chest tightness	5	35.7	4	19.1	0	0.0	2	25.0	10	22.2
8. Chest pain	2	14.3	6	28.6	0	0.0	0	0.0	8	17.8
9. Feeling of suffocation	2	14.3	4	19.1	0	0.0	1	25.0	7	15.6
10. Headache	9	64.3	7	33.3	2	33.3	2	50.0	20	44.4
11. Dizziness	1	7.1	4	19.1	0	0.0	1	25.0	6	13.3
12. Lightheadedness	3	21.4	4	19.1	0	0.0	1	25.0	8	17.8
13. Weakness	1	7.1	2	9.5	0	0.0	0	0.0	3	6.7
14. Numbness	3	21.4	4	19.1	0	0.0	0	0.0	7	15.[illegible]
15. Sleepiness	3	21.4	1	4.8	0	0.0	0	0.0	4	8.9
16. Nausea	5	35.7	7	33.3	1	16.7	1	25.0	14	31.1
17. Vomiting	3	21.4	1	4.8	0	0.0	1	25.0	5	11.1
18. Abdominal pain	3	21.4	1	4.8	0	0.0	1	25.0	5	11.1
19. Diarrhea	2	14.3	2	9.5	0	0.0	0	0.0	4	8.9

TABLE 15

Symptom Comparison

Allied Chemical vs. Rollins Environmental Employees

Symptom	Allied Chemical (71 workers) n	%	Rollins (35 workers) n	%	Level of Significance (Chi-Square)
Burning Nose	48	67.6	13	37.1	0.0028
Hoarseness	23	32.3	4	11.4	0.0198
Feeling of Suffocating	34	47.9	6	5.7	0.0021
Lightheadedness	0	0.0	7	20.0	0.0001
Weakness	0	0.0	3	2.8	0.0123

APPENDIX I

Collection and Analysis Methods

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

Analyte	Limit of Detection (per sample)	Collection Media	Analytical Method	Reference
Metals	0.5 ug	AA Filter	ICP-AES	29
Organics I	N.R.	Charcoa Tube	GC/MS	30
Organics II	N.R.	13mm GF and Chromosorb 102 Tube	GC/MS	31
Pesticides	N.R.	37mm GF	GC/MS	32
PCBs	0.05 ug	Florisil Tube	GC	33
H_2S	0.6 ug	Calcium Hydroxide	Spectro-photometry	34
Free Silica	0.03 mg	Bulk	XRD	35
<u>Anions</u>:		Prewashed Silica Gel Tube	Ion Chromato-graphy	36
Chloride	5 ug			
Nitrate	10 ug			
Bromide	10 ug			
Fluoride	5 ug			
Sulfate	10 ug			
Phosphate	20 ug			

NOTES:

1. N.R. means that the limit of detection was estimated, not reported as a definite number.
2. ICP-AES means inductively coupled plasma atomic emission spectrometry.
3. GC/MS means gas chromatography and mass spectrometry.
4. XRD means X-ray diffraction.
5. GF means that a glass fiber filter was used for sample collection.

   N.R. means that the limit of detection was not reported.

APPENDIX II

Sample Volumes and Durations

Rollins Environmental Services
Baton Rouge, Louisiana
November 6, 1980

Location	Sample Duration Hr + Min	Sample Volumes All Volumes are Expressed in Units of M^3						
		Metals	Organics I	Organics II	Pesticides	PCBs	H_2S	Anions
Landfarm	7+30	0.68	0.22	0.09	0.90	0.45	0.45	0.09
Unloading Pad	7+40	0.69	0.23	0.09	0.92	0.46	0.46	0.09
Landfill	6+25	0.58	0.20	0.08	0.77	0.38	0.38	0.07
Oil/Water Separator	4+50	0.44	0.14	0.06	0.58	----	0.29	0.06
Biosystem	5+18	0.48	0.16	0.06	0.64	0.32	0.32	0.06
Barrel Crusher	4+06	0.37	0.12					
Landfarm Pit	3+28	0.31	0.10					

NOTES:

1. Organics I designates those samples collected using charcoal tubes and analyzed for by gas chromatography and mass spectrometry.

2. Organics II designates those samples collected using a glass fiber filter and Chromosorb 102 sampling train and analyzed by gas chromatography and mass spectrometry.

APPENDIX III

Sampling and Analysis Methodology

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Substance	Collection Device	Flow Rate	Duration	Analytic Method	Limit of Detection	Reference
Anthracene	GF/SM Filter Porous Polymer	0.2 lpm	7-8 Hours	Reverse-Phase High Pressure Liquid Chromatography	0.1 ug	37
Benzene	Charcoal Tube	0.2 lpm	7-8 Hours	Gas Chromatography Mass Spectrometry	2 ug	38
Cyclohexane Solubles	GF/SM Filter	0.2 lpm	7-8 Hours	Cyclohexane Extraction Weight Determination	20 ug	39
Naphthalene	GF/SM Filter Porous Polymer	0.2 lpm	7-8 Hours	Reverse-Phase High Pressure Liquid Chromatography	0.16 ug	37
Indan	GF/SM Filter Porous Polymer	0.2 lpm	7-8 Hours	Reverse-Phase High Pressure Liquid Chromatography	2 ug	37
Indene	GF/SM Filter Porous Polymer	0.2 lpm	7-8 Hours	Reverse-Phase High Pressure Liquid Chromatography	0.2 ug	37
Silica (Free)	M-5 Filter	1.7 lpm	3-6 Hours	X-Ray Diffraction	30 ug	40
Toluene	Charcoal Tube	0.2 lpm	7-8 Hours	Gas Chromatography Mass Spectrometry	2 ug	38
Total Dust	M-5 Filter	1.7 lpm	3-6 Hours	Weight Determination	10 ug	41
o-Xylene	Charcoal Tube	0.2 lpm	7-8 Hours	Gas Chromatography Mass Spectrometry	2 ug	38

NOTE:

1. GF/SM means glass fiber silver membrane.

APPENDIX IV

Environmental Evaluation Criteria

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

Substance	NIOSH Recommended Standard		Reference	OSHA Standard		Reference
	8-Hour TWA ug/M3	Ceiling ug/M3		8-Hour TWA ug/M3	Ceiling ug/M3	
Benzene		3,000	42	30,000	80,000	43
Naphthalene				50,000		15
Crystalline Silica (Free Respirable)	50		44	Calculated from the Formula $\frac{10{,}000\ ug/M^3}{\%\ SiO_2 + 2}$		45
Crystalline Silica (Total Dust)				Calculated from the Formula $\frac{30{,}000\ ug/M^3}{\%\ SiO_2 + 2}$		45
Toluene	375,000	750,000 10 Minutes	46	750,000	1,125,000	43
Xylene	435,000	870,000 10 Minutes	47	435,000		15
Anthracene	No Standard					
Cyclohexane Solubles	No Standard (See Pages 6-9 of the text.)					
Indan	No Standard					
Indene	ACGIH suggests 45,000 ug/M3 (8-Hour TWA) Reference 8					

APPENDIX IV (Continued)

Environmental Evaluation Criteria

Rollins Environmental Services
Baton Rouge, Louisiana
March 17-20, 1981

29 CFR 1910.95
Table G-16
Permissible Noise Exposure

Duration Per Day Hours	OSHA Standard dBA Slow Response	NIOSH Recommended Criteria dBA
8	90	85
6	92	87
4	95	90
3	97	92
2	100	95
1 1/2	102	97
1	105	100
1/2	110	105
1/4	115	109