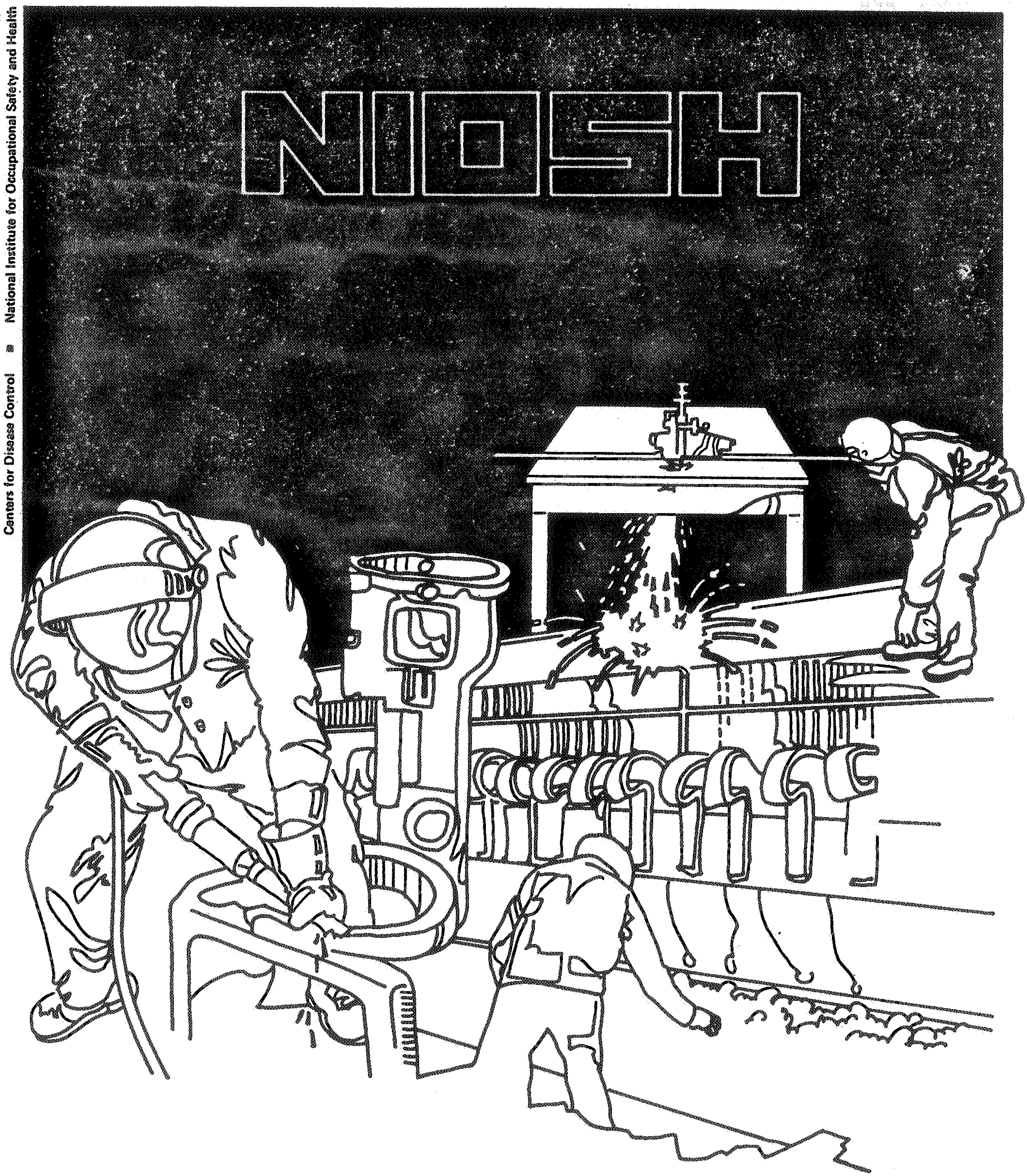
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 81-291-1030
U.S. CUSTOMS SERVICE
DEPARTMENT OF TREASURY
NEW ORLEANS, 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.

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I. SUMMARY

On April 20, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Department of the Treasury, U.S. Customs Service to conduct a health hazard evaluation at the U.S. Customs Laboratory, New Orleans, Louisiana. Of concern was the possible association between cancer among laboratory personnel and their work environment. Four chemists/laboratory directors working at the New Orleans Customs Laboratory are known to have died from or have developed leukemia (3 cases) or Hodgkin's disease (1 case).

The field investigation was conducted on June 25-26, 1981 at the U.S. Customs Laboratory. The laboratory and offices have a staff of 25 employees. The laboratory appears typical of a general chemistry laboratory. Two small exhaust ventilated hoods were installed in the inorganic laboratory in 1942 and were replaced with new hoods in the spring of 1981. Additional hoods were also added at that time in the organic and inorganic chemistry sections of the laboratory.

Numerous chemicals, both reagents and samples, are known to be used and stored in the laboratory. Many of these are on the tentative list of carcinogens released by EPA (Occupational Safety and Health Reporter, July 14, 1978). These chemicals are listed in the Appendix. Their presence in the laboratory does not necessarily reflect worker exposure. However, interviews with laboratory personnel indicated benzene was used under unvented conditions for washing glassware and as a reaction solvent prior to the early 1950's. Analysis of crude oil which has been tested in the laboratory for many years indicated from 0.1 to 0.6 mole percent of benzene.

Review of hospital records verified the three cases of leukemia and one case of Hodgkin's disease which have been reported. A search for further cases revealed two cases of carcinoma of the prostate, but no further cases of leukemia or lymphoma.

On the basis of this investigation NIOSH has determined that while no excessive exposures were currently found at the Customs laboratory, a health hazard could have existed in the past due to chemical exposures. Recommendations to help ensure safe working conditions and for medical screening of workers exposed in the past are included in Section VIII of this report.

It is recommended that employees who worked in the laboratory prior to 1980 receive standard hematology blood sample analyses annually to aid early identification of any further cases of leukemia.

Materials which contain known or suspected carcinogens should be used in ventilated hoods and stored in ventilated cabinets. Also, periodic checks of hoods for adequate face velocity of air is warranted.

KEYWORDS: SIC 2800, Laboratory, chemist, leukemia, cancer

II. INTRODUCTION

On April 20, 1981, the U.S. Customs Service, Washington, D.C., requested a health hazard evaluation of the U.S. Customs Laboratory in New Orleans, Louisiana. The request for this investigation was the result of concern for a current employee diagnosed as having hairy cell leukemia two additional cases of leukemia and one of Hodgkin's disease were recalled as having occurred in former laboratory employees.

A health hazard evaluation was conducted June 25-26, 1981, in the U.S. Customs Laboratory by an industrial hygienist and a physician.

The goals of the evaluation were to confirm the above cases, search for further cases, estimate the population at risk, evaluate the environmental conditions for possible sources of work-associated problems, and develop, based on findings, appropriate recommendations to government personnel to alleviate the situation.

III. BACKGROUND

The U.S. Customs Laboratory is housed on the third floor of the U.S. Customs Building, is air conditioned with individual units in each laboratory and office, and has a staff of 25 employees of whom approximately 20 are employed in the laboratory as chemists or technicians. The laboratory, offices and storage areas utilize approximately 7,000 sq. ft. The laboratory moved to its present location in 1908 and has had few alterations. Previously the laboratory was housed in the basement of this same building. The individual air conditioning units were installed in the 1950's primarily to maintain a constant temperature for the laboratory instruments. Two small hoods had been installed in the inorganic laboratory in 1942 and were replaced with new hoods in the spring of 1981. At the same time other hoods were added where previously there were no hoods.

IV. METHODS AND MATERIALS

A. Environmental

The environmental evaluation consisted of interviews with laboratory personnel about environmental conditions, a walk-through industrial hygiene survey and collection of air and bulk samples for organic vapor analysis.

Air samples were collected using charcoal tubes and analyzed for organic vapors by means of gas chromatography following elution by carbon disulfide. An estimate of the benzene, toluene and xylene isomer mixture in mole percent was made on four bulk crude oil samples by gas chromatographic determination of the concentration of the analytes in ∿1 L of headspace. The headspace sample was obtained by purging 10 mL of oil in an impinger with nitrogen and collecting the purge gas on charcoal. The charcoal tube samples were desorbed in carbon disulfide and the analyte concentration determined by standard methods. In order to avoid interference from alkanes and naphthenes in the sample, the gas chromatographic analysis was performed on a polar column. The highly saturated components of the sample elute very rapidly on a polar packing, leaving the later eluting aromatic components free from interference.

B. Medical

Medical evaluation consisted of review of hospital records and recovery of representative pathology specimens where possible, questioning of laboratory personnel about other cases of cancer in current or retired laboratory employees, review of laboratory employment records, and discussions with long-term employees on the nature and extent of present and former exposures in the laboratory.

V. EVALUATION CRITERIA

A. Environmental

The criteria for evaluating the 22 organic vapors assayed are the current American Conference of Governmental Industrial Hygienists Threshold Limit Values (ACGIH-TLV), the U.S. Department of Labor, Occupational Health Standards (OSHA), the NIOSH Criteria Documents, and the NIOSH Registry of Toxic Effects of Chemical Substances. Limits appearing below reflect the lowest found among these sources.

Substance	Ceiling Limit or STEL (ppm)	8-hour time Weighted Average (ppm)	Source	OSHA 8-hour Limit (ppm) (6)
Isopentane	610	120	NIEHS (1)	1,000
n-Pentane	610	120	NIEHS (1)	1,000
2,2-Dimethylbutane	510	100	NIEHS (1)	none
3-Methylpentane	510	100	NIEHS (1)	none
2-Methylpentane	510	100	NIEHS (1)	none
n-Hexane	125	100**	ACGIH (2)	500
Cyclopentane	900	600	ACGIH (2)	none
Methylcyclopentane	1,000*	500*	ACGIH (2)	none
n-Heptane	440	85	NIOSH (1)	500
Cyclohexane	375	300	ACGIH (2)	300
Methylcyclohexane	500	400	ACGIH (2)	500
n-Octane	385	75	NIOSH (1)	500
1,1,1-Trichloroethane	350	350	NIOSH (3)	350
Methyl ethyl ketone	300	200	ACGIH (2)	200
Isopropanol	500	400	ACGIH (2)	400
Benzene	1***	1	NIOSH (4)	10
Trichloroethylene	150	25	NIOSH (5)	100
Toluene	150	100	ACGIH (2)	200
Ethylene dichloride	15	5	NIOSH (3)	50
Xylenes; o, p, m	150	100	ACGIH (2)	100

* Proposed TLV ** TLV of 50 ppm proposed *** 2-hr TWA Limit

B. Medical

Medical evaluation criteria used were the physician's judgment based on personal interviews, communication with the affected employees' physicians, and an attempt to estimate the population at risk by reviewing employment records contained in the laboratory files. These employment records did not exist locally for individuals employed before 1950, a group which included one of the leukemia cases (case 3). No other local source of records exists.

VI. RESULTS AND DISCUSSION

A. Environmental

Seven 2 to 4-hour air samples were collected in the inorganic and organic laboratories during normal laboratory procedures. These were analyzed for the 22 vapors listed in Section V. Concentrations in air of those vapors detected are reported in Table 1. Benzene was found in four air samples ranging in vapor concentrations of 0.02 to 0.09 ppm. Other organic vapor concentrations were less than 0.50 ppm.

An estimate of the benzene, toluene and xylene isomer mixture in mole percent was made on four crude oil samples. The following assumptions were made in performing the analysis described in Section IV.

(1) The oil is an ideal solution, so that Raoult's Law may be applied to the headspace

$$X_{\text{mole fraction}} = \frac{\text{equilibrium partial pressure of analyte in headspace at equilibrium temperature}}{\text{vapor pressure of pure analyte at equilibrium temperature}}$$

(2) The volume of headspace samples did not deplete the concentration of analytes in the crude oil sample.

The assumptions need be only approximately valid in order to obtain an estimate of analyte concentrations in the crude oil as mole percent. Results are presented in Table 2.

Table 1. Solvent vapor concentrations for area and personnel samples in the inorganic and organic U.S. Customs Laboratory

Charcoal Tube Sample Number and Sampling Time (minutes)	Location/comments	Solvent Vapor Concentrations (ppm) Isopentane	n-Pentane	3-Methylpentane	2-Methylpentane	n-Hexane	Methylcyclo-hexane	1,1,1-Trichloro-ethane	Isopropanol	Benzene	Trichloro-ethylene	Toluene	Ethylene dichloride	Xylenes
1 (251)	Area, 1st organic, lab table top center of lab. Typical lab, acids and few solvents	0.02	--	--	--	--	--	--	--	--	--	--	--	--
2 (251)	Area, 2nd inorganic lab. center of lab on table top.	0.02	--	--	--	--	--	--	--	--	--	--	--	--
3 (247)	Area, organic lab, top of file cabinet in wet Chemistry work area.	0.08	0.08	--	0.03	--	--	0.03	--	0.02	--	0.07	--	--
4 (235)	Area, organic lab, table top, work area, center of room.	0.12	0.11	0.03	--	0.03	--	--	--	0.02	0.02	0.06	--	--
5 (68)	Personnel, B_2, physical science technician, testing crude oil.	--	0.09	0.08	--	0.18	0.11	--	--	0.09	0.20	0.37	--	--
6 (116)	Personnel, same as #5 in sequence.	0.23	0.17	0.06	--	0.07	0.07	0.07	0.16	0.09	0.18	0.41	0.06	0.04
7 (106)	Area, organic lab, table top near area with crude oil.	0.14	0.08	0.05	--	--	--	--	--	--	--	0.14	--	--

Table 2. Analysis of crude oil for analyte concentrations of the isomer mixture

Crude Oil, Sample Number, Origin, and Specific Gravity°API	Date Received in U.S. Customs Laboratory	Analyte concentration of the isomer mixture in mole percent		
		Benzene	Toluene	Xylene; o, p, m
7504, Algeria 42° API	06-23-81	0.2	0.4	5.4
7551, Nigeria 36° API	06-25-81	0.2	0.6	3.3
7502, Saudi Arabia 33.3° API	06-23-81	0.1	0.4	0.4
7560, Mexico 22.4° API	06-25-81	0.6	2.2	4.3

B. Medical

The following information was gathered on the four identified leukemia-Hodgkin's disease cases from a review of hospital records in the New Orleans area.

1) Case 1 - 46 year old white male.
Date of diagnosis: 3-31-81. Diagnosis - Hairy cell leukemia.
Lab exposure: 1965-1977. Alive.

2) Case 2 - 36 year old white male.
Date of diagnosis: 10-70. Diagnosis - Chronic granulocytic leukemia.
Lab exposure: 1956-1970
Date of death: February 13, 1979, at age 45.

3) Case 3 - 43 year old white male.
Date of diagnosis: 10-66. Diagnosis - Acute leukemia, undifferentiated.
Lab exposure: 1947-1966.
Date of death: November 2, 1966.

4) Case 4 - 65 year old white male.
Date of diagnosis: 01-17-80. Diagnosis - Histiocytic lymphoma.
Lab exposure: 1954-1973. Alive.

The search for further cases revealed two cases of carcinoma of the prostate (case 5 and 6) but no further cases of leukemia or lymphoma.

5) Case 5 - 55 year old white male.
Date of diagnosis: 1964. Diagnosis: Carcinoma of prostate
Lab exposure: 1949-1966.
Date of death: October 4, 1967.

6) Case 6 - 67 year old white male.
Date of diagnosis: 9-11-79. Diagnosis: Adenocarcinoma of the prostate.
Lab exposure: Unknown. Alive.

An attempt to estimate the population at risk was made by reviewing employment records from the laboratory files. These contained records of 90 individuals employed since 1950. Of these, 35 had been employed less than a year, and of the remaining 55, 14 were clerical employees. The records of the 41 laboratory personnel could be used to estimate population except that these records appear incomplete, as may be judged from the finding that of the leukemia and lymphoma cases only case 1's record was present, and neither of the records for cases 5 and 6.

Nevertheless, it can be stated with confidence that three cases of leukemia are an unusual occurrence in a laboratory population which over the years has probably not exceeded 20 chemists and technicians at any one time. The possibility that this is a unique event is enhanced because it cannot be excluded that all three cases are of granulocytic origin. The possibility that these three cases stem from exposure at a common point in time is reduced by the lack of substantial overlap in work periods in the laboratory. The periods of work were: Case 1 (1965-77), Case 2 (1956-1970, the date of diagnosis) and Case 3 (1947-66).

Numerous chemicals, both reagents and samples, are known to be used and stored in the laboratory. Many of these are on the tentative list of carcinogens released by EPA (Occupational Safety and Health Reporter, July 14, 1978). These chemicals are listed in the Appendix. Their presence in the laboratory does not necessarily reflect worker exposure. However, benzene was reportedly used under unvented conditions for washing glassware, as well as a reaction solvent, but the heaviest use stopped in the early 50's, prior to the employment of two of the leukemia cases. Since the 50's to the present, the laboratory appears typical of general chemistry laboratories during this period. Chemical exposures to any substance were not continuous, and although venting did not meet present standards, overall exposures to any single chemical were probably well below those commonly found in industry during this period. This leaves the possibility that the etiologic agent may be one of the materials unique to this laboratory, particularly something associated with organic raw materials tested in the lab.

This possibility could be further explored by obtaining more detailed histories of specific job responsibilities of Case 2 and Case 3 than were available at the laboratory during the initial visit. In the Revised Recommendation for an Occupational Exposure Standard for Benzene, numerous epidemiologic studies are reported. NIOSH considers the accumulated evidence from clinical as well as from epidemiologic data to be conclusive at this time that benzene is leukemogenic (4).

VII. CONCLUSIONS

This health hazard evaluation has confirmed the occurrence of three cases of leukemia (all potentially granulocytic), one case of lymphoma, and two of prostatic carcinoma, in this small working population. Precise population-at-risk estimates were unobtainable. A clearly common temporal or unusual chemical exposure could not be defined for the three leukemia cases. It is considered by the investigators to be unlikely that the three non-leukemia cases of cancer are related to the three leukemia cases.

No chemical air contaminants or other obvious specific hazards were found which might explain exposures in the laboratory. However, analysis of the crude oil samples indicated the presence of benzene and perhaps exposure of laboratory personnel to benzene could have been greater in the past due to lack of proper hood exhaust as judged by today's standards. Because of no records of detailed work histories and job descriptions, the investigators were not able to correlate cases with exposure to benzene from the crude oil.

VIII. RECOMMENDATIONS

1. Employees who worked in the laboratory prior to 1980 should receive standard hematology blood sample analyses which would include determinations of red cell, leukocyte and platelet counts, leukocyte differential counts, red cell volumes and hemoglobin concentrations annually to aid early identification of any possible further cases of leukemia.

2. Materials which contain known or suspected carcinogens should be used in ventilated hoods and stored in ventilated cabinets. Also, periodic checks of hoods for adequate face velocity of air is warranted.

IX. REFERENCES

1. Criteria for a Recommended Standard-Occupational Exposure to Alkanes, U.S. Department of Health, Education and Welfare. DHEW (NIOSH) Publication No. 77-151 (March 1977).

2. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1981, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1981.

3. Pocket Guide to Chemical Hazards, U.S. Department of Health, Education and Welfare and U.S. Department of Labor. DHEW(NIOSH) Publication No. 78-210 (Sept. 1978).

4. Revised recommendation for an Occupational Exposure Standard to Benzene. U.S. Department of Health, Education and Welfare. Unnumbered NIOSH Publication (1977).

5. Special Occupational Hazard Review with Control Recommendations-Trichloroethylene. National Institute for Occupational Safety and Health, Publication NIOSH 78-130 (1978).

6. General Industrial Standards, Occupational Safety and Health Administration, Publication OSHA 2206 (November 1978).

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY

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

Copies of this report have been sent to:

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(d) NIOSH Region VI

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APPENDIX

A tentative list of carcinogens released by the EPA (Occupational Safety and Health Reporter, July 14, 1978) was sent to the Laboratory Division Director, New Orleans, Louisiana to identify from this list reagents (R) normally used and stocked in the laboratory and agents contained in samples (S) frequently received for analysis in the laboratory. List I - based on Environmental Protection Agency Toxic Substances Control Act Candidate List and List II - based on U.S. International Trade Commission Production Data have duplicate agents and are shown as such in this appendix.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
TENTATIVE LIST OF CARCINOGENS FOR PROPOSED GENERIC POLICY

LIST 1 - BASED ON ENVIRONMENTAL PROTECTION AGENCY TOXIC SUBSTANCES CONTROL ACT CANDIDATE LIST

CATEGORY I

Compound

Acetamide (R & S)
Acetic Acid, Lead (2+)Salt (R)
Arsenic (R & S)
Arsenic Trioxide (R & S)
Asbestos (R & S)
Benzene (R & S)
Benzidine (R)
Beryl (S)
Beryllium (S)
Cadmium (S)
Carbon tetrachloride (R)
Chloroform (R)
Chromite (S)
Chromium (S)
Chromium(VI) oxide (1:3) (S)
Chromium(III) oxide (2:3) (S)
Cyclohexane, 1,2,3,4,5,6-Hexachloro- (S)
Ethylene, Trichloro- (S)
Hematite (S)
Lead acetate (II), Trihydrate (R)
Nickel (S)
Nickel, Bis(dibutyldithiocarbamato)- (S)
Nickel (II) oxide (S)
Tannic acid (R)
o-Toluidine (S)

CATEGORY II

Compound

Ethyl alcohol (R & S)
Iron (III) oxide (S)
Naphthalene (R)
Palladium(2+)chloride (S)
Petroleum (S)
Petroleum asphalt (S)
2,4-Xylenol (R)
2,5-Xylenol (R)
3,4-Xylenol (R)
3,5-Xylenol (R)

CATEGORY III

Compound

Acetic acid, Chloro- (S)
Acetic acid, (2,4,5-Trichlorophenoxy)-(S)
Boric acid (R & S)
Cellulose, Carboxymethyl ether, sodium salt (S)
Cobalt(2+)sulfide (R)
Ethylene oxide (S)
Formaldehyde (R)
Indole (R)
Iron (II) sulfate (1:1) (R & S)
Isobutyl alcohol (R)
Lactose (R & S)
Lead carbonate (R)
Maltose (R & S)
Mercury (S)
Paraffin (S)
Phenol (R & S)
Polyethylene (S)
Polyvinyl alcohol (S)
Propyl alcohol (R)
Silica, Crystalline- quartz (R)
Stearic acid, 12-Hydroxy-, methyl ester (S)
Styrene polymer (S)
Sulfanilamide (S)
Tantalum (S)
2,6-Xylenol (R & S)
Zinc chloride (R)

LIST II - BASED ON U.S. INTERNATIONAL TRADE COMMISSION PRODUCTION DATA

CATEGORY I ORGANICS

Compound

Acetamide (S)
Acetic acid, Chromium (3+) salt (R)
Acetic acid, Lead (2+) salt (R & S)
Benzene (R & S)
Carbon tetrachloride (R)
Chloroform (R)
Ethylene, Trichloro- (R & S)
Tannic Acid (R)
Toluidine (R & S)

CATEGORY I INORGANICS

Compound

Amosite (S)
Arsenic (R & S)
Arsenic Trioxide (S)
Asbestos (S)
Beryl (S)
Beryllium (S)
Cadmium (S)
Chromite (S)
Chromium (S)
Chromium(III)oxide (2:3) (S)
Chromium (VI) oxide (1:3) (S)
Chrysotile (S)
Crocidolite (S)
Dichromic Acid, Disodium salt (S)
Hematite (S)
Nickel (S)
Nickel Refinery Dust (S)
Serpentine (S)

CATEGORY II ORGANICS

Compound

Ethyl alcohol (R & S)
Naphthalene (R & S)

CATEGORY II INORGANICS

Compounds

Iron (III) Oxide (S)
Palladium (2+) Chloride (S)
Rhodium (III) Chloride (1:3) (S)
Silica, Crystalline-Quartz (S)

CATEGORY III ORGANICS

Compound

Acetic Acid, (2,4,5-Trichlorophenoxy) (S)
Phenol (R & S)
Phenol, 2,4-Dichloro (S)
Polyethylene Glycol (S)
Polyvinyl Alcohol (S)
Styrene Polymer (S)

CATEGORY III INORGANICS

Compound

Ammonium Chloroplatinate (R & S)
Boric Acid (R & S)
Cobalt (S)
Cobalt (2+) Chloride (S)
Cobalt (II) Nitrate (1:2) (S)
Cobalt (2+) Oxide (S)
Cobalt (2+) Sulfide (S)
Iron (II) Sulfate (1:1) (S)
Lead Carbonate (R & S)
Magnetite (S)
Mercury (S)
Tantalum (S)
Ytterbium (S)
Ytterbium (III) Nitrate (1:3) (S)
Zinc Chloride (S)
Zinc Sulfate (S)