✓ 1D

01.04- 09/15/95-00[redacted]
171

Final

RCRA Facility Investigation
Naval Station Roosevelt Roads
Puerto Rico

Volume II of II

Prepared For:

Department of the Navy
Atlantic Division
Naval Facilities
Engineering Command
Norfolk, Virginia

Under the

LANTDIV CLEAN Program

Comprehensive Long-Term
Environmental Action Navy

FINAL

HEALTH AND SAFETY PLAN ADDENDUM

RCRA FACILITY INVESTIGATION

NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

CONTRACT TASK ORDER 0223

SEPTEMBER 14, 1995

Prepared for:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY **ES-1**

1.0 INTRODUCTION **1-1**
- 1.1 Policy 1-1
- 1.2 Project Plans 1-1
- 1.3 References 1-1
- 1.4 Pre-Entry Requirements 1-3

2.0 PROJECT PERSONNEL AND RESPONSIBILITIES **2-1**

3.0 SITE CHARACTERIZATION **3-1**
- 3.1 Facility Background 3-1
- 3.2 Facility HASP Objective 3-2
- 3.3 Description of Areas under Investigation 3-2
  - 3.3.1 SWMU 1 - Former Cremator Disposal Site (IR Site 5) 3-2
  - 3.3.2 SWMU 2 - Langley Drive Disposal Site (IR Site 6) 3-3
  - 3.3.3 SWMU 3 - Base Landfill (IR Site 7) 3-5
  - 3.3.4 SWMU 6 - Building 145 (IR Site 11) 3-6
  - 3.3.5 SWMU 7 - Tow Way Fuel Farm 3-7
  - 3.3.6 SWMU 8 - Tow Way Fuel Farm Disposal Pits 3-7
  - 3.3.7 SWMU 9 - Tanks 212-217 Sludge Burial Pits (IR Site 13) 3-8
  - 3.3.8 SWMU 11 - Old Power Plant/Building 38 (IR Site 16) 3-9
  - 3.3.9 SWMU 12 - Fire Training Pit Oil/Water Separator 3-10
  - 3.3.10 SWMU 13 - Old Pest Control Shop/Building 258 (IR Site 18) 3-11
  - 3.3.11 SWMU 14 - Fire Training Pit Area (IR Site 17) 3-12
  - 3.3.12 SWMU 23 - Oil Spill Separator Tanks 3-14
  - 3.3.13 SWMU 24 - Oil Spill Oil/Water Separator and Adjoining Pad 3-15
  - 3.3.14 SWMU 25 - DRMO Storage Yard 3-15
  - 3.3.15 SWMU 26 - Building 544 Area 3-16
  - 3.3.16 SWMU 31 - Waste Oil Collection Area/Buildings 31 and 2022 (IR Site 10) 3-17
  - 3.3.17 SWMU 32 - PWD Storage Yard/Battery Collection Area/ Building 31 (IR Site 10) 3-18
  - 3.3.18 SWMU 37 - Waste Oil Storage Area/Building 200 3-20
  - 3.3.19 SWMU 39 - Building 3158/Former Battery Drain Area 3-21
  - 3.3.20 SWMU 46 - Pole Storage Yard Covered Pad 3-22
  - 3.3.21 SWMU 51 - New AIMD Storage Pad/Building 379 3-23
  - 3.3.22 AOC B - Building 25 (IR Site 10) 3-23
  - 3.3.23 AOC C - Transformer Storage Pad 3-25
- 3.4 Hazard Evaluation 3-25
  - 3.4.1 Chemical Hazards 3-26
  - 3.4.2 Physical Hazards 3-29
  - 3.4.3 Radiation Hazards 3-32
  - 3.4.4 Environmental Hazards 3-32
  - 3.4.5 Task-Specific Hazards 3-34
  - 3.4.6 Summary 3-40

TABLE OF CONTENTS (Continued)

Page

4.0 SITE CONTROL 4-1
4.1 Site Access 4-1
4.2 Site Conditions 4-2
4.3 Work Zones 4-2
4.3.1 Level C and B Activities 4-2
4.3.2 Level D and D+ Activities 4-3
4.4 "Buddy System" 4-4
4.5 Safe Work Practices 4-4
4.6 Sanitation Procedures/Site Precautions 4-4

5.0 ENVIRONMENTAL MONITORING 5-1
5.1 Personal Monitoring 5-1
5.2 Point Source Monitoring 5-2
5.3 Perimeter Monitoring 5-3
5.4 Specific Air Monitoring Equipment and Frequency 5-4
5.5 Equipment Maintenance and Calibration 5-4
5.6 Monitoring Documentation 5-4

6.0 PERSONAL PROTECTIVE EQUIPMENT 6-1
6.1 Personal Protective Equipment Selection 6-1
6.2 Site-Specific Levels of Protection 6-2
6.3 Respiratory Protection 6-3
6.3.1 Level C 6-3
6.3.2 Level D+ 6-3
6.4 Care and Cleaning of Personnel Protective Equipment 6-4

7.0 DECONTAMINATION PROCEDURES 7-1
7.1 Personnel Decontamination 7-1
7.2 Equipment Decontamination 7-2
7.3 Decontamination Materials 7-2

8.0 EMERGENCY PROCEDURES 8-1
8.1 Scope 8-1
8.2 Pre-Emergency Planning 8-1
8.3 Emergency Coordinator 8-1
8.4 Communications/Telephone Numbers 8-2
8.5 Assembly Area 8-3
8.6 Emergency Hospital Route 8-3
8.7 Emergency Medical Treatment 8-4
8.8 Injuries 8-4
8.8.1 Physical Injury 8-4
8.8.2 Chemical Injury 8-4
8.9 Emergency Decontamination Procedures 8-5
8.10 Personal Protection and First Aid Equipment 8-6
8.11 Notification 8-7
8.12 Hazard Assessment 8-7
8.13 Security 8-8
8.14 Emergency Alerting 8-8
8.15 Training 8-10
8.16 Spill Containment Procedures 8-10

TABLE OF CONTENTS (Continued)

Page

9.0 TRAINING REQUIREMENTS 9-1
9.1 General 9-1
9.2 Site-Specific Training 9-2

10.0 MEDICAL SURVEILLANCE REQUIREMENTS 10-1

11.0 HEALTH AND SAFETY PLAN APPROVAL 11-1

12.0 DECLARATION OF HEALTH AND SAFETY PLAN REVIEW 12-1

LIST OF TABLES

Number

3-1 Chemical/Physical Properties of Constituents Detected During Previous Sampling at Naval Station Roosevelt Roads
3-2 Chemical Exposure Information for Constituents Detected During Previous Sampling at Naval Station Roosevelt Roads

5-1 Monitoring Equipment and Frequency for Field Activities Conducted at Naval Station Roosevelt Roads

9-1 OSHA Training History of Baker Project Personnel

10-1 Medical Surveillance Testing Parameters

LIST OF FIGURES

Number

4-1 Site Location Map
4-2 Typical Contamination Reduction Zone Layout

8-1 Emergency Telephone Numbers
8-2 Hospital Route
8-3 Emergency Medical Services

LIST OF ATTACHMENTS

A Baker Environmental, Inc. (Baker) Safety Standard Operating Procedures (SOPs)
B Material Safety Data Sheets for Constituents Detected During Previous Sampling at Naval Station Roosevelt Roads
C Chemical/Material Data Sheets for Materials Stored, Used, or Processed at a SWMU or AOC
D Emergency Procedures for Exposure to Hazardous Materials/Waste

EXECUTIVE SUMMARY

This "Facility" Health and Safety Plan (HASP) addresses the RCRA Facilities Investigation (RFI) of 19 Solid Waste Management Units (SWMUs) and 2 Areas of Concern (AOC) for Naval Station Roosevelt Roads (NSRR), Ceiba, Puerto Rico. The purpose of this RFI is to determine the nature, rate, direction and extent of releases of hazardous waste, including hazardous constituents, from SWMUs and AOCs at NSRR including areas off site impacted by the release(s) from NSRR, and to gather all necessary data to support the Corrective Measures Study.

The chemical hazards associated with the tasks at these SWMUs or AOC are expected to include potential exposure to varying levels of volatile and semivolatile organic compounds, pesticides, polychlorinated biphenyls, and inorganics that were previously detected, or materials/waste that are stored at a SWMU or AOC.

The physical hazards will include working around heavy equipment, underground/overhead utilities, uneven/sloped terrain, and heat stress. The environmental hazards include potentially hazardous flora, fauna, and etiologic agents. Each of these hazards is described in Section 3.0.

Section 5.0 describes the environmental monitoring requirements which consist of using a photoionization detector (PID), Dräger Tubes, and an oxygen/low explosive limit (O_2/LEL) meter.

The information provided by previous investigations and record searches indicates a relatively low chemical hazard risk to site personnel, therefore, the assigned levels of protection for these SWMUs and AOCs will be Levels D through D+ with protection upgrades dependent upon the results of SWMU and AOC reconnaissance as identified in the pre-entry briefing, monitoring results, and the Site Health and Safety Officer's discretion. Section 6.0 describes the personal protective equipment to be used.

Section 8.0 describes emergency procedures, which includes Figure 8-2, showing the route to the Naval hospital, along with first aid procedures, communication procedures, and other site concerns.

1.0 INTRODUCTION

1.1 Policy

It is the policy of Baker Environmental, Inc. (Baker) that all on-site hazardous waste management activities be performed in conformance with a Site-Specific Health and Safety Plan (HASP). The HASP is written based on the anticipated hazards and expected work conditions and applies to activities performed by both Baker and Baker's subcontractors. The HASP may be modified/updated with the approval of the Project Health and Safety Officer (PHSO) and Project Manager. Proper notification will be given to the Atlantic Division, Naval Facilities Engineering Command (LANTDIV) Navy Technical Representative (NTR) for Contract Task Order (CTO) 0223 when significant changes to the HASP are implemented.

The HASP is based on an outline developed by the United States Coast Guard (USCG) for responding to hazardous chemical releases (USCG Pollution Response COMDTINST-M16456.30) and by NIOSH, OSHA, USCG, and USEPA's recommended health and safety procedures (Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities). This HASP, at a minimum, meets the requirements under OSHA Standard 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response). This plan has been designed as a Site-Specific Facility HASP for the Resource Conservation and Recovery Act (RCRA) Facilities Investigation (RFI) at Naval Station Roosevelt Roads (NSRR), Ceiba, Puerto Rico.

1.2 Project Plans

The Data Collection Quality Assurance Plan (DCQAP), the Data Management Plan (DMP), and Community Relations Plan (CRP) are bound as individual documents within the Project Management Plan (PMP) and will accompany the HASP in the field.

1.3 References

The following publications have been referenced in the development and implementation of this HASP.

- American Conference of Governmental Industrial Hygienists (ACGIH). 1993. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1993-1994.

- The Center for Labor Education and Research, Lori P. Andrews, P.E., Editor. 1990. Worker Protection During Hazardous Waste Remediation, Van Nostrand Reinhold, New York, New York.

- Lewis, Richard J., Sr. 1991. Hazardous Chemicals Desk Reference, 3rd Edition, Van Nostrand Reinhold, New York, New York.

- National Institute for Occupational Safety and Health/Occupational Safety and Health Administration/U.S. Coast Guard/U.S. Environmental Protection Agency (NIOSH/OSHA/USCG/EPA). 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.

- Occupational Safety and Health Administration. 1993. Title 29 Code of Federal Regulations, Parts 1910 and 1926.

- United States Coast Guard. 1991. Policy for Response to Hazardous Chemical Releases. USCG Pollution Response COMDTINST-M16465.30.

- United States Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH. 1990. NIOSH Pocket Guide to Chemical Hazards. June 1990.

- United States Environmental Protection Agency, Office of Emergency and Remedial Response, Emergency Response Division. 1992. Standard Operating Safety Guides. June 1992.

1.4 Pre-Entry Requirements

During site mobilization, the Site Health and Safety Officer (SHSO) will perform a reconnaissance of each site (work areas) as identified in the Work Plan to evaluate and determine chemical, environmental, and physical hazards, establish or confirm emergency points of contact and procedures, and review any other issues deemed necessary to address site safety and health. The SHSO will then conduct a health and safety briefing with site personnel (as identified in Section 2.0) to discuss data obtained from the previous site reconnaissance, provisions outlined in this HASP, and appropriate safety and health related procedures and protocols.

2.0 PROJECT PERSONNEL AND RESPONSIBILITIES

The following personnel are designated to carry out the stated job functions for both project and site activities. (Note: One person may carry out more than one job function; personnel identified are subject to change.) The responsibilities that correspond with each job function are outlined below.

PROJECT MANAGER: Chris Boes

The project manager will be responsible for assuring that all activities are conducted in accordance with the HASP. The Project Manager has the authority to suspend field activities if employees are in danger of injury or exposure to harmful agents. In addition, the Project Manager is responsible for:

- Assisting the Project Health and Safety Officer (PHSO), as designated below, in Site-Specific HASP development for all phases of the project.
- Designating a SHSO and other site personnel who will assure compliance with the HASP.
- Reviewing and approving the information presented in this HASP.

PROJECT HEALTH AND SAFETY OFFICER: Barbara Cummings

The PHSO will be responsible for general development of the HASP and will be the primary contact for inquiries as to the contents of the HASP. The PHSO will be consulted before changes to the HASP can be approved or implemented. The PHSO will also:

- Develop new protocols or modify the HASP as appropriate and issue amendments.
- Resolve issues that arise in the field with respect to interpretation or implementation of the HASP.

- Monitor the field program through a regular review of field health and safety records, on-site activity audits, or a combination of both.

- Determine that all Baker personnel have received the required training and medical surveillance prior to entry onto a site.

- Coordinate the review, evaluation, and approval of the HASP.

SITE MANAGER: (To be provided in the Final HASP submission)

The Site Manager will be responsible for assuring that all day-to-day activities are conducted in accordance with the HASP. The Site Manager has the immediate authority to suspend field activities if employees are subjected to a situation that can be immediately dangerous to life or health. The Site Manager's responsibilities include:

- Assuring that the appropriate health and safety equipment and personal protective equipment (PPE) has arrived on site and that it is properly maintained.

- Coordinating overall site access and security measures, including documenting all personnel arriving or departing the site (e.g., name, company and time).

- Approving all on site activities, and coordinating site safety and health issues with the SHSO.

- Assisting the SHSO in coordinating emergency procedures with the Naval Activity, emergency medical responders, etc., prior to or during site mobilization activities.

- Assuring compliance with site sanitation procedures and site precautions.

- Coordinating activities with Baker and subcontractor personnel.

- Overseeing the decontamination of field sampling equipment.

- Assuming the responsibilities as indicated under "Field Team Leader," in their absence.

SITE HEALTH AND SAFETY OFFICER: (To be provided in the Final HASP submission)

The SHSO will be responsible for the on-site implementation of the HASP. The SHSO also has the immediate authority to suspend field activities if the health or safety of site personnel is endangered, and to audit the subcontractor training, fit testing, and medical surveillance records to verify compliance. These records will be maintained at the Baker Command Post. The SHSO will also:

- Coordinate the pre-entry briefing and subsequent briefings.

- Assure that monitoring equipment is properly calibrated and properly operated.

- Assure compliance with the Standard Operating Procedures (SOPs) in Attachment A.

- Inform personnel of the material safety data sheets (MSDSs) located in Attachments B and C and emergency procedures for exposure to hazardous materials/waste presented in Attachment D.

- Manage health and safety equipment, including instruments, respirators, PPE, etc., that is used during field activities.

- Confirm emergency response provisions, as necessary, in cooperation with Naval Activity, emergency medical care, etc., prior to or during site mobilization activities.

- Monitor conditions during field activities to ensure worker compliance with the HASP and evaluate if more stringent procedures or a higher level of PPE should be implemented, and informing the PHSO and Project Manager.

- Document, as necessary, pertinent information such as accident investigation and reporting, designated safety inspections, a record of site conditions, personnel

involved in field activities, and any other relevant health and safety issues. This information will become part of the official site records.

- Oversee the decontamination of personnel and determine safe boundary procedures for activities requiring Level C or higher protection levels.

- Act as the Emergency Coordinator.

FIELD TEAM LEADER: (To be provided in the Final HASP submission)

The Field Team Leader will be responsible for:

- Safety issues relevant to the tasks under their direction.

- Determining safe boundary procedures for activities requiring Level D or D+ protection levels.

- Assuring that PPE is properly maintained.

- Complying with the conditions as outlined under Field Team Members.

- Assuming the responsibilities as indicated under "Site Manager" in their absence.

FIELD TEAM MEMBERS: (To be provided in the Final HASP submission)

The Field Team Members will be responsible for:

- Familiarity with the HASP.

- Complying with the contents of the HASP.

- Attending training sessions to review the HASP, and staying informed of additional safety and health information.

- Being alert to identified and unidentified hazards, and reporting unidentified hazards to the SHSO and Site Manager, as soon as possible.

- Offering suggestions, ideas, or recommendations that may improve or enhance site safety.

- Conducting site activities in an orderly and appropriate manner.

- Reporting accidents/injuries, however minor, to the SHSO as soon as possible.

Subcontractor personnel are responsible for:

- Complying with all OSHA regulations relevant to their work.

- Complying with the conditions as outlined under Field Team Members.'

- Having a competent safety monitor on site.

- Obtaining the appropriate training, fit testing, and medical surveillance requirements under 29 CFR 1910.120 and 1910.134 and providing this documentation to the Site Manager prior to or during site mobilization.

- Complying with the training and medical surveillance requirements as outlined in Sections 9.0 and 10.0, respectively, and providing their own PPE that meets or exceeds the level of protection as outlined in this HASP.

SUBCONTRACTOR COMPANIES:

Drilling Operations:	(To be provided in Final HASP submission)
Survey Operations:	(To be provided in Final HASP submission)
Analytical Services:	(To be provided in Final HASP submission)

LANTDIV REPRESENTATIVES:

- Mr. Art Wells (804) 322-4795

ACTIVITY/STATION/BASE REPRESENTATIVES:

- Ms. Madeline Rivera, Public Works Department (809) 865-4429

FEDERAL/STATE/LOCAL REPRESENTATIVES:

- Not assigned

3.0 SITE CHARACTERIZATION

This section provides information on the background, HASP objective, description, and hazard evaluation for each area under investigation.

3.1 Facility Background

Naval Station Roosevelt Roads (NSRR) occupies part of the northern side of the east coast of Puerto Rico, along Vieques Passage with Vieques Island lying to the east about 10 miles off the harbor entrance. The north entrance to NSRR is about 35 miles east along the coast road (Route 3) from San Juan. The closest large town is Fajardo (population about 37,000), which is about 10 miles north of NSRR off Route 3. Ceiba (population about 17,000) adjoins the west boundary of NSRR.

The NSRR occupies over 33,500 acres, with some of the holdings being prepared for release to the Commonwealth of Puerto Rico. NSRR has administrative and command responsibilities for some operations separated from the main base on Vieques Island. The primary mission of NSRR is provision of full support for Atlantic Fleet weapons training and development activities.

The climate of NSRR is characterized as warm and humid, with frequent showers occurring throughout the year. The prevailing wind direction reflects the easterly trade winds. The warmest months are August and September, while the coolest are January and February. Mean annual maximum temperatures range from 82.0°F in January to 88.2°F in August. The mean annual minimum temperatures vary from 64.0°F in January to 73.2°F in June. The hurricane season is from mid-June through mid-September; maximum winds exceed 95 knots during severe hurricanes.

The regional area of NSRR consists of an interrupted, narrow coastal plain with small valleys extending from the Sierra de Luquillo range, which has been severely eroded by streams into valleys several hundreds of feet deep. Slopes of up to 60° are common.

Start-Up Date: November 1995

Investigation Duration: Intermittently for 2 years

3.2 Facility HASP Objective

This "Facility" Health and Safety Plan (HASP) addresses the RCRA Facilities Investigation (RFI) of 19 Solid Waste Management Units (SWMUs) and 2 Areas of Concern (AOCs) for Naval Station Roosevelt Roads (NSRR), Ceiba, Puerto Rico. The purpose of this RFI is to determine the nature, rate, direction and extent of releases of hazardous waste, including hazardous constituents, from SWMUs and AOCs at NSRR including areas off site impacted by the release(s) from NSRR, and to gather all necessary data to support the Corrective Measures Study. The various SWMUs and AOCs are addressed in detail in the section that follows.

3.3 Description of Areas under Investigation

Specific information for each SWMU or AOC to be addressed in this RFI such as potential hazards, description/observations, previous findings, and surrounding population/topography is outlined below. In some instances only limited information is available.

3.3.1 SWMU 1 - Former Cremator Disposal Site (IR Site 5)

Potential Hazards: Contact with potentially-contaminated soil and groundwater. Mosquitoes are expected to be prevalent in this area; special care will need to be taken if the clearing of vegetation requires the use of machetes or powered weed cutters.

Description/Observations: This SWMU operated from the early 1940s until the early 1960s and was the main station landfill during this time. Waste material was disposed of by piling, burning and compacting (A.T. Kearney, Inc., 1988). An estimated 100,000 tons of waste including scrap metal, inert ordnance, batteries, tires, appliances, cars, cables, dry cleaning solvent cans, paint cans, gas cylinders, construction debris, dead animals, and residential waste was disposed of at this site (NEESA, 1984). No reliable information exists regarding the amounts of material present in the disposal area that could be hazardous; however, in 1984, the Initial Assessment Study (IAS) team estimated that as much as 1,000 tons of hazardous material could be present in the area (NEESA, 1984).

In 1988, the RCRA Facility Assessment (RFA) Visiting Site Inspection (VSI) team observed an oily, silver-toned substance floating at the water's edge. Dead mangroves were observed several feet out from the water's edge and extending up and down the shoreline (A.T. Kearney, Inc., 1988). According to a facility representative, this was due to a spill of JP-5 (aviation kerosene) in November of 1986. An area measuring approximately 50 feet in diameter completely devoid of vegetation was found within the boundaries of this unit (A.T. Kearney, Inc., 1984). The area affected by this spill is included in the Installation Restoration (IR) program as Site 14.

Previous Findings: In 1988, ESE, Inc. (ESE) produced a report that evaluated the data from two rounds of verification sampling. Five surface water, five sediment and five groundwater samples were collected in each round of sampling. The sediment samples contained isolated, low levels of pesticides, and elevated levels of antimony, selenium and methylene chloride (Technical Review Committee Meeting Minutes, 1989). The surface water samples revealed several metals that exceeded ambient water quality criteria. Groundwater samples indicated thallium, copper, arsenic, chromium (trivalent and hexavalent) and selenium in levels that exceeded primary drinking water standards. Low levels of organic compounds were also detected in some of the groundwater samples (Technical Review Committee Meeting Minutes, 1989).

A total of 21 soil samples and one groundwater sample were collected at this SWMU during the Supplemental Investigation (Baker, 1993). Trace organic contaminants were detected in each media. The results of a risk assessment conducted as part of the Supplemental Investigation indicate that there is no threat to human health or the environment associated with these media.

Surrounding Population/Topography: This SWMU is located away from populated areas; it is grossly overgrown with vegetation which covers uneven terrain. The area will need to be cleared by earth moving equipment prior to sample collection.

3.3.2 SWMU 2 - Langley Drive Disposal Site (IR Site 6)

Potential Hazards: Contact with potentially-contaminated soil and groundwater. Mosquitoes are expected to be prevalent in this area; special care will need to be taken if the clearing of vegetation requires the use of machetes or powered weed cutters.

Description/Observations: In 1984, the IAS team performed a site inspection. During the inspection, the IAS team observed partially buried metal and concrete objects, old fuel lines, flexible metal hoses, small containers containing pellets, steel cables, hardened tar, rubble, and ten to fifteen 55-gallon drums that were corroded. The drum contents, usually consisting of a whitish solid with a green outer crust, were exposed (NEESA, 1984). The IAS team estimated the volume of disposed waste to be approximately 1,700 cubic yards, of which approximately 20,000 pounds could be hazardous material.

In 1988, a RFA was performed at this site. The VSI team observed a dump site covering an area of approximately 40 feet x 150 feet. Within the perimeter were lengths of thick cable, broken concrete blocks, ringed metal hoses, and six severely corroded drums. At least one of the drums was filled with a white, damp chalky substance (A.T. Kearney, Inc., 1988).

Previous Findings: In 1988, ESE produced a report that evaluated data from two rounds of sampling. Thirty-two soil samples, six sediment, six surface water and one groundwater sample were collected during the two rounds of sampling. Elevated levels of lead were found in some soil samples (Technical Review Committee Meeting Minutes, 1989). During Round 2, two soil samples were analyzed for EP Toxicity for lead only. The results of these analyses indicated that the soil samples did not exhibit sufficient levels of lead in the extract to be classified as hazardous waste. Elevated levels of total chromium, copper and selenium were detected in surface water samples (Technical Review Committee Meeting Minutes, 1989).

A total of 16 soil samples and one groundwater sample were collected at this SWMU during the Supplemental Investigation (Baker, 1993). Organic contaminants were detected in each media. The results of a risk assessment conducted as part of the Supplemental Investigation indicate that there is no threat to human health or the environment associated with these media.

Surrounding Population/Topography: This SWMU is located away from populated areas; it is grossly overgrown with vegetation which covers uneven terrain. The area will need to be cleared by earth moving equipment prior to sample collection.

3.3.3 SWMU 3 - Base Landfill (IR Site 7)

Potential Hazards: Contact with potentially-contaminated sediment. Mosquitoes are expected to be prevalent in this area; special care will need to be taken if the clearing of vegetation requires the use of machetes or powered weed cutters. Also, ant colonies were noted in groundwater monitoring wells and wasp nests in trees; animal life appears to be very active in this area.

Description/Observations: The Base Landfill (IR Site 7) is located south of the Industrial Area Wastewater Plant (Building 1758) and operated from the early 1960s until 1978. The landfill covers 85 acres, and is separated into several different disposal areas (A.T. Kearney, Inc., 1988). Some of these "areas" are undetectable from the ground. Methods of disposal involved the excavation of a trench to the water table, filling the trench with waste, spreading and compacting the waste with a bulldozer, then covering the waste with soil. It is estimated that from 40 to 60 tons of waste per day were disposed of in the past (A.T. Kearney, Inc., 1988). Wastes that were disposed of at this SWMU include, residential wastes, scrap metal, cables, paint waste, solvents, PCBs, OTTO Fuel II, Agentine, Askarel, pesticides, lubricating oil, unlabeled 55-gallon drums, dead animals, inert ordnance, digested sludge, construction debris, asbestos, and possibly Super Tropical Bleach (STB), a decontaminating agent (NEESA, 1984).

Previous Findings: In 1988, ESE produced a report evaluating two rounds of verification sampling and analysis. Eight groundwater monitoring wells were installed, and samples of groundwater were collected and analyzed from each well. In addition, three composite soil samples were collected from the drum ditch (ESE 1988). The ESE report indicates that only low levels of oil and grease were detected in the soil samples. The report also indicated that low levels of organic compounds, as well as metal concentrations exceeding drinking water criteria, were detected in the groundwater samples collected during both rounds of sampling (ESE 1988).

Eight groundwater samples were collected from monitoring wells at this SWMU during the Supplemental Investigations (Baker, 1993). Trace concentrations of organic contaminants were detected.

The landfill is still operating and accepting wastes in accordance with Environmental Quality Board (EQB) regulations.

Surrounding Population/Topography: Area is essentially unpopulated, though workers are on the grounds to monitor current landfill operations. The terrain is uneven, dumped material is exposed in some areas. Some clearing will be required prior to sample collection.

3.3.4 SWMU 6 - Building 145 (IR Site 11)

Potential Hazards: Contact with potentially-contaminated standing water in building and soil.

Description/Observations: This SWMU comprises IR Site 11. The building is a bunker, approximately 60 yards long, 7 feet high, and 8 feet wide with three openings to the surface through the roof. The openings are covered with dilapidated wood structures. There is one entrance at ground level. The 1984 IAS team reported the presence of approximately sixty 55-gallon drums, one hundred 5-gallon pails, and a number of other small containers (NEESA, 1984). The condition of the containers ranged from being intact and neatly stacked to randomly placed and leaking (A.T. Kearney, Inc., 1988). The 1984 IAS Report stated that the drums and other containers had been in the building for sometime, probably since 1957. Some of the materials identified by the IAS team included spray paint, olive drab paint, black boot polish and some adhesives (NEESA, 1984). The IAS team concluded that the majority of the material (approximately 2,000 gallons) could be classified as hazardous (NEESA, 1984).

In 1988, the RFA Visual Site Inspection (VSI) team reported that Building 145 was empty except for some protective clothing and some water on the floor. There were several old paint covered gloves and pieces of clothing, broken pallets and several empty paint cans outside [the] unit (A.T. Kearney, Inc., 1988). The RFA VSI team indicated that there was no evidence of a release to the environment.

The 1993 RFA reinspection found conditions to be similar to those of 1988 (TRC, 1993).

Previous Findings: None Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The SWMU is located within a material/equipment storage yard utilized by the Army National Guard. The area surrounding the unit is very flat.

3.3.5 SWMU 7 - Tow Way Fuel Farm

Potential Hazards: Contact with petroleum contaminated groundwater.

Descriptions/Observations: The Tow Way Fuel Farm has been operational for many years and has had a number of recorded instances of major spills and possible leakage from the tanks. The area has been subjected to intensive investigations. Free product has been found floating on the groundwater and is presently being recovered as part of an Interim Remedial Action.

Previous Findings: Benzene and ethlybenzene have been found at significant concentrations throughout the site. As indicated, free product occurs on the groundwater surface. The product exhibits various degrees of weathering.

Surrounding Population/Topography: The Tow Way Fuel Farm occupies the steep side of a hill above Forrestal Road. Ensenada Honda (the Harbor) lies within 300-500 feet of the site.

The Fuel Farm is active with work crews performing maintenance and operational functions as needed. Access by road is good. Fast access is excellent since the grass is mowed; however, the terrain is steep in some area.

3.3.6 SWMU 8 - Tow Way Fuel Farm Disposal Pits

Potential Hazards: Contact with sludges associated with the clean-out of petroleum storage tanks.

Descriptions/Observations: SWMU 8 is actually discrete (but unknown) locations within the Tow Way Fuel Farm (SWMU 7). Therefore, the same conditions prevail.

Previous Findings: See SWMU 7 description.

Surrounding Population/Topography: See SWMU 7 description.

3.3.7 SWMU 9 - Tanks 212-217 Sludge Burial Pits (IR Site 13)

Potential Hazards: Contact with potentially-contaminated sludge and groundwater. Also, ant colonies were noted in groundwater monitoring wells and wasp nests in trees.

Description/Observations: The 1984 IAS report indicates that these tanks were constructed in 1948 for the storage of aviation gasoline (AVGAS) and that the tanks were cleaned about every five years until 1978. This does not include tanks 210 and 211, which were abandoned in 1950 and probably cleaned only once (NEESA, 1984). This report indicates that cleaning resulted in the removal of 20 to 30 drums (800 to 1,250 gallons) of leaded sludge per tank (NEESA, 1984). The IAS report estimates that between 30,000 and 50,000 gallons of leaded sludge were disposed of at these areas over a 40-year period (NEESA, 1984). This sludge was disposed of in a series of pits 8 feet x 8 feet x 8 feet (A.T. Kearney, Inc., 1988). These pits were located within 300 feet of the tank that was being cleaned. After the sludge settled in the pits, it was covered with three to four feet of soil (A.T. Kearney, Inc., 1988).

The 1988 RFA report indicates a start date of 1940 instead of 1948 as noted in the 1984 IAS report. The VSI team was unable to locate the buried pits during their inspection and the pits remained unlocateable in 1993.

Previous Findings: In 1988, ESE performed two rounds of verification sampling at this SWMU. Six sediment samples were collected during each round of sampling (Technical Review Committee Meeting Minutes, 1989). According to ESE, oil and grease were detected in each round, but levels were not significant when shipping activities in the area were considered. Lead was also detected in both rounds, but not in significant levels (Technical Review Committee Meeting Minutes, 1989). Low levels of volatile organic compounds were detected in Round 2, but not in Round 1. Twelve surface water samples were also collected. Two of the six Round 1 samples indicated low levels of oil and grease. Oil and grease were not detected in any Round 2 surface water samples. Low levels of lead were detected in all Round 2 surface water samples. Eleven wells were sampled during each round (Technical Review Committee Meeting Minutes, 1989). During Round 1, four wells contained significant levels of fuel-derived organic constituents. During Round 2, only two of the four wells continued to show significant fuel-derived organic constituents.

Surrounding Population/Topography: This SWMU consists of eight fuel storage tanks. Tanks 212 through 215 are located on a hilltop about 4,000 feet southeast of tanks 212 through 215, north of Forrestal Drive (NEESA, 1984). The area is isolated, access is limited due to a locking gate.

3.3.8 SWMU 11 - Old Power Plant/Building 38 (IR Site 16)

Potential Hazards: Contact with potentially-contaminated soil, sediment, and possibly cement.

Description/Observations: According to the 1984 RFA report, Building 38 was a 60-megawatt steam turbine facility that generated power from the early 1940s through 1949. The facility used Bunker C fuel, which was stored in two 50,000-gallon reinforced concrete tanks located directly northwest of the building. (NEESA, 1984). In the 1979s, Bunker C fuel was observed in manholes near Building 38 during heavy rainfalls. Bunker C fuel was also discharged to the enlisted beach through the old cooling water outlet for the power plant (NEESA, 1984).

The 1988 RFA report states that this SWMU is Toxic Substance Control Act (TSCA) regulated. This was told to the VSI team by a facility representative. Located inside Building 38 is a cyclone fence which surrounds a curbed 8-inch concrete pad. PCB-contaminated items (e.g., old transformers and full 55-gallon drums) are temporarily stored on the concrete pad inside the cyclone fence (A.T. Kearney, Inc., 1988). A Defense Reutilization and Marketing Office (DRMO) contractor disposes these items. The VSI team observed drums that they believed to contain PCB-contaminated soil outside the cyclone fence. The VSI team also observed oil contaminated sorbent inside the fence on the concrete pad (NEESA, 1984). A facility representative told the VSI team that the oil spill inside the fence was from a non-PCB transformer (<50 ppm PCBs) and that laboratory results were pending regarding the contents of the drums located outside of the fence (NEESA, 1984).

Previous Findings: In 1988, ESE produced a Remedial Action Alternative Analysis Report. ESE collected 38 soil samples from the site (9 in Round 1 and 29 in Round 2). These samples were analyzed for PCBs, oil and grease, volatile organic compounds (VOCs), ethylene dibromide (EDB), xylenes, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK or MIK). In Round 2, an EP toxicity test for lead was completed. The analytical results indicated the presence of PCB and lead contamination at the site. Lead concentrations were less than the EP toxicity standard for lead.

Other constituents detected, but not at levels of concern, were MEK as well as oil and grease (Technical Review Committee Meeting Minutes, 1989).

In 1992, Versar prepared a Remedial Investigation/Feasibility Study for this site. During their investigation, Versar collected numerous surface water, sediment, soil, wipe and chip samples.

Seven surface water and six sediment samples were collected from this SWMU during the Supplemental Investigation (Baker, 1993). Organic contaminants were detected in both media.

Surrounding Population/Topography: Area around building is essentially level but uncovered caissons are present. The building is vacant but personnel pass by building daily in route to the base landfill.

3.3.9 SWMU 12 - Fire Training Pit Oil/Water Separator

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: This SWMU began operations in 1983; however, the 1984 IAS report does not address this SWMU. The first mention of this SWMU is in the 1988 RFA report. According to the RFA, the fire training pit oil/water separator is an inground concrete tank that measures approximately 7 feet x 30 feet x 10 feet deep. Waste oils are burned at the Fire Training Pit during training exercises, the excess of which is collected in the oil/water separator. Water from this unit is pumped to the Sewer Drainage System (SWMU 38) to be processed by one of the Naval Station wastewater treatment plants. Oils from this unit are pumped back into the Fire Training Pit (SWMU 14). The VSI team observed a ground level opening that was covered by heavy grating. The VSI team also noted an area of dead grass, adjacent to the oil/water separator, and oil stains on the curbing and guardrail uprights (A.T. Kearney, Inc., 1988).

No evidence of releases was seen during the 1993 RFA reinspection (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The SWMU is located in a flat, maintained, grassy area approximately 300 feet from the Fire Department.

3.3.10 SWMU 13 - Old Pest Control Shop/Building 258 (IR Site 18)

Potential Hazards: Contact with potentially-contaminated soils.

Description/Observations: This SWMU comprises IR Site 18. The IAS report describes this SWMU as the following:

- The pest control shop was located at Building 258 from the late 1950s through 1983. Pesticides were stored in Building 258 and also on the parking apron. In 1976, a 55-gallon drum of Malathion, which was stored outside the building, ruptured and the contents spilled onto the ground, eventually washing into the drainage ditch in back of the building. This same ditch received rinse waters from the cleaning of pesticide equipment over a storm drain which discharged to the ditch. Excess pesticides were also poured into this ditch. Past environmental engineering surveys cite numerous aquatic kills due to pesticides entering the ditch. The area surrounding the building is devoid of vegetation, although the drainage ditch does not show any signs of stressed vegetation.

- Pesticides used in the past include DDT, Paris Green, maldane, malathion, and chlordane. There is no information available, either from records or interviewees, regarding the amounts or concentrations of the pesticides used (NEESA, 1984).

In 1988, a RFA was performed at this SWMU. The VSI team noted that a faint but discernible pesticide odor was present behind the building and inside what was then the Diving Club pump room. They did not observe any signs of stressed vegetation. The president of the diving club, Mr. Seufert, reported to the VSI team that club members had decontaminated the inside of the building before occupying it. According to Mr. Seufert, decontamination involved washing the inside walls and floor with bleach before sealing with a vinyl coating. The meeting room was then tiled, but the pump room was not (A.T. Kearney, Inc., 1988).

Previous Findings: In 1988, ESE performed two rounds of verification sampling. Fifteen soil samples were collected in Round 1 and analyzed for pesticides at this site. Several pesticides, including chlordane were detected in the surficial soils in the area adjacent to Building 258. In addition, eight sediment samples were collected at this site (two in Round 1 and six in Round 2) and analyzed for pesticides. Chlordane and other pesticides were detected in the sediment samples collected from the drainage ditch which conveys storm water runoff from the site. A total of eight surface water samples were also collected at this site (two in Round 1 and six in Round 2) and analyzed for pesticides. Chlordane and other pesticides were detected in the surface water samples collected from the drainage ditch which conveys storm water runoff. Three shallow monitoring wells were installed at the site and groundwater samples were collected in Round 2. Groundwater samples were analyzed for pesticides. A low concentration of DDD (0.0017 μg/L) was detected in one of the three monitoring wells at the site (Technical Review Committee Meeting Minutes, 1989).

Since the 1988 RFA, the building has been demolished. The RFA reinspection of the site found no visible signs of releases (TRC, 1993).

Six groundwater, 11 soil, one surface water and one sediment sample were collected from this SWMU during the Supplemental Investigation (Baker, 1993) organic contaminants (i.e., DDT series and chlordane series) were detected in all media. A risk assessment conducted as part of the Supplemental Investigation indicated that there is no threat to human health or the environment associated with these media.

Surrounding Population/Topography: Area is unpopulated with essentially even terrain with drainage ditches along the road side.

3.3.11 SWMU 14 - Fire Training Pit Area (IR Site 17)

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: This SWMU comprises IR Site 17. The IAS report indicated the following about SWMU 14:

- The crash crew training area was operated by the Air Operations Department from early 1960s through 1983.

- Two unlined pits were used in the past for fire fighting training. The first pit, which was approximately 40 feet in diameter, was used from the early 1960s through the beginning of 1983. Assuming 20 years of operation, about 120,000 gallons of waste solvents, fuels, and oils were placed in the pits and set on fire for fire fighting training. Also burned were wood, trash, plastic, fuel filter elements, oily rags, and other debris. The fires were extinguished using aqueous film-forming foam (AFFF) and potassium bicarbonate (Purple K). Past aerial photographs show drainage from this pit to the ditch along the runway shoulder. The new fire training pit was built at the same location as the old pit. When the new pit was built, all of the oil-stained, contaminated soil was excavated and most likely disposed of in the base landfill.

- The second pit was used temporarily during the construction of the new fire training pit in 1983. This unlined gravel pit has a diameter of 200 feet and was used approximately six times. Approximately 3,000 gallons of waste fuel, oil, and solvents were burned in this area. Only small amounts of fuel were allowed to soak into the ground (NEESA, 1984).

In 1988, a RFA inspection was performed at this SWMU. During the inspection, the VSI team observed that within the concrete curbing of the pit was a metal structure (what appeared to be the tank from a railroad tank car and large pieces of scrap metal) underlain by a layer of bricks which rested on the concrete lining. The metal structure, rocks and concrete curbing were completely black. Immediately adjacent to the pit was an area of darkly stained soil measuring approximately 40 feet by 100 feet. Vegetation was observed to be growing in the stained area adjacent to the pit (A.T. Kearney, Inc., 1988).

The 1993 RFA reinspection found conditions similar to those seen in 1988 (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The Fire Department is located approximately 500 feet from the SWMU. The surrounding area is relatively flat with mowed grass around the unit and dense foliage within 200 feet. Operational runways and taxiways pass near the site.

3.3.12 SWMU 23 - Oil Spill Separator Tanks

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: Located approximately 100 feet inshore from the fuel pier are three oil spill separator tanks which process waste pumped in from the Ships Waste Off-load Barges (SWMU 22). The oil spill separator tanks are large steel boxes that are underlain by a concrete pad with an 8-inch curb (A.T. Kearney, Inc., 1988). Each box has a pipe that extends out laterally from the bottom.

After the water settles to the bottom of the tank, a valve on the pipe is opened, and the contents are allowed to spill out until all the water has been removed. The separated oil is then transferred to the Oil Spill Oil/Water Separator (SWMU 24). This added process of separation is necessary because the majority of liquid pumped up by Donuts (SWMU 21) and SWOBs (SWMU 22) consists of sea water. Each oil spill separator tank is constructed of steel and, according to facility representatives, has a 2,000-gallon capacity (A.T. Kearney, Inc., 1988).

The VSI team noted black staining on the concrete pad, curbing and areas of asphalt around the SWMUs both in 1988 and during the 1993 RFA reinspection (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The tanks are located near the harbor pier immediately adjacent to the oil spill response building. A crew works in the general vicinity.

3.3.13 SWMU 24 - Oil Spill Oil/Water Separator and Adjoining Pad

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: According to the 1988 RFA report, the oil spill oil/water separator is a below ground structure built of concrete with steel grating covering the top at ground level (A.T. Kearney, Inc., 1988). Facility representatives reported to the VSI team that the oil/water separator has a capacity of 1,500 gallons. This unit receives discharge from the Oil Spill Separator Tanks (SWMU 23). After separation, the waste oil is removed by DRMO. The final disposal of wastewater was not determined by the VSI team (A.T. Kearney, Inc., 1988). The VSI team also did not determine if an overflow control device existed at this SWMU. They did not observe any sign of a release at the time of the VSI.

Minor staining around the edge of the separator was observed during the 1993 RFA reinspection (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The separator is on the harbor pier immediately adjacent to the oil spill response building which is actively manned.

3.3.14 SWMU 25 - DRMO Storage Yard

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: This unit is an area measuring approximately 40 feet x 100 feet and is located immediately adjacent to the Ignitable Storage Facility (SWMU 18) (A.T. Kearney, Inc., 1988). In 1988, a facility representative stated to the VSI team that this unit was used for hazardous waste storage prior to the use of the Ignitable Storage Facility (SWMU 18) and DRMO Hazardous Waste Storage Facility (SWMU 17) (A.T. Kearney, Inc., 1988). A facility representative told the VSI team that this SWMU was being used to store hazardous materials at the time of the inspection.

Evidence of past release was observed during the VSI. Several oil stains, the largest measuring approximately 20 feet in diameter, were observed (A.T. Kearney, Inc., 1988).

During the 1993 RFA reinspection, the area could not be accurately located but may coincide with an area is now used as storage of raw material (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The yard is relatively flat, graveled area behind the DRMO building. Frequent vehicular and personnel traffic is present.

3.3.15 SWMU 26 - Building 544 Area

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: This SWMU is comprised of approximately twenty-five 30-gallon drums, some of which had polyethylene liners (A.T. Kearney, Inc., 1988). The 1988 RFA report indicates that these drums were located behind Building 544 and were surrounded by thick brush (A.T. Kearney, Inc., 1988). The VSI team noted that some of the drums contained engine lubricating oil, and that one of the labels had the number 9150-231-6654 stamped on it (A.T. Kearney, Inc., 1988). The VSI team could not identify the contents in all of the drums because not all of the drums were labeled. The VSI team also observed a tar-like substance leaking onto the ground (A.T. Kearney, Inc., 1988).

In 1992, the Navy conducted a site inspection of this SWMU. The site has changed since the 1988 RFA was issued. Building 544 had been demolished (in approximately 1990). The concrete foundation of Building 544 remains. The drums had been removed. No evidence of stained soil was observed during the 1993 RFA reinspection (TRC, 1993); however, it is possible that the incorrect area was examined.

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The jungle abuts two sides of the area while the remaining two sides are comprised of flat contractor lay-down yard. Transient contractor personnel are common.

3.3.16 SWMU 31 - Waste Oil Collection Area/Buildings 31 and 2022 (IR Site 10)

Potential Hazards: Contact with potentially-contaminated soil and groundwater.

Description/Observations: This SWMU is part of IR Site 10. According to the 1988 RFA, the Transportation Shop services Public Works Department vehicles inside Building 31 and in the yard just north of the building. Approximately 30 yards from the Transportation Shop warehouse is a concrete pad used for the temporary storage of 55-gallon waste oil drums, although none were present at the time of the VSI. A 6-inch concrete curb surrounds the pad which measures approximately 13 feet by 20 feet. A steel drainage pipe with a broken valve is set into the curbing, and at the time of the 1988 VSI, was in the open position. The yard surrounding this unit is asphalt. No leakage was evident at the time of the VSI; however, with the drain pipe valve broken in the open position any spills on the concrete pad would flow directly onto the Public Works Department yard (A.T. Kearney, Inc., 1988).

The 1984 IAS report does not specifically discuss SWMU 31 but discusses Building 31. According to the IAS report, the area around Building 31 was used for open storage of drummed material. The IAS report noted the following:

- Near Building 31 approximately 50 drums were found within the vegetation bordering the north side of Building 31 transportation lot. Most of the drums are full to partially full of unknown contents. The Public Works Department attempted to remove some of these drums; however, the condition of the drums resulted in massive leakage. The spill contaminated a flatbed truck before running onto the ground, staining an approximately 10-foot-diameter circle of soil. An extremely strong

creosote or solvent odor was present. These drums and the spill can be easily accessed by base personnel. The spilled material was identified by the Navy as asphalt, and will be sent to Defense Property Disposal Office (DPDO) for sale or reuse. Three drums were not identified and are being held (NEESA, 1984).

Previous Findings: In 1988, ESE performed two rounds of verification sampling for IR Site 10 (SWMUs 31 and 32, and AOC B). Groundwater samples were collected from eight wells. The results of the analyses indicated that presence of low levels of organic compounds and the presence of some metals at levels that exceeded primary drinking water standards and ambient water quality criteria.

The pad was in full use in 1993 (during the RFA reinspection) and heavy staining both on the pad and around the perimeter was present (TRC, 1993).

Eight soil samples were collected from IR Site 10 during the Supplemental Investigation (Baker, 1993). Organic contaminants were present in trace concentrations. A risk assessment conducted as part of the Supplemental Investigation indicated that there is no threat to human health or the environment associated with this media.

Surrounding Population/Topography: Various occupied buildings surround this area with intense vehicular activity within the fenced areas. Overall the area is level.

3.3.17 SWMU 32 - PWD Storage Yard/Battery Collection Area/Building 31 (IR Site 10)

Potential Hazards: Contact with potentially-contaminated soil and groundwater.

Description/Observations: This SWMU is part of IR Site 10. It consists of a number of batteries that were stored on the bed of a truck and on a pallet on the ground. This SWMU is located approximately 100 yards northeast of the transportation shop warehouse. The 1988 VSI team noted that several dozen batteries were in various stages of decay, but that none of the batteries were corroded to the point of leakage. Most, according to the VSI team, appeared to contain electrolyte. The VSI did not observe any evidence of release.

The 1984 IAS report does not address SWMU 32 specifically, but instead discusses general site conditions around Buildings 25 and 31. The 1984 report notes the following:

- Building 25 was used from 1951 until the structure collapsed in 1979 by the Public Works Supply Department for temporary storage of materials to be turned over to DPDO. According to aerial photographs, the entire area around the building was used for open storage of drummed material from at least 1957.

- The entire area in and around the collapsed building is overgrown with vegetation, although historical aerial photographs show the area to be relatively free of vegetation other than ground cover through 1977. Materials found in and around Building 25 included 20 to 25 apparently empty to partially filled 55-gallon drums; ten to fifteen 5-gallon pails; office furniture; mechanical devices; construction rubble; industrial gas cylinders; asbestos sheeting; fiberglass buoys; and transformers.

- Of particular interest were the 5-gallon pails, the drums, and a large transformer found at the collapsed building. The 5-gallon pails had become corroded, exposing a substance similar to that found at the Langley Drive site. The compound has a green-colored crust about 1/2-inch thick, encasing a white material with the consistency of semi-dry plaster. A large transformer is lying on its side at the east corner of the building. No evidence of oil leakage was apparent.

- Material was also found along the various access roads and consisted of drums, office furniture, asbestos, rubber, and a pole-mounted transformer from which oil has leaked. Some of these areas exhibited stressed vegetation. There are several other areas of disposed material (about five acres) between the access routes. A 1957 photograph was taken by a tenant. Activity shows that the area around Building 145 was used as a general storage area for several hundred drums. During the IAS team's overflight, CONEX containers were also found in a clearing at this area.

Previous Findings: In 1988, ESE performed two rounds of verification sampling for IR Site 10 (SWMUs 31 and 32, and AOC B). Groundwater samples were collected from eight wells. The results of the analyses indicated that presence of low levels of organic compounds and the presence

of some metals at levels that exceeded primary drinking water standards and ambient water quality criteria.

Eight soil samples were collected from IR Site 10 during the Supplemental Investigation (Baker, 1993). Organic contaminants were present in trace concentrations. A risk assessment conducted as part of the Supplemental Investigation indicated that there is no threat to human health or the environment associated with this media.

Surrounding Population/Topography: Various occupied buildings surround this area with some activity within the fenced areas. Overall the area is level with smaller areas of uneven terrain.

3.3.18 SWMU 37 - Waste Oil Storage Area/Building 200

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: According to the 1988 RFA, this unit consisted of nineteen 55-gallon drums resting on wooden pallets, situated on a raised, covered concrete pad behind Hanger 200. The drums were observed by the VSI team to contain waste gasoline and lubricating oil from Aircraft Intermediate Maintenance Department (AIMD) operations.

During the 1988 VSI, minor oil stains were observed on the concrete pad, and a minor area on the nearby grass was observed to have stressed vegetation (A.T. Kearney, Inc., 1988).

Previous Findings: In 1988, ESE performed two rounds of verification sampling and analysis.

One soil sample was collected as a background sample in Round 1. This sample was analyzed for oil and grease, lead, VOA, xylene, MEK, and EDB. Elevated levels of oil and grease (8.21 mg/kg) were detected in this soil sample.

A total of six sediment samples were collected for Site 8 (3 samples during each round). Oil and grease levels ranged from 69-4740 mg/kg.

A total of eight surface waters were collected from Site 8 during both Rounds. Three were collected in Round 1 and five during Round 2. Significant levels of oil and grease (ranging from 5 to 102 μg/L) were found in Round 1 samples. Oil and grease were not detected in Round 2 samples (Technical Review Committee Meeting Minutes, 1989).

During the 1993 RFA reinspection, the area was found to be well managed. A minor area of stressed vegetation was seen at the rear of the unit. Fresh soil from the area yielded measurable organic vapors (TRC, 1993).

Surrounding Population/Topography: This SWMU is located at the edge of the paved aircraft apron near Building 200. Frequent, short duration, activity occurs here related to hazardous waste management.

3.3.19 SWMU 39 - Building 3158/Former Battery Drain Area

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: According to the 1988 RFA, this unit consists of a storage building and covered battery drainage area. This building stores waste batteries and battery acid that are wastes generated by Naval Mobile Construction Battalion (NMCB or "Seabeds") operations. The metal battery drain tank (shaped like a funnel) is underlain by a curbed concrete pad. Battery contents are poured into the drain tank and the battery acid is caught below in a container. The curbing around the pad is cracked and stained, indicating that there have potentially been past releases to the soil (A.T. Kearney, Inc., 1988).

The Navy, during a site visit in March 1992, observed no visible signs of release to the soils. This area is no longer used for storage of spent batteries.

The area is no longer used for battery storage according to the 1993 RFA reinspection. It is now employed to store flammable materials. The original pad could not be found (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The pad occupied a portion of the flat, graveled, seabee yard. Pedestrian and vehicular traffic is common.

3.3.20 SWMU 46 - Pole Storage Yard Covered Pad

Potential Hazards: Contact with potentially-contaminated soil and cement.

Description/Observations: According to the 1988 RFA report, this unit was cited in the Navy Assessment and Control of Installation Pollutants (NACIP) Program report as a Public Works Department hazardous waste storage area that had been used to store transformers and 55-gallon drums of PCB-contaminated material. The NACIP report further stated that the area showed evidence of oil spillage. A facility representative confirmed that this unit had formerly been used to store transformers during the 1988 VSI. The VSI team observed that this unit was a covered concrete pad, and that it was used for the storage of products including insulators, telephone poles, small cardboard boxes of electrical equipment, and several full 5-gallon pails, one marked as electrical lubricant. The VSI team also noted that the unit was surrounded by a cyclone fence. Telephone poles were piled near the entrance. No evidence of release was observed by the VSI team (A.T. Kearney, Inc., 1988).

During the 1993 RFA reinspection, the pad was observed to be clean with only some wire present (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: Unknown

3.3.21 SWMU 51 - New AIMD Storage Pad/Building 379

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: SWMU 51 consists of a curbed concrete storage pad located outside Building 379. This storage pad is roofed and enclosed with a cyclone fence. It was first identified during the 1993 RFA reinspection, and is presently utilized by the AIMD facilities in place of SWMU 33. Also present at this SWMU is a 200-gallon tank which touches the storage pad, but is outside the curbed area. The entire pad area is surrounded by asphalt pavement. Oil stains were observed emanating from two drain valves in the curb surrounding this pad, and from the 200-gallon tank located outside the pad curb (TRC, 1993).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The flat pad is constructed on the edge of the hanger apron. Periodic waste management activities occur here.

3.3.22 AOC B - Building 25 (IR Site 10)

Potential Hazards: Contact with potentially-contaminated soil and groundwater.

Description/Observations: This AOC is part of IR Site 10. The 1984 IAS report noted the following:

- Building 25 was used from 1951 until the structure collapsed in 1979 by the Public Works Supply Department for temporary storage of materials to be turned over to DPDO. The entire area around the building was used for open storage of drummed material from at least 1957, according to aerial photographs.

- The entire area in and around the collapsed building is overgrown with vegetation, although historical aerial photographs show the area to be relatively free of vegetation other than ground cover through 1977.

- Materials found in and around Building 25 include 20 to 25 apparently empty to partially filled 55-gallon drums; 10 to 15 5-gallon pails; office furniture; mechanical devices; construction rubble; industrial gas cylinders; asbestos sheeting; fiberglass buoys; and transformers.

- Of particular interest are the 5-gallon pails, the drums, and a large transformer found at the collapsed building. The compound has a green-colored crust about 1/2-inch thick, encasing a white material with the consistency of semi-dry plaster. A large transformer is lying on its side at the east corner of the building. No evidence of oil leakage was apparent (NEESA, 1984).

The 1988 RFA VSI team observed that Building 25 had collapsed. They also noted the following:

- It appeared that the majority of material stored there consisted of old clothing, empty wooden boxes and small empty shells. No sign of release was noted during the VSI; however, it is possible that some amount of material was completely covered by vines and could not be observed during the VSI (A.T. Kearney, Inc., 1988).

Previous Findings: Eight soil samples were collected from IR Site 10 during the Supplemental Investigation (Baker, 1993). Organic contaminants were present in trace concentrations. A risk assessment conducted as part of the Supplemental Investigation indicated that there is no threat to human health or the environment associated with this media.

Surrounding Population/Topography: This flat area is presently used as a material/equipment storage area for the Army National Guard.

3.3.23 AOC C - Transformer Storage Pad

Potential Hazards: Contact with potentially-contaminated soil.

Description/Observations: The 1988 RFA report describes this AOC as follows:

- This AOC is comprised of two raised concrete pads that , at the time of the VSI, were used for storage of transformers. During the VSI, 40 transformers were observed to be stored on the storage pad to the south, which measured approximately 20 feet x 50 feet. This pad was covered by ripped canvas stretched over a wooden frame. The north pad was uncovered and contained at least 25 transformers and 20 to 40 batteries. The products stored at this unit were in good condition. Standing oil inside the north pad and release to the soil through a crack in the concrete were observed. Transformers of various sizes were scattered around both the south pad and the north concrete pad.

The 1993 RFA reinspection indicated that the site remains as found in 1988 except more transformers are present (TRC, 1993). Site representatives indicated that transformer removal was imminent (within 30 days).

Previous Findings: Not Available. Note: The SHSO and Site Manager will perform a reconnaissance of this area prior to initiating investigative activities, and review safety concerns with site personnel during the pre-entry briefing.

Surrounding Population/Topography: The SWMU occupies a flat area behind the print shop. Minimal activity occurs near the pads.

3.4 Hazard Evaluation

The pre-entry briefing and subsequent safety meetings will serve to address the hazards particular to a SWMU or AOC, such as sloping ground, uneven terrain, etc. If new hazards are identified, the SHSO will then add them to the HASP in the field along with the date of modification. Additionally, site personnel are expected to follow "safe" work practices as described in this HASP.

Given the information provided in Section 3.3, a hazard evaluation can be performed. In the next five subsections, this evaluation will discuss the chemical, physical, radiation, environmental and task-specific hazards associated with the RFI at NSRR. A summary of the hazard evaluation is provided in Section 3.4.6.

3.4.1 Chemical Hazards

Hazardous chemicals can be absorbed into the body through various pathways. These pathways include:

- Inhalation of vapors, gases, or particulates.
- Ingestion of contaminated particulates from hand-to-mouth contact.
- Dermal and eye contact from direct, unprotected contact.
- Absorption through the eye or skin from exposure to concentrations in the air.

The chemical exposure potential for personnel working at NSRR is expected to relate directly to the chemicals identified from analytical analyses provided from previous sampling investigations and/or the chemicals or materials that were documented to be present at each SWMU or AOC. For those chemicals detected during previous sampling investigations, the chemical/physical properties and health hazards/routes of entry have been provided in Tables 3-1 and 3-2, respectively. Additionally, Chemical/Material Data Sheets are included in Attachment B.

Those materials that were documented to be present at each area under investigation that were either used, stored, or processed at a SWMU or AOC, are listed below. If available, a Chemical/Material Data Sheet has been provided in Attachment C. Those materials that do not have a Chemical/Material Data Sheet will have an asterisk (*) next to them.

- Polychlorinated Biphenyls (SWMUs 3, 32, 46 and AOCs B, C)
- Otto Fuel II (SWMU 3)
- Agentine (SWMU 3)*
- Asbestos (SWMUs 3, 32 and AOC B)
- Super Tropical Bleach (SWMU 3)*
- Paint/Adhesives (SWMU 6)*

- Diesel Fuel (SWMU 30)
- Bunker C Fuel (SWMU 11)
- Aviation Gas (AVGAS) (SWMUs 9, 37)
- Waste Oils (SWMUs 12, 14, 23-26, 31, 37)*
- Waste Solvents/Fuels (SWMUs 14, 23-26, 31)*
- Spent Batteries/Battery Acid (SWMUs 32, 39)
- Scrap Metal (SWMU 1, 2, 5, 6, 16)
- Inert Ordnance (SWMU 1 and 3)

The material not having MSDSs available generally fall into groups of chemicals. The groups of chemicals include:

- Paints/Adhesives
- Waste Solvents/Fuels
- Spent Batteries/Battery Acid
- Waste Oils

The following provides a summary of the general hazards from each of these chemical groups.

Paint/Adhesives

There are various kinds of paints and adhesives. Generally the main health concern is from volatile organic compounds. The physical hazards associated with this group is flammability. A wide range of overexposure symptoms exists from the volatile organic compounds including; mucous membrane irritation, coughing, nausea and vomiting, dizziness, confusion, and unconsciousness.

Waste Solvents/Fuels

The greatest physical hazards associated with many solvents is a result of their flammability. Solvents may cause dermatitis and dry skin (with prolonged exposure), and are poisonous if ingested. Inhalation causes narcosis, a feeling of light-headedness, dizziness or euphoria, as well as headaches and nausea. Long-term exposure from ingestion or inhalation can lead to kidney and liver damage.

Contact with the lighter fuels causes rapid drying of the skin, leading to chapping, cracked skin, and dermatitis. The vapors are irritating to the eyes, nose, and throat. Inhalation leads to dizziness, nausea, and headaches. Ingestion is poisonous, and causes damage to the central nervous system, kidneys, and liver.

Spent Batteries/Battery Acid

Skin and eyes can be burned from direct contact with acid. Inhaled acid fumes can burn the respiratory tract, including the mouth, nose, throat, and lungs. Lungs burned with acid fumes often develop pulmonary edema, a condition in which the lungs fill with fluid, making breathing difficult.

Waste Oils

Waste oils will cause skin irritation from prolonged contact. The waste oils are generally toxic if ingested. The physical hazard associated with oil is due to combustibility.

Due to the nature of the activities conducted at SWMU 14 (i.e., burning/incineration of chemical wastes), dioxins (namely TCDD) may be present. TCDD is immobile in contaminated soil and may be retained for years, therefore, extra precautions shall be taken at this SWMU to avoid contact with potentially-contaminated soils.

For SWMU 51, data is incomplete as to the hazardous materials that may be present.

The data presented in a chemical/material data sheet reflects the chemical and toxicological properties of the specific compound in a pure, non-diluted state. As such, when these compounds are detected in environmental media (i.e, soil, groundwater, sediment, and surface water), the hazards are anticipated to be substantially less than those associated with exposure to "pure" compounds. The data presented in these data sheets will, therefore, be utilized as reference information when questions arise as to a constituents' chemical and toxicological property or measures for emergency response.

3.4.2 Physical Hazards

Physical hazards that are potential concerns for NSRR are discussed in the subsections below.

3.4.2.1 Confined Space Entry

Confined space entry is not anticipated during activities to be conducted at NSRR, therefore, confined space entry procedures have not been provided. However, should circumstances arise that may require entry into a confined space, the PHSO will be contacted and entry-specific procedures according to 29 CFR 1910.146 will be provided at that time.

3.4.2.2 Thermal Stress

Heat stress is a serious concern for the various work activities. Provisions for monitoring of heat stress are outlined in Attachment A - Baker Safety SOPs.

3.4.2.3 Noise

Elevated noise levels may be produced during drilling and other heavy equipment operations, as well as "airfield" traffic; therefore, hearing protection may be required during certain operations and/or in certain locations. The SHSO is responsible for making this determination based on past experience with the size and type of equipment being used and the location of sampling relative to air traffic.

3.4.2.4 Explosion and Fire

In general, the following items present potential explosion or fire hazards and will be monitored closely as they pertain to each area under investigation:

- Explosion and fire resulting from:
  - Heavy equipment malfunction
  - Penetration into underground utility/service lines (gas, electric, fuel)
  - Ignition of trapped flammable vapors

- Vehicular accidents
- Puncturing of drums or containers during drilling operations

Provisions for monitoring for potential fire/explosive conditions may include the use of an oxygen/combustible gas meter (as indicated in Section 5.2) and the performance of utility checks prior to conducting intrusive activities. As additional concerns are identified, provisions for making changes to the HASP will be presented by the SHSO, as needed.

3.4.2.5 Utilities

Underground utility clearance must be obtained before any intrusive activities are performed; this clearance will be provided by a representative for NSRR. If underground utilities are identified in these areas, the ground above the utility lines will be physically marked (e.g., spray paint or flags). Baker personnel will notify the base representatives at least five working days prior to intrusive activities to acquire a utility clearance. A minimum of a 24-inch tolerance zone must be used for underground utilities.

The generally accepted uniform color code for underground utilities is as follows:

- Red - Electric power lines, cables, conduit and lighting cables
- Yellow - Gas, oil, steam, petroleum, or gaseous materials
- Orange - Communication, alarm or signal lines, cables or conduit
- Blue - Water, irrigation, and slurry lines
- Green - Sewers and drain lines
- White - Proposed excavation

Energized overhead electric lines may present a risk of electrocution. OSHA standards require that equipment maintain certain distances from power lines. For lines 0 to 50 kilovolts (kV), the minimum distance is 10 feet. Lines carrying over 50 kV require that equipment maintain 10 feet, plus an additional 0.4 inch for each 1 kV over 50. On very humid days or during episodes of rain, these distances will be doubled.

3.4.2.6 Heavy Equipment

One of the primary physical hazards on the site is associated with the use of heavy equipment, which includes the use of a drill rig or backhoe. Only operators trained, qualified, and authorized will be permitted to operate the heavy equipment.

General hazards associated with the drill rig include moving parts, such as the auger and cathead. Personnel must remain clear of moving parts and must avoid loose-fitting clothing that can become entangled in the moving parts. Personnel working near a drill rig must be aware of the location and operation of the emergency shut off devices. Personnel are to stand clear of the drill rig immediately prior to starting the engine.

During backhoe operations, a "spotter" will be in place to direct the backhoe operator. Other personnel in the area, such as those conducting sampling, are to remain close together and in the line of sight of the operator. These personnel can proceed to the trenching/excavation area only when an "all clear" is given by the spotter and operator. Caution must be exercised in these work areas to avoid slips, trips, and falls. Personnel are not permitted to enter into any trenches. Any sampling conducted will be done from the bucket of the backhoe. Personnel must also avoid stepping/walking within 2 feet of the top of an excavation to avoid falling or causing the trench to collapse. Trenches are to be filled at the end of each event or, at a minimum, at the end of each day.

Noise from the operation of the heavy equipment will limit verbal warning abilities. Hand signals will be prearranged between operators and personnel working in and around heavy equipment. Backup alarms must operate properly on the heavy equipment.

The drilling subcontractor representatives are to provide any other cautions that need to be observed when working around this equipment during the HASP pre-entry briefing.

3.4.2.7 Fall Hazards

Due to the potential for steep slopes/uneven terrain and activities conducted around caissons at SWMU 11 and the oil/water separator at SWMU 12, fall hazards are a high concern for activities at NSRR. Therefore, the SHSO is responsible for assessing the hazard potential during each

SWMU/AOC walkthrough and discussing safety precautions during the pre-entry briefing. Where needed, each of these precautions will be added to the site HASP in the field.

3.4.2.8 Ordnance

During soil intrusive activities at the three landfill areas an unexploded ordnance (UXO) subcontractor will be on-staff. The soil intrusive areas at the landfill sites will be cleared by the UXO subcontractor prior to the commencement of work. The UXO subcontractor will present all applicably standard operating procedures and safety guidelines during the HASP briefing.

3.4.3 Radiation Hazards

The use or disposal of radiological wastes or radioisotopes has not been documented at NSRR, therefore, a radiation survey meter will not be assigned for these activities.

3.4.4 Environmental Hazards

The following paragraphs identify the potential hazards associated with flora and fauna at NSRR. If additional concerns are identified, they will be added to this HASP.

3.4.4.1 Hazardous Flora

Incidence of contact by individuals to poisonous/thorny plants is high, especially during surface water and sediment sampling activities; therefore, bare skin should be covered (i.e., long pants and shirt, steel toe boots, leather or cotton gloves, safety glasses, and head protection) as much as practical when working in forested or densely vegetated areas. Personnel should avoid entering an area in the direct path of known poisonous flora; a secondary route should be selected. Care should also be taken when walking in such areas as uneven terrain or vines may present a tripping hazard.

While attempting to cut into dense underbrush, hazards exist from the sharp machete and gas-powered weed cutter, therefore, care should be taken when using such devices. (Note: Hearing protection, steel toe boots, gloves, and safety glasses are required when using weed cutters.) All rashes and other injuries will be reported to the SHSO as soon as they are known.

3.4.4.2 Hazardous Fauna

Mosquitoes and sand flies pose a nuisance and physical hazard to field personnel; they distract workers, leading to accidents, and pose a physical threat by transmitting live microorganisms. Sand fly bites that are repeatedly scratched can cause secondary infections. Avoiding the use of perfumes and scented deodorants and donning light colored clothing is preferable. The use of Avon's "Skin So Soft" or other insect repellent is encouraged and will be provided, as needed in the Baker Field Trailer.

There is a potential to come in contact with other dangerous insects; these include centipedes, fire ants, bees, wasps, hornets, mites, fleas, and spiders. All personnel should perform "checks" on each other periodically and at the end of the work shift, especially when working in grassy or forested areas. All insect bites must be reported to the SHSO.

There are no poisonous snakes indigenous to Puerto Rico, only nonpoisonous snakes such as the Boa Constrictor. Feral (wild) dogs and cats have been observed.

Mongeese, rats, and mice have been documented to (potentially) carry rabies. There is some evidence that mongeese can be infected with the rabies virus in an attenuated form, allowing them to carry and spread the virus for considerable time before succumbing to the disease. Any observed unusual behavior by mongeese and other mammals must be reported. Signs of rabies can be characterized in two forms. Furious rabies exhibits agitation and viciousness followed by paralysis and death. Dumb rabies exhibits lethargy and paralytic symptoms followed by death. Behavioral indicators for both include fearlessness and change in nocturnal/diurnal rhythms.

Working in wet or swampy areas unprotected shall not be allowed due to the presence of a variety of etiologic (disease-causing agents). Contact with surface water will be kept to a minimum. There have been several incidents of infection by schistosomes (blood flukes) from contact with surface water. The aquatic snail vector, Australorbis Glabratus, transmits the schistosomes into surface waters, predominantly drainage ditches. Even momentary contact (especially in the presence of blisters, cuts, and open sores) with contaminated surface water is sufficient to acquire an infection. Accidental skin contact requires that the area be washed with isopropyl alcohol (as directed by

SHSO). Symptoms of infection are fever, diarrhea, itchy skin, and CNS damage. Schistosomiasis is hard to treat and, once established in its host, may remain for several years.

Prior to initiating site activities, each individual shall be questioned as to any known sensitivities to the previously mentioned organisms or agents.

3.4.5 Task-Specific Hazards

Listed below are summaries for the hazards associated with each potential task for an area under investigation. Levels of protection outlined in Section 6.0 were selected based on this task-specific hazard identification, information obtained from previous investigations and site visits, and previous experience with similar investigations or activities.

3.4.5.1 Task 1 - Sediment/Surface Water Sampling (SWMUs/AOCs 3, 6 and 11)

Chemical

- Potential for contaminated material to be splashed onto body or in eyes.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of volatile constituents or volatile fraction of semivolatile constituents within the sediments or surface water.
- Absorption of constituents through the skin.

Physical/Environmental

- Muscle strain from boring with hand auger.
- Sampling operations that occur from boats. These operations must comply with Baker's Safety SOP for Safe Boat Operations.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral (i.e., wild) animal life.

3.4.5.2 Task 2 - Land Surveying (SWMUs/AOCs 1, 2, 3, 6, 9,11, 23, 24, 25, 26, 31, 32, 37, 39, 46, 50, 51, C)

Chemical

- Skin contact with potentially-contaminated soil.
- Ingestion of contaminated material from hand-to-mouth contact.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.

3.4.5.3 Task 3 - Surface Soil Sampling (SWMUs/AOCs 12, 14, 23-26, 31, 37, 39, 46, 50, 51, C)

Chemical

- Skin contact with potentially-contaminated soil.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Absorption of constituents through the skin.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.
- Muscle strain from boring with hand auger.

3.4.5.4 Task 4 - Monitoring Well Installation (SWMUs/AOCs 1, 2, 3, 6, 9, 31, B)

Chemical

- Potentially-contaminated mud, soil, or water to be splashed onto body or in eyes.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Absorption of constituents through the skin.

Physical/Environmental

- Heavy objects landing on foot/toe or head.
- Elevated noise levels from heavy equipment operation.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Overhead hazards from drill rig operations.
- Interaction with native and feral animal life.
- Contact with underground utility lines.
- Muscle strain from lifting hazards.

3.4.5.5 Task 5 - Monitoring Well Development (SWMUs/AOCs 1, 2, 3, 6, 9, 31, B)

Chemical

- Potential for groundwater to be splashed onto body or in eyes.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.

3.4.5.6 Task 6 - Groundwater Sampling/Slug Test (SWMUs/AOCs 1, 2, 3, 6, 9, 31, B)

Chemical

- Potential for contaminated water to be splashed onto body or in eyes.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants emitting from the well opening.

Physical/Environmental

- Skin irritation from contact with insects and vegetation.
- Muscle strain from lifting bailers or removing slug.
- Cuts from using knives to cut bailer rope.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Interaction with native and feral animal life.

3.4.5.7 Task 7 - Soil Gas Survey (SWMUs/AOCs 14, 26, 32, 37)

Chemical

- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Skin contact with potentially-contaminated material.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Contact with underground utilities, fuel lines, etc.
- Interaction with native and feral animal life.

3.4.5.8 Task 8 - Soil Boring-Sampling (SWMUs/AOCs 1, 2, 6, 9, 11, 31, 32, B)

Chemical

- Potential for contaminated mud, soil, or water to be splashed onto body or in eyes.
- Skin contact with potentially-contaminated soil.
- Ingestion of potentially-contaminated soils from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Elevated noise levels from heavy equipment operations.
- Muscle strain from lifting hazards.
- Skin irritation from contact with insects and vegetation.
- Contact with underground utilities.
- Interaction with native and feral animal life.
- Heavy objects landing on foot/toe or head.
- Slips/trips/falls from sloped, uneven terrain; crawling over and under obstacles.

3.4.5.9 Task 10 - Test Pit/Trenching (SWMU 11)

Chemical

- Skin contact with contaminated soil.
- Ingestion of contaminated soils from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Overhead hazards from backhoe operations.
- Skin irritation from contact with insects and vegetation.
- Contact with underground utilities.
- High grade slopes that may require shoring according to OSHA Standards.

- Interaction with native and feral animal life.
- Explosion from contact with explosive/ignitable materials.
- Elevated noise levels from heavy equipment operation.
- Slips/trips/falls from sloped and uneven excavation materials or landscape.

3.4.5.10 Task 11 - Tanker/Roll-Off Box Sampling (SWMU 11)

Chemical

- Skin contact with potentially-contaminated soil or water.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of potentially volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Slips/trips/falls from elevated heights (i.e., top of roll-off box or tanker) onto ground.
- Falling into potentially-contaminated material in roll-off box.
- Cuts, abrasions, or sprains from climbing onto roll-off box or tanker.
- Muscle strain when using bailer or hand auger.

3.4.5.11 Task 12 - Wipe Sampling (SWMU 11)

Chemical

- Skin contact with potentially-contaminated building materials.
- Ingestion of contaminated material from hand-to-mouth contact.

Physical/Environmental

- Interaction with native and feral animal life.

3.4.5.12 Task 13 - (Decontamination Procedures)

Chemical

- Skin or eye contact with potentially-contaminated soil, water, or decontamination chemical.
- Ingestion of contaminated material or decontaminated chemical from hand-to-mouth contact.
- Injection of contaminated water during pressure washing of drill rig augers.

Physical/Environmental

- Slips/trips/falls.
- Skin irritation from contact with insects and vegetation.
- Muscle strain from lifting and bending.
- Heavy object landing on foot/toe while moving augers.

3.4.6 Summary

The information provided in Section 3.4 details the hazards associated with the RFI at NSRR. This information is used to ascertain what levels of protection will be required for each field activity at each area under investigation. In determining the levels of protection, the following items are considered:

- Quantity that is available for absorption
- Amount of time that is available for absorption
- Frequency with which the exposure occurs
- Physical form of the constituents
- Presence of other constituents
- Toxicity of the constituents
- Ventilation, natural or otherwise
- Appropriate hygienic practices
- Protective equipment in use
- HASP training

Based on this section and the information furnished in Section 3.3, levels of protection will be assigned. Refer to Section 6.2, Site-Specific Levels of Protection.

4.0 SITE CONTROL

In every HASP measures need to be addressed for managing the daily control (i.e., access, site conditions, etc.). The following subsections provide a discussion of each site control measure that will be consistent for all site RFI activities at NSRR.

4.1 Site Access

The Site Manager is designated to coordinate overall access and security at each area under investigation. Perimeters for activities to be conducted at NSRR will be established according to the site boundary procedures identified in Section 4.3, local conditions, the items listed below, and Navy Activity requirements.

- Site visitors will need proof of current medical clearances and training certification in compliance with 29 CFR 1910.120 and 1926.65 to receive access to the Exclusion Zone.

- Personnel will not be permitted within the Work Zone (i.e., Exclusion Zone) or Contamination Reduction Zone (CRZ) without proper authorization from the SHSO.

- All personnel arriving or departing the site will be documented in the site logbook.

- All activities on site must be cleared through the Site Manager and documented in the site logbook.

- The on-site Command Post will be established at the Baker Field Trailer, which will be in the Support Zone and oriented upwind from all Work Zones.

- Figure 4-1 identifies the location of the NSRR facility. Specific work site location mapping are located in the project work plans. A copy of the work plan will accompany the HASP and be available at the project site.

4.2 Site Conditions

Specific site conditions are as follows:

- The prevailing wind conditions are generally easterly to northeasterly.
- Anticipated weather conditions include hot, temperatures ranging from 70 to 90°F.
- Site topography varies, refer to Section 3.3 for SWMU/AOC-specific topography.

4.3 Work Zones

To reduce the accidental spread of hazardous substances by workers from a potentially-contaminated area to a clean area, zones will be delineated to ensure that work activities and contamination are confined to the appropriate areas, and to keep unauthorized personnel from entering the work zones. The sections below identify the requirements based on the level of protection in use.

4.3.1 Level C and B Activities

All zones for activities conducted under Level C and B shall be established utilizing control boundaries between the Work Zone, the Contamination Reduction Zone (CRZ), and the Support Zone (i.e., Clean Zone). These boundaries shall be defined as follows:

- Work Zone - The area where the primary investigation activity occurs.
- Hotline - The boundary between the Work Zone and CRZ.
- CRZ - The area between the Work Zone and the Support Zone which is located upwind of the site investigative activities.
- Contamination Control Line - The boundary between the CRZ and the Support Zone.

- Support Zone - The outermost area next to the CRZ and upwind of the site investigative activities.

These boundaries will be demarcated using one or more of the following materials:

- Colored boundary tape, cones, or equivalent for the Hotline or the Decontamination Corridor of the CRZ.

- Barriers for the Contamination Control Line such as posted signs and/or barricades.

Refer to Figure 4-2 for a "General Contamination Reduction Zone Layout."

Note: There are currently no sites designated for Level C activities at this time.

4.3.2 Level D and D+ Activities

All zones for activities conducted under Levels D or D+ shall be established according to the guidelines set forth in the subsections below.

4.3.2.1 Populated Areas

In populated areas, Work Zones for activities conducted under Level D or D+ protection levels shall be established in such a manner as to preclude unauthorized personnel from entering the investigative area. A boundary will be established to separate the Work Zone from the Support Zone using available materials such as the Baker Field Vehicle, natural boundaries (e.g., buildings, structures, fences), or signs/placards, boundary tape, cones, barricades, etc.

4.3.2.2 Unpopulated/Secluded Areas

In unpopulated or secluded areas, the aforementioned materials may not be used due to the exclusive nature of the site, the short duration of the activity, and the low risk to outside populations. The SHSO and/or Field Team Leader is responsible for making this determination.

4.4 "Buddy System"

All site activities that involve hazards and/or the potential for contact with hazardous materials will be performed by a work team of no fewer than two people (i.e., Buddy System).

4.5 Safe Work Practices

Routine safe work practices may consist of:

- Conducting operations in a manner to reduce exposure of personnel and equipment.
- Implementing appropriate decontamination procedures.
- Conducting sampling activities from an upwind location.
- Adherence to applicable safety regulations in OSHA Standards 29CFR 1910 and 1926.
- Setting up barriers to exclude unauthorized personnel from contaminated areas.
- Minimizing the number of personnel and equipment at each area under investigation.
- Establishing work zones within each area under investigation.
- Establishing control points for ingress to and egress from work zones.

4.6 Sanitation Procedures/Site Precautions

Provisions for sanitation procedures and site precautions to be followed on site are outlined below.

- A supply of clearly marked potable water, tightly closed, and equipped with a tap.

- Single service disposal cups.

- Outlets for non-potable water, clearly marked, for fire fighting or other purposes. Cross-contamination of the potable supply shall be prevented.

- One toilet facility for up to 20 personnel which is either chemical, recirculating, combustion, or flush, depending on local code requirements. Two toilet facilities will be required for greater than 20 personnel.

- A place for food handling meeting applicable laws or suitable alternatives to such facilities will be provided (i.e., nearby restaurants, food wagons, etc.).

- Clean wash water will be available in the decontamination zone during Level C activities, and the Baker Field Trailer for all other operations. Disposable towelettes will be available in each Baker Field Vehicle for periodic cleanups.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated. Smoking will also not be allowed in areas where flammable materials are present. Hands and face must be thoroughly washed before breaking for meals and upon leaving the site. "Contaminated" work garments are not to be worn off site.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact lenses are <u>not permitted</u> to be worn on site.

- Facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is not permitted on personnel who are or may be required to wear respirators.

- Contact with contaminated or potentially-contaminated surfaces should be avoided. Wherever possible, do not walk through puddles, leachate, discolored surfaces, kneel on ground, lean, sit or place equipment on drums/containers.

- Medicine and alcohol can potentate the effects of exposure to toxic chemicals, therefore, prescribed drugs should only be taken by personnel when approved by a qualified physician. Alcoholic beverage intake should be minimized or avoided during after-hour operations.

- Alcoholic beverages and firearms are prohibited on site.

- All site personnel will observe any posted sign, warning, fence, or barrier posted around contaminated areas.

- Site personnel must wear the proper attire while on site. At a minimum, this will include steel-toed boots, work pants (e.g., jeans or other durable material), and work shirt (e.g., short or long-sleeved, made of a durable material). Tank tops, muscle shirts, and sweat pants are not permitted.

5.0 ENVIRONMENTAL MONITORING

Environmental monitoring will be performed at each area under investigation; the level and degree of monitoring will be dependent on each field activity.

5.1 Personal Monitoring

Personal monitoring will be accomplished using realtime environmental monitoring instrumentation directed at the breathing zone (BZ) (the area bordered by the outside of the shoulders and from the mid-chest to the top of the head) of work party personnel. Breathing zone monitoring will be performed each time a reading is taken at the point source (i.e., after well is opened for groundwater sampling, after breaking ground for soil sampling, etc.). The guidelines below identify the protection levels required according to the action levels measured for the PID and Dräger Tubes.

PID[1]

- Background[2] = Level D/D+
- >1 mu (meter unit) above background for up to 1 continuous minute in the BZ = Level C plus Dräger Tube Monitoring at the point source
- >1 mu above background for up to 15 continuous minutes in the BZ = Stop work and consult the SHSO
- Instantaneous peak concentrations >10 mu in the BZ = Stop work and consult the SHSO

(1) PID with 10.2 eV ultraviolet lamp set on the 1X Scale.
(2) Background is typically 1 to 2 mu

MINIRAM [1]

- Background to 0.5 mg/m^3 = Level D+
- 0.5 mg/m^3 to <2 mg/m^3 = Level C
- ≥ 2 mg/m^3 = Stop Work and Consult PHSO

(1) Action levels are based on a "worst case" PEL of 0.05 mg/m^3 for lead (lead has lowest PEL of non-volatile particulate concerns). This assumes that 10% of the soil fraction that could adsorb to soil particulates (generated in the air) contains metal particulate. Therefore, 0.05 mg/m^3 divided by 10% (0.1) = 0.5 mg/m^3 in the breathing zone.

* An OSHA PEL is a time-weighted average concentration for a normal eight-hour work day and 40-hour work week to which nearly all workers may be repeatedly exposed day after day without expected adverse effect.

Dräger Tubes(1) (used to determine if Level C or D+ protection levels are adequate for highly volatile constituents when a PID/FID response meets the level identified above)

- Below limits of detection (BLD) to less than the Action Level (1/2 of the Exposure Level [EL])(2) = Level D/D+
- Action Level to the EL = Level C (if adequate NIOSH certified air-purifying cartridge is available) or stop work and consult the SHSO
- >The EL = Level B or stop work and consult the SHSO

(1) Dräger Tubes to be used include: benzene (67 28561)
sulfuric acid (67 28781)

(2) Refer to Table 3-1, Section 3.0, for explanation.

5.2 Point Source Monitoring

Point source monitoring which is monitoring performed at the source of the sampling/investigative activity (i.e., borehole, monitoring well, etc.) will comply at the action levels outlined below. Instrumentation to be used will include a PID and an Oxygen/Combustible Gas Meter.

PID

- If detecting levels greater than background, immediately measure the BZ levels following the action levels set forth in Section 5.1.

- For levels greater than 10 times the background level, retreat upwind, monitor BZ, and return after allowing source to aerate.

- For levels that are sustained, contact the SHSO for guidance.

Oxygen/Combustible Gas Meter[1]

Oxygen Meter

- 19.5% to 23.5% = continue working
- <19.5% or >23.5% = Stop Work immediately and consult the SHSO

Combustible Gas Meter[2]

- <20% of the Lower Explosive Limit (LEL) = continue working
- >20% of the LEL = Stop Work immediately and consult the SHSO

[1] Used to evaluate physical safety in conjunction with PID/FID.
[2] Assigned action levels are for non-confined space entry operations .

As work progresses, the scope of monitoring may be extended based on monitoring results, odor detection, changing work conditions, and signs or symptoms of exposure. Any or all of these conditions will be immediately investigated and acted upon by the SHSO.

5.3 Perimeter Monitoring

Perimeter monitoring which is defined as monitoring performed at borders beyond the Support Zone and often at the "fence line" will be required based on action levels that will remain consistent for site activities. The PID action levels are outlined below.

- The PID will be used periodically to scan the perimeter as a means of documenting any volatile releases that may extend past the work zone, when volatile

concentrations exceed 50 mu (2 X Scale) at the point source or 10 mu (1 X Scale) at the breathing zone.

5.4 Specific Air Monitoring Equipment and Frequency

Monitoring equipment and frequency for each area under investigation can be found in Table 5-1. Dräger Tubes are typically required when air concentrations reach a certain level according to a PID response. Action levels that govern changes in levels of protection can be found in Section 5.1.

5.5 Equipment Maintenance and Calibration

Baker's procedures for the return of equipment to inventory and for maintenance of the equipment shall be followed in order to assure that the optimum level of operation is maintained for the item. Equipment calibration under the direction of the SHSO will be completed daily before and after use the calibration information is to be entered onto the equipment calibration form. All forms will be maintained on site for the duration of the project with copies to be given to the Equipment Manager once the equipment has been returned to the office. Procedures for equipment maintenance and calibration follow those guidelines found in the operating manual provided by the manufacturer (included with each piece of equipment) or in Baker's Standard Operating Procedures for Administrative, Field, and Technical Activities Manual.

5.6 Monitoring Documentation

As environmental monitoring is performed, documentation of the results will be entered into the Field Logbook of the individual performing the monitoring. Documentation is to include the date, time, instrument result, general location, weather conditions, and specific location such as point source, breathing zone, or area. Copies of the Field Logbook will be placed in a binder and remain in the Baker Field Trailer on site until the end of the field activities, whereby the log sheets will become part of the permanent file.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 Personal Protective Equipment Selection

The personal protective equipment available for the various levels of protection is listed in the table below. The assigned item number will correspond to each field activity as defined in Section 6.2.

Item No.	Personal Protective Equipment
1	Chemical-Resistant Clothing (Polyethylene-coated Tyvek®)
2	Chemical-Resistant Clothing (Saranex®)
3	Uncoated Tyvek®/Kleenguard® Coveralls
4	Normal Work Clothes
5	Air-Line Respirator (ALR) with 5-minute escape pack
6	Self-Contained Breathing Apparatus (SCBA) for rescue
7	NIOSH 5-minute Escape Pack (on standby)
8	Full-face Cartridge Respirator
9	Half-face Cartridge Respirator
10	Full-face Cartridge Respirator (on standby)
11	Half-face Cartridge Respirator (on standby)
12	Chemical-Resistant Gloves (Nitrile inner - double layer)
13	Chemical-Resistant Gloves (Nitrile inner - single layer)
14	Chemical-Resistant Gloves (Rubber/Neoprene outer)
15	Chemical-Resistant Gloves (Nitrile outer)
16	Work Gloves (outer)
17	Chemical-Resistant Overboots (with steel toe and shank)
18	Chemical-Resistant Overboots (w/o steel toe)
19	Steel Toe Boots
20	Safety Glasses
21	Safety Goggles
22	Face Shield
23	Hard Hat
24	Hearing Protection (as necessary)
25	Chest/Hip Waders (as necessary)
26	Safety Vests

6.2 Site-Specific Levels of Protection

Based on the information provided in Section 3.0, Site Characterization, the levels of protection and corresponding personal protective equipment have been designated for the following field activities. Upgrading or downgrading the level of protection will be based on realtime monitoring, working conditions, and the discretion of the SHSO.

Note: No single combination of protective equipment and clothing is capable of protection against all hazards. PPE should be used in conjunction with safe work practices, effective decontamination, and good personal hygiene.

SWMUs/AOCs	Field Activity	Level of Protection					PPE (Item No.)
		B	C	D +	D	Other	
3 and 11	Sediment Sampling			X			4, 10, 12, 19, 20, 25
6	Surface Water Sampling			X			4, 10, 12, 19, 20, 25
(as needed)	Land Surveying				X		4, 16, 19
12, 13, 14, 23, 24, 25, 26, 37, 39, 46, 51, AOCs B and C	Surface Soil Sampling			X			4, 10, 12, 16, 19, 20
1, 2, 9A, 9C, 31, 32, and AOC B	Monitoring Well Installation			X			(3) 4, 10, 13, 15, 18, 19, 20, 23, 24
1, 2, 9A, 9C, 31, 32, and AOC B	Monitoring Well Development					(1)	
1, 2, 9A, 9B, 9C, 31, 32, and AOC B	Groundwater Sampling			X			4, 10, 12, 19, 20
1, 2, 9A-C, 31, and AOC B	Slug Test			X			4, 10, 12, 19, 20
14, 26, 37	Soil Gas Survey			X			4, 10, 11, 16, 19, 20
6, 9A, 9B, 9C, 11, 13, 31, 32, and AOC B	Soil Boring - Sampling			X			(3) 4, 10, 13, 15, 18, 19, 20, 23, 24
11	Test Pitting/ Trenching (with sediment sampling)			X			(3), 4, 10, 13, 15, 18, 19, 20, 23, 24
(as needed)	Tanker/Roll-Off Box Sampling					(3)	

SWMUs/AOCs	Field Activity	Level of Protection					PPE (Item No.)
		B	C	D +	D	Other	
11, 46	Wipe Sampling			X			4, 10, 12, 16, 19, 20
(as needed)	Equipment Decontamination			X			4, 15, 20

EXCEPT IN EMERGENCY SITUATIONS, CHANGES TO THE SPECIFIED LEVELS OF PROTECTION SHALL ONLY BE MADE WITH THE APPROVAL OF THE SHSO AND THE SITE MANAGER, IN CONSULTATION WITH THE PHSO AND PROJECT MANAGER.

6.3 Respiratory Protection

Site-specific respiratory protection requirements as outlined below will comply with the procedures in Attachment A - Baker Safety SOPs.

6.3.1 Level C

The "North" or "MSA" full-face NIOSH-certified negative pressure Air-Purifying Respirator with an organic vapor/HEPA cartridge is the appropriate cartridge for use with the detected hazardous materials and the measured contaminant concentrations will be used at this level. Upgrades/downgrades in this level of respiratory protection will be based on measured realtime air contaminant concentrations (see Section 5.1) and the SHSO's observations.

Cartridge changeover will occur when one or more of the following have been observed: exposure duration greater than eight hours for vapor/gas cartridges; breathing resistance; a noticeable odor or taste; eye/throat irritation; and other indicators such as end of service life indicators for specialty filter cartridges.

6.3.2 Level D+

A NIOSH-certified negative pressure air-purifying respirator, meeting all the requirements identified under Level C, will remain on standby at this level.

6.4 Care and Cleaning of Personnel Protective Equipment

Provisions for the care and cleaning of personal protective equipment used on site can be found in Attachment A - Baker Safety SOPs.

7.0 DECONTAMINATION PROCEDURES

Procedures to follow for the decontamination of personnel and equipment, as well as handling of materials generated during decontamination, are discussed in the following sections.

7.1 Personnel Decontamination

Personnel leaving the Work Zone will be thoroughly decontaminated. The following protocol will be used for the decontamination stations according to levels of protection assigned to each field activity:

Level D	Level D+	Level C	Level B
1. Equipment drop	1. Equipment drop	1. Equipment drop	1. Equipment drop
2. Boot and glove gross contamination removal*	2. Outer boot and glove wash	2. Outer boot and glove wash	2. Outer boot and glove wash
3. Boot and glove wash*	3. Outer boot and glove rinse	3. Outer boot and glove rinse	3. Outer boot and glove rinse
4. Boot and glove rinse*	4. Tape Removal	4. Tape Removal	4. Tape Removal
5. Tape Removal*	5. Outer boot and glove removal	5. Outer boot and glove removal	5. Outer boot and glove removal
6. Boot removal*	6. Coverall removal/ disposal	6. Coverall removal/ disposal	6. SCBA or escape tank removal
7. Glove removal*	7. Inner glove removal/disposal	7. Respirator removal	7. Coverall removal/ disposal
8. Hand/Face wash	8. Hand/face wash	8. Inner glove removal/disposal	8. SCBA or ALR face shield removal
9. Equipment wipe down	9. Equipment cleaning	9. Hand/face wash	9. Inner glove removal/disposal
		10. Respirator cleaning/ sanitizing	10. Hand/face wash
		11. Equipment cleaning	11. Respirator cleaning/ sanitizing
			12. Equipment cleaning

*Optional - depends on degree of contamination and type of PPE used.

The following decontamination equipment is required for Level C protection levels and recommended for Level D+ protection:

- Two small tubs (one set of wash and rinse water)
- Scrub brush
- Towels*
- Disposable wipes*
- Pressurized sprayers for rinsing
- Contaminated clothing disposal bag or drum*
- Contaminated liquids disposal drum
- Respirator cleaning solution
- Liquinox and water as the decontamination solution

* Minimum for Level D decontamination.

The decontamination liquids and clothing will be contained and disposed according to policy defined in the Sampling and Analysis Plan (SAP).

7.2 Equipment Decontamination

Provisions for the decontamination of equipment will be based on the size and type of equipment used. Specific decontamination procedures for NSRR will be found in the SAP.

7.3 Decontamination Materials

The protocols outlined in the SAP for the handling of materials used for decontamination such as packaging, storing, and disposing will be followed to: (1) minimize the risk of off-site exposures that could endanger public health; and (2) limit the potential for liabilities associated with handling, containment, storage, and transportation of contaminated materials. These protocols comply with Baker's SOP on "Handling Site Investigation-Derived Wastes," located in the Standard Operating Procedures for Administrative, Field, and Technical Activities Manual.

8.0 EMERGENCY PROCEDURES

8.1 Scope

The emphasis in this section has been placed on those procedures that would most likely be implemented in the event of an emergency.

8.2 Pre-Emergency Planning

All applicable Navy/local emergency response contacts (On-Scene Commander, Fire Department, Security, Ambulance, Hospital, etc.) at NSRR will be contacted prior to or during site mobilization activities. This notification will be performed by the SHSO and/or Site Manager. The information discussed may include:

- A description of site activities.
- Anticipated site hazards.
- Hazardous chemicals/materials brought on site.
- Expected length of time on site.
- Specific requirements the emergency response facilities may require.
- Confirmation of emergency phone numbers.
- Security measures that must be followed by site personnel.

Specific points of contact, where applicable, will be established and added to the HASP. If requested, Material Safety Data Sheets which are maintained at the Command Post will be provided at this time.

8.3 Emergency Coordinator

The SHSO acting as the Emergency Coordinator is responsible for field implementation of these Emergency Procedures. As the Emergency Coordinator, specific duties include:

- Familiarizing all on-site personnel with the emergency procedures and the emergency coordinator's authority.

- Identifying the nearest telephone in the event of an emergency.

- Communicating site emergency procedures and requirements to all Baker and subcontractor personnel.

- Specifying a backup/alternate Emergency Coordinator.

- Controlling activities of subcontractors and contacting the emergency response groups, as necessary.

- Anticipating, identifying, and assessing fires, explosions, chemical releases, and other emergency situations to the best of the coordinator's ability.

- Familiarity with site personnel trained in emergency first aid and adult CPR.

8.4 Communications/Telephone Numbers

Internal communications will rely on direct communication (via verbal and two-way radios) between site personnel. External communications will employ a telephone located in the Baker Field Trailer and various telephones located throughout the Base (near the investigation areas). Telephone communication at the Command Post (Baker Field Trailer) will be established as soon as practicable. The telephone number is (to be determined).

The "Buddy System" will be in effect at all times; any failure of communication requires an evaluation of whether personnel should discontinue activities.

Air horns will be used for communication during emergency evacuation of personnel. One long (3 second) air horn blast is the emergency signal to indicate that all personnel should evacuate the Work Zone.

Coordination between Baker and subcontractor personnel is the responsibility of the Site Manager. The best means for securing the lines of communication will be determined at the pre-entry briefing. Hand signals, as outlined below, will be used in the event that radio communications fail:

Hand gripping throat	-	Can't breathe (typically Level C/B activities)
Grip partner's wrist or both hands around waist	-	Leave area immediately
Hands on top of head	-	Need assistance
Thumbs up	-	OK, I am all right, I understand
Thumbs down	-	No, I do not understand

Emergency telephone numbers will be posted in the Baker Field Trailer and maintained in each Baker Field Vehicle. The list of emergency phone numbers is presented in Figure 8-1.

8.5 Assembly Area

In the event of an emergency, personnel will be instructed to meet initially at the Baker Field Vehicle and eventually at the Baker Field Trailer. Where applicable, personnel will exit the work area through the contamination reduction zone. At this location, emergency needs will be provided such as:

- Assembly for evacuated personnel
- First aid for injured personnel
- Decontamination material
- Communications

8.6 Emergency Hospital Route

An emergency hospital route map (Figure 8-2) showing the location of the local hospital will be posted in the Baker Field Trailer and maintained in the Baker Field Vehicle. Personnel will be informed of the location of the map during the pre-entry briefing. Due to the large number of SWMUs and AOCs the written directions to the Naval Hospital will be provided prior to the start of work in each area.

8.7 Emergency Medical Treatment

This section provides information on the nearest emergency medical facility and corresponding emergency telephone numbers, as presented on Figure 8-3.

Contact will be made with emergency personnel prior to the start of activities (see Section 8.2).

8.8 Injuries

If injuries are not serious or life threatening, affected personnel may be transported by other site personnel to the local medical facility, if necessary. Emergency medical response personnel will be contacted in the event of serious or multiple injuries. Medical personnel will be provided with all available information regarding the nature of the incident, chemicals involved, etc. Instances requiring treatment beyond "first aid" will be handled at appropriate facilities and reported to the Project Manager and PHSO within 24 hours. There will be a minimum of two persons during each phase of field activities that will be trained in standard first aid and adult CPR. These personnel will also be familiar with Baker's program for potential exposure to bloodborne pathogens as outlined in the Baker Safety SOPs in Attachment A. Subcontractors will be responsible for securing proper medical attention for their employees. Baker may assist the subcontractor, if necessary.

8.8.1 Physical Injury

If an employee working in a contaminated area is physically injured, first aid procedures are to be followed. Depending on the severity of the injury, emergency medical response from NSRR Naval Hospital personnel may be sought to stabilize victim for transport to the Base hospitals. If the employee can be moved, he/she will be taken from the Exclusion Zone to the CRZ and decontaminated, if necessary (refer to Section 8.9). Then, if circumstances permit, administer emergency first aid and transport to an awaiting ambulance or to a local emergency medical facility.

8.8.2 Chemical Injury

If the injury to a worker is chemical in nature (e.g., direct contact/exposure), the following first aid procedures are to be instituted:

- Eye Exposure - If contaminated solid or liquid gets into the eyes, wash the eyes immediately at the 15-minute emergency eyewash station (or with the emergency eye wash bottle when an eye wash station is not available). Obtain medical attention immediately.

  NOTE: Contact lenses will not be worn while working at any site.

- Skin Exposure - If contaminated solid or liquid gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If solids or liquids penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately.

- Swallowing - If contaminated solid or liquid has been swallowed, immediately contact the Florida Poison Information Center at (813) 253-4444. Do not induce vomiting in an unconscious person. Obtain medical attention as directed by the Poison Control Center.

- Breathing - If a person has difficulty breathing, move the exposed person to fresh air at once. If breathing is not evident, check for pulse and perform appropriate first aid, either rescue breathing or CPR, depending on the condition. Obtain medical attention immediately.

Procedures to follow in the event of a chemical exposure are included in Attachment D.

8.9 Emergency Decontamination Procedures

In the event of a medical emergency, patients are to be adequately decontaminated before transfer (if possible) to prevent contamination of the medical transport vehicle and medical facility. Emergency personnel decontamination will include the following, depending on the level of protection.*

Level D	Level D+	Level C
• Equipment drop • Tape, boot, and glove removal • Coverall removal	• Equipment drop • Tape, outer boot, and glove removal • Coverall removal/ disposal • Inner glove removal/ disposal	• Equipment drop • Tape, outer boot, and glove removal • Coverall removal/ disposal • Respirator removal • Inner glove removal/ disposal

* If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination and wrap injured personnel with clean garments/blankets to avoid contaminating other personnel or transporting equipment.

All emergency personnel are to be immediately informed of the injured person's condition, potential contaminants, and provided with all pertinent chemical data.

If necessary, one of the site personnel equipped with appropriate PPE may accompany the injured worker and perform decontamination with supervision of medical personnel.

8.10 Personal Protection and First Aid Equipment

PPE available for emergency response will include the following:

- Polyvinyl chloride boots
- Tyvek® suits, polyethylene coated and uncoated
- Nitrile gloves (inner and outer)
- Neoprene and Nitrile Gloves (outer)
- Face shields and goggles

PPE and first aid equipment will be available in the support zone (i.e., Baker Field Vehicle or Baker Field Trailer).

Emergency and first aid equipment can be found at the following locations:

Fire Extinguisher:	Baker Field Trailer and Contractor Field Vehicle
First aid kit:	Baker Field Trailer and Baker Field Vehicle
Emergency eye wash bottle:	Baker Field Trailer and Baker Field Vehicle
Air Horn:	With Personnel
15-minute Emergency Eye Wash Station:	Near Area With Greatest Potential for Chemical Splash/Exposure

8.11 Notification

If the Emergency Coordinator determines that the site has an uncontrolled situation, such as a spill, fire, or explosion, that could threaten human health or the environment, the coordinator will immediately call the Fire Department, the Activity Contact, the Project Manager, and the NTR as soon as possible. The notification report will include:

- Description of incident (e.g., release, fire).
- Name and telephone number of individual reporting the emergency.
- Location of incident.
- Name and quantity of material (s) involved (if known).
- The extent of injuries and number of casualties.
- The possible hazards to human health or the environment and recommended cleanup procedures.
- Assistance that is requested.

8.12 Hazard Assessment

The Emergency Coordinator will assess possible hazards to human health or the environment that may result from an uncontrolled situation, to the best of the individual's abilities, incorporating the following steps, as appropriate.

- Assess the immediate need to protect human health and safety.

- Identify the materials involved in the incident including exposure and/or release pathways and the quantities of materials involved.

- Inform appropriate personnel, as identified in Section 8.10, who will determine if release of material(s) meets USEPA requirements for reportable quantities for spills under the RCRA or CERCLA.

This assessment may consider both the direct and indirect effects of the chemical release, fire, explosion, or severe weather conditions (e.g., the effects of any toxic, irritating, or asphyxiating gases that are liberated).

8.13 Security

During activation of these Emergency Procedures, the Emergency Coordinator or his/her designated representative will control access to the site and maintain an incident log until the appropriate personnel, such as the Navy On Scene Commander, arrives and takes control. The incident log will include:

- Activities that have occurred since the incident was first reported.
- Tasks currently being performed and where.
- Rescue and response equipment used.
- Protective equipment being used.

8.14 Emergency Alerting

This section outlines the emergency alerting procedures, according to the location and type of emergency.

Personnel Injury in the Work Zone:

- Initiate a verbal warning or one long airhorn blast and move all unaffected site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).

- Send the rescue team into the Work Zone (if required) to remove the injured person to the hotline.

- Have the SHSO and/or Site Manager evaluate the nature of the injury and assure that the affected person is decontaminated according to Section 8.9.

- If required, contact an ambulance and/or the designated medical facility.

In all situations when an on-site emergency results in evacuation of the Work Zone, personnel shall not reenter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The HASP has been reviewed and, if appropriate, modified.
4. Site personnel have been briefed on any changes in the HASP.

Personnel Injury in the Support Zone:

- The Site Manager and SHSO will assess the nature of the injury; if the cause of the injury or loss of the injured person does not affect the performance of other site personnel, operations may continue.

- If the injury increases the risk to others, a verbal warning or one long airhorn blast shall be sounded and all remaining site personnel will move to the command post for further instructions.

- Activities on site will stop until the added risk is mitigated.

Fire/Explosion:

- Initiate a verbal warning or one long airhorn blast and move all site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).

- Alert the fire and security departments and move all nonessential personnel to the Baker Command Post to await further instructions.

- Activities will stop until the added risk is mitigated.

Personal Protective Equipment Failure:

- If any site worker experiences difficulty, failure, or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately cease work activities, leave the Work Zone, and repair or replace the defective equipment.

- Reentry will not be permitted until the equipment has been repaired or replaced.

Other Equipment Failure:

- If any other equipment on site fails to operate properly, the Field Team Leader shall notify the Site Manager and SHSO to determine the effect of this failure on site operations. If the failure affects the safety of site personnel, work with the equipment will cease until the situation is evaluated and appropriate actions taken.

8.15 Training

Site personnel will read the details in the Emergency Procedures prior to the pre-entry briefing. The Emergency Procedures will be reviewed by site personnel during the pre-entry briefing and will be rehearsed on a monthly basis or as needed.

8.16 Spill Containment Procedures

In the event that a small (less than the reportable quantity), easily-controlled spill of hazardous substances (gasoline, oil, etc.) occurs during the implementation of field activities, spill containment will be utilized to prevent the additional migration of contaminants through the site area. Large, uncontrolled spills will be handled by qualified response organizations under the direction of the Base and/or Navy On-Scene Commander. Any release to soils or surface waters equaling or exceeding the reportable quantities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (40 CFR 302) or the USEPA Clean Water Act (40 CFR 116 and 117) will be reported to the Activity contact who in turn will report it to the appropriate authorities.

Specific spill containment procedures will be dependent on the type of materials spilled and the type of environment affected. Potential spill containment procedures may include diking with absorbent material/pads, then removal or containment of the contaminated materials. Spill containment materials will be located within close proximity to the storage area of the hazardous substances in a manner such that the pathway remains accessible and free of obstructions. Spill containment materials available on site may include:

- Vermiculite
- Ground corn cobs
- Dirt or sand
- Shovel

9.0 TRAINING REQUIREMENTS

Training requirements for site personnel are outlined in the sections below.

9.1 General

All Baker employees, subcontractors, or other personnel entering the site will need to have received training in compliance with the OSHA Standard 29CFR 1910.120. Baker employees engaged in field activities which potentially expose workers to hazardous substances receive a minimum of 40 hours of instruction off site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. Key points of the 40 hour training include field demonstrations, respiratory fit testing and training, risk assessment, toxicology, chemical reactivity, use of monitoring equipment, downrange work procedures, site safety procedures, levels of protection, protective clothing, decontamination, and practical field exercises (e.g., donning, doffing, and working in personal protective ensembles for personal protection Levels A, B, and C).

In addition to the initial 40-hour training program, Baker requires site employees to receive an annual 8-hour refresher training course on the items specified by the 29 CFR 1910.120 standard. The general purpose of the 8-hour refresher is to ensure that personnel retain the knowledge necessary to be adequately protected and stay current with proper site health and safety procedures.

Baker also requires that personnel involved with on-site employee supervision receive, in addition to 40 hours initial training and three days of supervised field experience, at least eight additional hours of specialized training at the time of job assignment. Training topics include, but are not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques. The 8-hour supervisory training is required to ensure that supervisors have the knowledge necessary to understand and use the various Health and Safety Programs and to implement the elements of the HASP. Table 9-1 provides the appropriate OSHA Training History for Baker Project Personnel.

9.2 Site-Specific Training

Site-specific training, as discussed in Section 1.3, will consist of an initial health and safety briefing on the following information:

- Names of individuals responsible for site health and safety and methods of communicating safety and health concerns.
- Roles and responsibilities of site personnel.
- Site-specific health and safety hazards.
- Use of PPE.
- Work practices by which employees can minimize risk.
- Safe use of equipment on site.
- Recognition of symptoms and signs of exposure to hazardous materials.
- Site control measures.
- Decontamination procedures.
- Emergency procedures.

The SHSO will conduct the initial site-specific training prior to the initiation of field activities for each new area under investigation.

10.0 MEDICAL SURVEILLANCE REQUIREMENTS

This Site-Specific HASP will require that project personnel, who may be exposed to materials having potentially adverse and deleterious health effects, obtain medical clearance from Baker's Board Certified Occupational Health Physician in accordance with 29 CFR 1910.120(f) prior to entry onto the site. Baker's corporate medical surveillance program establishes a medical baseline and monitors for symptoms of overexposure for individuals who participate in Preliminary Assessments, Site Inspections, Remedial Investigations, Feasibility Studies, and construction-phase services at sites covered by the Department of Labor, OSHA, Hazardous Waste Operations and Emergency Response Standard, 29 CFR 1910.120. Additionally, the program is intended to determine the individual's capability for performing on-site work, including wearing chemical protective clothing and respiratory protective equipment.

All Baker employees that will be engaged in site activities covered by the 1910.120 standard receive a Group III physical examination by a Board Certified Occupational Health Physician who has provided information on the individual's site activities and exposure or anticipated exposure levels. This exam is received initially upon hire, then once every 12 months thereafter. More frequent medical examinations, consultations, and/or laboratory testing will be provided if the examining physician determines that an increased frequency of examination is required. A complete Group III medical exam includes parameters such as height, weight, vision, temperature, blood pressure, and a complete review of occupational and medical histories. Other tests in a Group III exam include chest x-rays, electrocardiogram, spirometry, urinalysis, and blood tests. Table 10-1 describes the medical surveillance testing parameters performed annually on Baker employees. The need for additional monitoring depending on site conditions will be evaluated on a case-by-case basis.

Prior to entry onto the site, all personnel, including subcontractors, will be required to provide medical clearance information from their company physician to the SHSO stating that they are physically capable of performing the activities required.

11.0 HEALTH AND SAFETY PLAN APPROVAL

This HASP has been reviewed by the following personnel prior to submission to LANTDIV.

Barbara Cummings	PHSO	_____
Name (print)	Title (print)	Signature
Chris Boes	Project Manager	_____
Name (print)	Title (print)	Signature
Joseph Rozum	Technical Review	_____
Name (print)	Title (print)	Signature

12.0 DECLARATION OF HEALTH AND SAFETY PLAN REVIEW

All site personnel indicated below have reviewed and are familiar with this Health and Safety Plan for the RFI and NSRR.

(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)

SECTION 3.0
TABLES

TABLE 3-1

CHEMICAL/PHYSICAL PROPERTIES OF CONSTITUENTS DETECTED DURIGN PREVIOUS SAMPLING AT NSRR

Chemical	Media	Location	Exposure Limit (EL)[a]	N.F.P.A. Rating[b]			Vapor Pressure[c]	Specific Gravity[d]	Ionization Potential (eV)
				H	F	R			
Volatile Organic Compounds:									
Benzene	Groundwater and Soil	SWMUs 2 and 9	1 ppm (CA)	2	3	0	76 mm	0.880	9.24
1,2-dichloroethene	Groundwater	SWMU 3	50 ppm 100 ppm-C (CA)	2	3	2	260 mm	1.280	9.65
Ethylbenzene	Soil	SWMU 2	100 ppm	2	3	0	9 mm	0.867	8.76
Toluene	Groundwater, Soil, Surface Water, and Sediments	SWMUs 2 and 9	200 ppm	2	3	0	30 mm	0.866	8.82
Polynuclear Aromatic Hydrocarbons:									
Coal Tar Pitch Volatiles	Soil	SWMUs 2, 31, and 32	0.2 mg/m^3 (CA)	--	--	--	NA	NA	NA
Polychlorinated Biphenyls:									
as Arochlor 1254	Soil	SWMUs 11 and 46	0.5 mg/m^3 (CA and Skin)	--	--	--	0.00006 mm	1.38 (at 77°F)	NA

(a) EL - Exposure Limit = A time-weighted average concentration for a normal eight-hour work day and 40-hour work week to which nearly all workers may be repeatedly exposed day after day without expected adverse effect. The EL represents published Exposure Levels according to the following hierarchical order: (1) OSHA PELs; (2) NIOSH RELs; (3) ACGIH TLVs; and, (4) other recognized sources.

(b) National Fire Protection Association rating for Health (H), Flammability (F), and Reactivity (R) from 0 (insignificant) to 4 (highly significant)

(c) Vapor Pressure = Expressed as mm/Hg at STP (unless otherwise mentioned).

(d) Specific Gravity = At 68°F (unless otherwise mentioned).

CA - Suspected or Proven Carcinogen

NA - Not Available

ppm - parts per million (in air)

mg/m^3 - milligrams per cubic meter (in air)

Skin - Potential significant contribution to the overall exposure by the cutaneous route

C - Ceiling value

TABLE 3-1 (Continued)

CHEMICAL/PHYSICAL PROPERTIES OF CONSTITUENTS DETECTED DURIGN PREVIOUS SAMPLING AT NSRR

Chemical	Media	Location	Exposure Limit (EL)[a]	N.F.P.A. Rating[b]			Vapor Pressure[c]	Specific Gravity[d]	Ionization Potential (eV)
				H	F	R			
Pesticides:									
Aldrin	Soil	SWMU 2	0.25 mg/m³ (CA and skin)	2	0	0	0.00008 mm	1.60	NA
Benzene Hexachloride (as Lindane)	Soil	SWMUs 1 and 2	0.5 mg/m³ (CA and skin)	2	1	0	0.00001 mm	1.85	NA
Chlordane (gamma)	Soil, Surface Water, Sediments, and Groundwater	SWMU 13	0.5 mg/m³ (CA and skin)	--	--	--	0.00001 mm	1.56 (at 77°F)	NA
DDT (including DDD and DDE)	Soil, Surface Water, Sediments, and Groundwater	SWMUs 1, 2, 13, 31, and 32	1 mg/m³ (CA and skin)	--	--	--	Low	0.99	NA
Endosulfan (I) II	Soil	SWMUs 2 and 13	0.1 mg/m³ (skin)	--	--	--	NA	NA	NA
Endrin	Soil	SWMU 2	0.1 mg/m³ (skin)	3	1	0	Low	1.70	NA
Heptachlor	Groundwater	SWMU 1	0.5 mg/m³ (CA and skin)	--	--	--	0.0003 mm (at 77°F)	1.66	NA
Inorganics:									
Arsenic (as inorganic arsenic)	Soil	SWMU 2	10 µg/m³ (CA)	3	1	0	0 mm	5.73	NA

(a) EL - Exposure Limit = A time-weighted average concentration for a normal eight-hour work day and 40-hour work week to which nearly all workers may be repeatedly exposed day after day without expected adverse effect. The EL represents published Exposure Levels according to the following hierarchical order: (1) OSHA PELs; (2) NIOSH RELs; (3) ACGIH TLVs; and, (4) other recognized sources.

(b) National Fire Protection Association rating for Health (H), Flammability (F), and Reactivity (R) from 0 (insignificant) to 4 (highly significant)

(c) Vapor Pressure = Expressed as mm/Hg at STP (unless otherwise mentioned).

(d) Specific Gravity = At 68°F (unless otherwise mentioned).

CA - Suspected or Proven Carcinogen
NA - Not Available
ppm - parts per million (in air)
mg/m³ - milligrams per cubic meter (in air)
Skin - Potential significant contribution to the overall exposure by the cutaneous route
C - Ceiling value

TABLE 3-1 (Continued)

CHEMICAL/PHYSICAL PROPERTIES OF CONSTITUENTS DETECTED DURIGN PREVIOUS SAMPLING AT NSRR

Chemical	Media	Location	Exposure Limit (EL)[a]	N.F.P.A. Rating[b]			Vapor Pressure[c]	Specific Gravity[d]	Ionization Potential (eV)
				H	F	R			
Barium (as soluble compounds)	Soil	SWMU 2	0.5 mg/m^3	1	0	2	Low	3.24 to 3.86	NA
Chromium (as Chromium III)	Soil	SWMUs 31 and 32	0.5 mg/m^3	3	0	1	NA	NA	NA
Copper (as dusts/mists)	Soil	SWMU 2	1 mg/m^3	--	--	--	0 mm	8.94	NA
Lead (as inorganic lead)	Soil, Surface Water, and Sediment	SWMUs 2, 9, 11, 31, and 32	50 µg/m^3 (CA)	--	--	--	0 mm	11.34	NA
Zinc (as zinc oxide, respirable function)	Soil	SWMUs 2, 31, and 32	5 mg/m^3	--	--	--	0 mm	5.61	NA

(a) EL - Exposure Limit = A time-weighted average concentration for a normal eight-hour work day and 40-hour work week to which nearly all workers may be repeatedly exposed day after day without expected adverse effect. The EL represents published Exposure Levels according to the following hierarchical order: (1) OSHA PELs; (2) NIOSH RELs; (3) ACGIH TLVs; and, (4) other recognized sources.

(b) National Fire Protection Association rating for Health (H), Flammability (F), and Reactivity (R) from 0 (insignificant) to 4 (highly significant)

(c) Vapor Pressure = Expressed as mm/Hg at STP (unless otherwise mentioned).

(d) Specific Gravity = At 68°F (unless otherwise mentioned).

CA - Suspected or Proven Carcinogen
NA - Not Available

ppm - parts per million (in air)
mg/m^3 - milligrams per cubic meter (in air)

Skin - Potential significant contribution to the overall exposure by the cutaneous route
C - Ceiling value

TABLE 3-2

CHEMICAL EXPOSURE INFORMATION FOR CONSTITUENTS DETECTED DURING PREVIOUS SAMPLING AT NSRR

Substance	Routes of Entry[1]	Health Hazard
Volatile Organic Compounds:		
Benzene	Inhalation, absorption, ingestion, skin/eye contact	Cumulative bone marrow damage; suspect leukemogen
1,2-dichloroethene	Inhalation, ingestion, skin/eye contact	Narcosis; CNS effects
Ethylbenzene	Inhalation, ingestion, skin/eye contact	Moderate irritation of the eye, nose and throat; narcosis
Toluene	Inhalation, absorption, ingestion, skin/eye contact	Moderate irritation of the eyes, nose, and throat; narcosis; suspect teratogen; mutagen
Polynuclear Aromatic Compounds:		
as Coal Tar Pitch Volatiles	Inhalation, skin/eye contact	Cumulative lung changes; suspect carcinogen
Polychlorinated Biphenyls as Arochlor 1254	Inhalation, absorption, ingestion, skin/eye contact	Cumulative liver change; chloracne; suspect carcinogen
Pesticides:		
Aldrin	Inhalation, absorption, ingestion, skin/eye contact	Cumulative liver damage; suspect carcinogen; CNS depression
Benzene Hexachloride (Lindane)	Inhalation, absorption, ingestion, skin/eye contact	Cumulative liver and CNS damage; suspect carcinogen and mutagen
Chlordane	Inhalation, absorption, ingestion, skin/eye contact	Cumulative liver damage; suspect carcinogen
DDT (including DDD and DDE)	Inhalation, absorption, ingestion, skin/eye contact	Chronic and cumulative toxicity; mutagen; suspect carcinogen
Endosulfan II	Inhalation, absorption, ingestion, skin/eye contact	Acute CNS toxin; cumulative kidney damage; suspect carcinogen; cumulative kidney damage
Endrin	Inhalation, absorption, ingestion, skin/eye contact	Suspect carcinogen; acute CNS toxicity
Heptachlor	Inhalation, absorption, ingestion, skin/eye contact	Cumulative liver damage; suspect carcinogen; CNS effects

TABLE 3-2 (Continued)

CHEMICAL EXPOSURE INFORMATION FOR CONSTITUENTS DETECTED DURING PREVIOUS SAMPLING AT NSRR

Substance	Routes of Entry[1]	Health Hazard
Inorganics:		
Arsenic (as inorganic arsenic)	Inhalation, absorption, ingestion, skin/eye contact	Cumulative systemic poison; suspect carcinogen
Barium (as soluble compounds)	Inhalation, ingestion, skin/eye contact	Acute lung and gastrointestinal effects, baritosis
Chromium (as Chromium III)	Ingestion, skin/eye contact	Cumulative lung damage; suspect carcinogen
Copper (as dusts/mists)	Inhalation, ingestion, skin/eye contact	Mild irritation of the eyes, nose, throat and skin
Lead (as inorganic lead)	Inhalation, ingestion, skin/eye contact	Cumulative blood effects; cumulative neurologic effects; reproductive hazards
Zinc (as zinc oxide, respirable function)	Inhalation	Acute systemic toxicity (metal fume fever); mutagen

(1) Routes of entry are not listed in order as to greatest or least hazard potential.

SECTION 5.0
TABLES

TABLE 5-1

MONITORING EQUIPMENT AND FREQUENCY FOR EACH TASK CONDUCTED AT NSRR

Field Activity	PID [1]	Drager Colorimetric Tubes [1]		Oxygen/ Combustible Gas Meter	MINIRAM
		[67 28561] Benzene	[67 28781] Sulfuric Acid		
Sediment/Surface Water Sampling	I&P	A	A		
Land Surveying	D				
Geophysical Investigation	D				
Surface Soil Sampling	I&P	A	A		
Monitoring Well Installation	C	A	A	I&P	C
Monitoring Well Development	I&P				
Groundwater Sampling/Slug Test	I&P	A	A		
Soil Gas Survey	I&P	D	D		I&P
Soil Boring Sampling	C	A	A	I&P	C
Test Pit/Trenching	C	D	D	I&P	C
Tanker/Roll-Off Box Sampling	I&P	D	D		
Wipe Sampling	D	D	D		

I = Initially - At start of job task to confirm designated protection level.
P = Periodically - When site condition or set-up changes, or when a new area is entered.
C = Continuously - Monitor levels continuously (at a minimum every 15 minutes).
D = At the discretion of the SHSO.
A = According to action levels.
PID = Photoionization Detector

Note: As air concentrations are measured, they should be documented in the individual's field logbook.

[1] Refer to the manufacturer's operating manual and Baker SOP prior to operation.

SECTION 9.0
TABLES

TABLE 9-1

OSHA TRAINING HISTORY OF BAKER PROJECT PERSONNEL*

Personnel	Title/Role	Training Status	
Chris Boes	• Project Manager	• 40-hr. training completed:	2/88
		• Supervisory training:	5/91
		• 8-hr. refresher completed:	8/95
		• First Aid Training:	3/94
		• CPR Training:	7/95
		• Medical surveillance:	5/95
Barbara Cummings	• Project Health and Safety Officer	• 40-hr. training completed:	10/91
		• Supervisory training:	9/91
		• 8-hr. refresher completed:	4/95
		• First Aid Training:	11/94
		• CPR Training:	11/94
		• Medical surveillance:	5/95
(to be provided in the Final HASP Submission)	• Site Manager/Project Geologist	• 40-hr. training completed:	
		• Supervisory training:	
		• 8-hr. refresher completed:	
		• First Aid Training:	
		• CPR Training:	
		• Medical surveillance:	
(to be provided in the Final HASP Submission)	• Site Health and Safety Officer/ Field Team Leader	• 40-hr. training completed:	
		• Supervisory training:	
		• 8-hr. refresher completed:	
		• First Aid Training:	
		• CPR Training:	
		• Medical surveillance:	
(to be provided in the Final HASP Submission)	• Environmental Scientist	• 40-hr. training completed:	
		• Supervisory training:	
		• 8-hr. refresher completed:	
		• First Aid Training:	
		• CPR Training:	
		• Medical surveillance:	

* Training history for contractor personnel will be maintained at the Command Post.
NA - Not Applicable

SECTION 10.0
TABLES

TABLE 10-1

MEDICAL SURVEILLANCE TESTING PARAMETERS*

Group II - Individuals Occasionally in the Field (10-30 days/year)

- Medical History (Physical Exam)
- Eye Exam
- EKG (baseline and for individuals over 40 years of age)
- Chest X-ray (baseline then every 5 years)
- Spirometry
- CBC with differential
- SMA 12 or 26 (liver enzyme scan)

Group III - Individuals Frequently in the Field (>30 days/year)

- Medical History (Physical Exam)
- Eye Exam
- EKG (baseline then annually for individuals over 40 years of age)
- Audiometry
- Chest X-ray (baseline then every 3 years)
- Spirometry
- CBC with differential
- SMA 12 or 26 (liver enzyme scan)
- Urinalysis (glucose scan)
- Specific Blood and Urine Tests (dependent on field exposure)**

Group III with Asbestos - Individuals frequently in the field whom also work with asbestos

- Group III testing with the Asbestos Medical Questionnaire w/Pulmonary Function Test ($FVC_{1.0}$ and $FEV_{1.0}$)

* The attending physician has the right to reduce or expand the medical monitoring on an annual basis as he/she deems necessary.

** To be performed for individuals identified by the attending physician as being chronically exposed to organic compounds.

SECTION 4.0
FIGURES

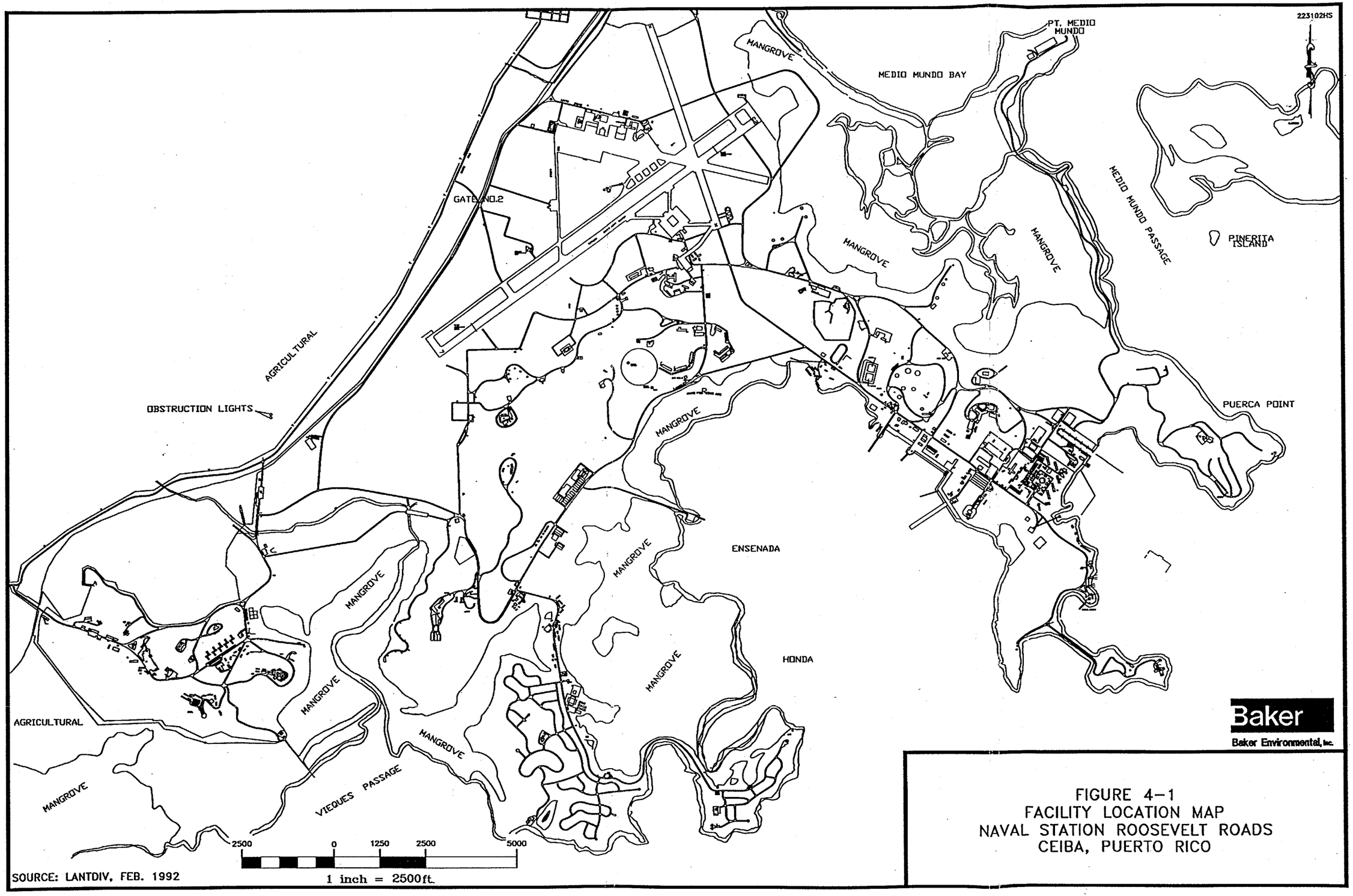


FIGURE 4-1
FACILITY LOCATION MAP
NAVAL STATION ROOSEVELT ROADS
CEIBA, PUERTO RICO

00171B01Z

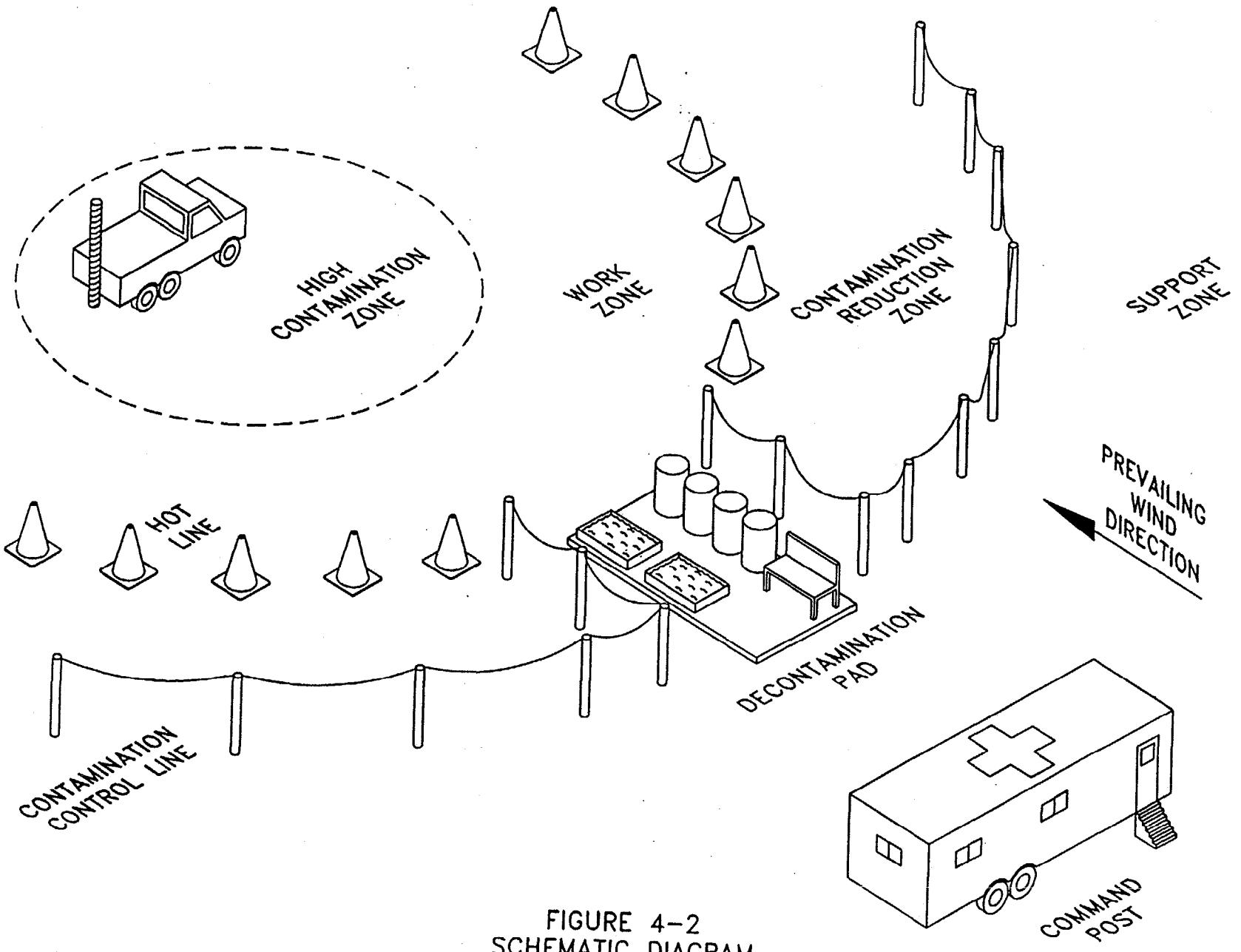


FIGURE 4-2
SCHEMATIC DIAGRAM
GENERAL CONTAMINATION
REDUCTION ZONE LAYOUT

Baker
Baker Environmental, Inc.

211202WP

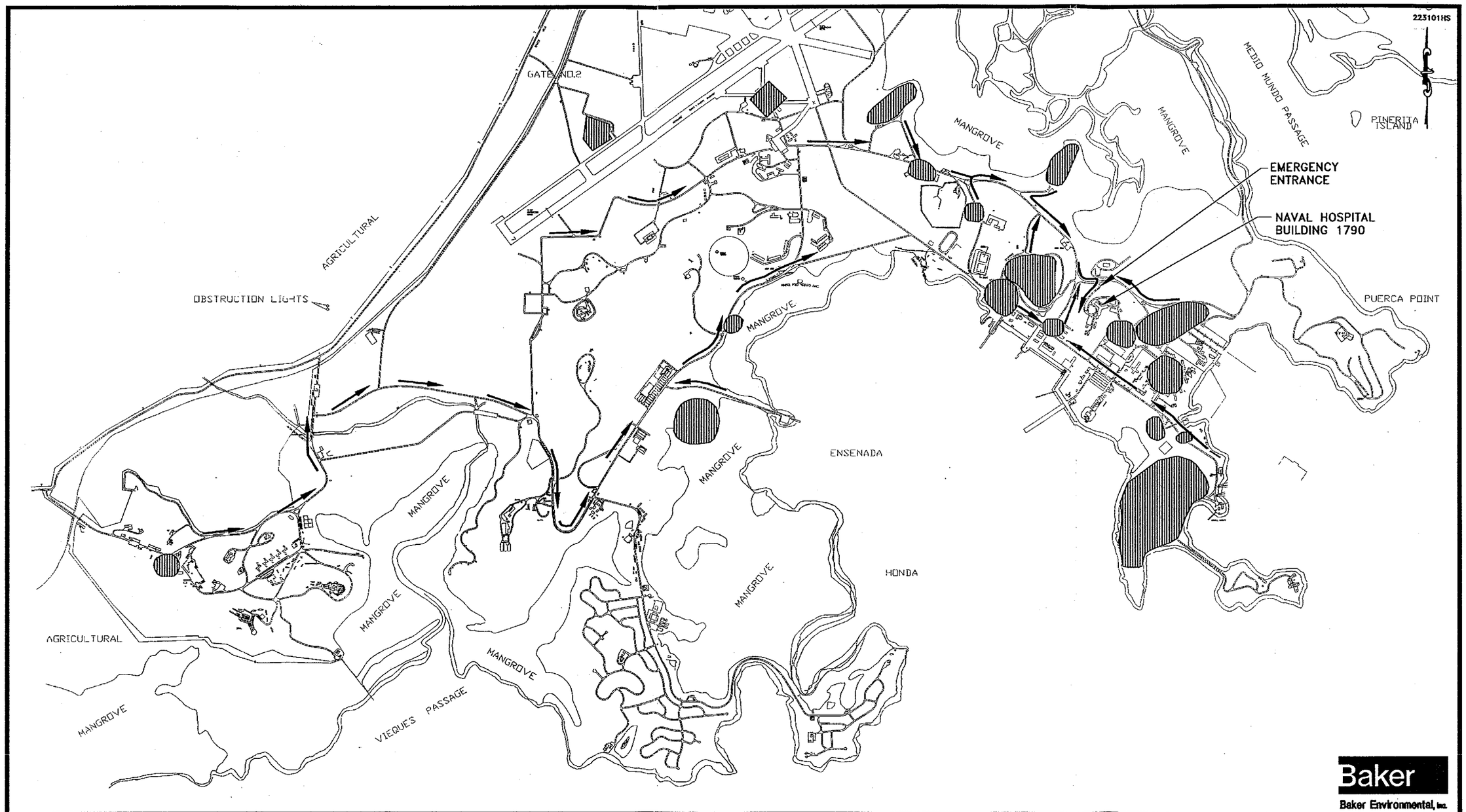
SECTION 8.0
FIGURES

FIGURE 8-1

EMERGENCY TELEPHONE NUMBERS

NSRR	Telephone Number On-Base Phone	Telephone Number Off-Base Phone	Contact*
Security (Police)	4195	(809) 865-4195	
Fire (On-Scene Commander)	4100	(809) 865-4100	
Ambulance (On-Base)	4144	(809) 865-4144	
Ambulance (Extreme Emergencies)	(9) 721-6999	(809) 721-6999	
Hospital (On-Base)	4133	(809) 865-4133	
Hospital (Extreme Emergencies)	(9) 721-6999	(809) 721-6999	
General Information	2000	(809) 865-2000	
Public Works	4429	(809) 865-4429	Ms. Madeline Rivera
Florida Poison Information Center	(9) 813-253-4444	(813) 253-4444	Response Operator
National Response Center	(9)1-800-424-8802	1-800-424-8802	Response Operator
CHEMTREC	(9)1-800-424-9300	1-800-424-9300	Response Operator
ASTDR	(9)404-639-9615	(404)639-0615	Response Operator
Baker Project Manager	(9)412-269-2065	(412)269-2065	Mr. Thomas Fuller
LANTDIV NTR	(9)804-322-4795	(804)322-4795	Mr. Art Wells

* Remaining points of contact will be identified prior to the start of activities.



LEGEND

SWMU AND/OR AOC

SOURCE: LANTDIV, FEB. 1992

2500 0 1250 2500 5000

1 inch = 2500ft.

FIGURE 8-2
EMERGENCY HOSPITAL ROUTE FOR
SWMU AND AOC INVESTIGATIONS
AT NAVAL STATION ROOSEVELT ROADS
CEIBA, PUERTO RICO

00171B037

FIGURE 8-3

EMERGENCY MEDICAL SERVICES

Chemical and Nonchemical Exposure Incidents

The nearest hospital is:

Name	NSRR Naval Hospital
Address	Building 1790
On-Base Telephone No.	4133
Off-Base Telephone No.	(809) 865-4133

Local ambulance service is available from:

Name	NSRR Naval Hospital
On-Base Telephone No.	4144
Off-Base Telephone No.	(809) 865-4144

Extreme Emergency

In instances of extreme emergency, or for "stable patient transfer" to nearby public hospitals or those located in the continental United States, contact will be made with Aero Ambulance Service of San Juan, Puerto Rico (Main Offices are in Fort Lauderdale, Florida). The SHSO and Site Manager will serve as the primary contacts, however, site personnel will be permitted to make contact in extreme emergencies.

Emergency Telephone Numbers:	Aero Ambulance Transport (ask for Jacob) (809) 721-6999 (San Juan Office) (800) 443-8042 (Fort Lauderdale Office)

Attachment A
Baker Environmental, Inc.
Safety Standard Operating Procedures

ATTACHMENT A

BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES*

TABLE OF CONTENTS

1.0 Confined Space Entry Program**

2.0 Respiratory Protection Program

3.0 Care and Cleaning of Personal Protective Equipment

4.0 Bloodborne Pathogens

5.0 Heat Stress

6.0 Cold Stress**

7.0 Safe Boat Operations

*To be provided in Final HASP submission

**Not Applicable

Baker
Baker Environmental, Inc.

2.0 - RESPIRATORY PROTECTION PROGRAM

This Respiratory Protection Program presents the elements necessary for administering a successful program. Attached at the end of this program is a copy of the following Baker Environmental, Inc. (Baker) forms:

- Qualitative Respirator Fit Test Record
- Air-Supplying Respirator Inspection Form
- Air-Purifying Respirator Inspection Form

2.1 PURPOSE

The purpose of the Baker Respiratory Protection Program is to govern the selection and use of respiratory protection by Baker personnel. This program is also designed to meet requirements of the Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910.134 and 1926.103, "Respiratory Protection."

2.2 SCOPE

This program applies to Baker SRN personnel including temporarily-assigned SRI and SII personnel who may be involved with potential respiratory hazards as part of their job duties. This program outlines the procedures to follow when respiratory equipment is required.

2.3 RESPONSIBILITY

Baker provides the necessary respiratory equipment to protect the safety and health of each Baker employee. The Baker SRN Project Health and Safety Officer (PHSO) and Project Manager are responsible for identifying the need for this Respiratory Protection Program at project sites. The Baker Site Health and Safety Officer (SHSO) and Site Manager are responsible for implementing and administering the Respiratory Protection Program in the field. Baker employees are to use and maintain the respiratory protection provided in accordance with training received and instructions outlined in this program.

2.4 HAZARD ASSESSMENT

The key elements of a respiratory protection program must start with an assessment of the inhalation and ingestion hazards present in the work area. Because Baker's services involve a variety of environmental and industrial hygiene studies, it is not practical to identify all possible hazards to which all employees could be exposed within the scope of this document. Therefore, it is essential that a task specific assessment be conducted prior to the initiation of any activities on a given project. This task specific assessment shall be part of the site-specific Health and Safety Plan (HASP).

After a task-specific assessment is completed and it is determined that there is a potential for airborne exposure concentrations to exceed the recommended limits, engineering and administrative controls should be implemented. If the exposure cannot be reduced, or it is not feasible to reduce

the airborne exposure below the recommended limits, respirators will be selected by the PHSO and/or SHSO on the basis of:

- Toxicity
- Maximum expected concentration
- Oxygen levels
- Warning properties of the substance(s) involved
- Sorbent limitations
- Facepiece fit
- Mobility requirements
- Type of use (routine, escape, or emergency entry)
- Possibility of ingestion of toxic materials
- Respirator attributes

2.5 TRAINING

Each respirator wearer shall be given training, by a qualified individual, which will include explanations and discussions of:

- Opportunity to wear respiratory protection in an uncontaminated environment.
- Respirator fit testing (qualitative)
- The respiratory hazard(s) and what may occur if the respirator is not used properly.
- The reasons for selecting a particular type of respirator.
- The function, capabilities, and limitations of the selected respirator.
- The method of donning the respirator and checking its fit and operation.
- The proper wearing of the respirator.
- Respirator maintenance, repair, and cleaning.
- Recognizing and handling emergency situations.

Employees who have attended the 40-hour training in accordance with 29 CFR 1910.120 (HAZWOPER) will be provided with the basic information necessary to comply with the OSHA training requirements and will only need to attend a supplementary session provided by qualified Baker personnel. The annual HAZWOPER 8-hour refresher will serve to reinforce these issues on an annual basis. Records of the training and fit-testing will be maintained for a minimum of 30 years following termination of employment for each employee.

2.6 TYPES OF RESPIRATORS

Baker purchases and provides, as necessary, the following respirators:

- North half-face (Model 7700) and full-face (Model 7600) air-purifying respirators

- North positive pressure 30-minute Self-Contained Breathing Apparatus (SCBAs) (Model 800)

- North positive pressure supplied airline respirators with 5-minute escape air cylinders (Model 85500).

- MSA Ultra Twin full-face respirator (Model 480263)

- MSA Comfo II half-face respirator (Model 479529)

Only respiratory equipment certified by the appropriate approval agencies (e.g., NIOSH, MSHA) according to Title 30, Part II of the Code of Federal Regulations, will be distributed to Baker employees. All Baker employees who regularly perform tasks requiring respiratory protection will be issued their own half-face and/or full-face respirator, provided the employee can achieve a proper fit and is medically capable of wearing the equipment.

Because 30-minute SCBAs, positive pressure supplied airline respirators, and 5-minute escape air cylinders are used less frequently, this equipment will be distributed on an as-needed basis.

2.7 AIR QUALITY

Compressed air used for respiration shall be of high purity. Breathing air shall meet at least the requirements of the specification for Grade D Breathing Air (or higher) as described in Compressed Gas Association Commodity Specification G-7.1-1966. Breathing air may be supplied to respirators from cylinders; oxygen must never be used with air-line respirators.

Air cylinders shall be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR Part 178). Air-line couplings shall be incompatible with outlets for other gas systems to prevent inadvertent servicing of air-line respirators with nonrespirable gases or oxygen.

Breathing gas containers (air cylinders) shall be marked in accordance with American National Standard Method of marking Portable Compressed Gas Containers to Identify the Material Contained, A48.1-1954; Federal Specification BB-A-1034a, June 21, 1968, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG-B00675b, April 27, 1965, Breathing Apparatus, Self-Contained.

Breathing air, as supplied by air compressors, shall be of high purity and meet the requirements of the specification for Grade D Breathing air (or higher) as described in Compressed Gas Association Commodity Specification G-7.1-1966.

The compressor for supplying air shall be equipped with necessary safety and standby devices. A breathing air-type compressor shall be used. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system and suitable in-line air-purifying sorbent beds and filters installed to further assure breathing air quality. A receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in the event of compressor failure, and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor shall be frequently tested for carbon monoxide to insure that it meets the specifications outlined above.

2.8 CLEANING AND MAINTENANCE

Respiratory equipment that is used on an as-needed basis shall be maintained by qualified personnel. This equipment shall be cleaned/sanitized, then rinsed and air-dried, after each use.

Respiratory equipment that has been issued to an employee shall be cleaned/sanitized then rinsed and air-dried by the wearer, (specified by OSHA in 29 CFR 1910.134) which ensures that it will be maintained in clean and good operating condition. Inspections shall be conducted on a regular basis during usage and prior to each project requiring the potential usage of the equipment.

All respirators shall be stored in a plastic bag within a cool/dry location, in a manner that will protect them against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. They shall be stored to prevent distortion of rubber or other elastomer parts. Cartridges will not be stored while attached to an air-purifying respirator at anytime.

Parts replacement and repairs shall be performed only by appropriate personnel. Equipment requiring repairs shall be reported to appropriate Baker personnel. Examples of inspection forms are included at the end of this text.

2.9 INSPECTIONS

At the time of cleaning, and before and after each use, respirators will be inspected. Deteriorated components will be replaced before the respirator is placed back into service, or the respirator will be replaced. Repair components must be obtained from the manufacturer of the respirator to maintain the NIOSH certification. Emergency-use respirators and self-contained breathing apparatuses (SCBAs) will be inspected after each use or at a minimum, once a month. Sample inspection forms for both air-purifying respirators and air supplying respirators are attached. These forms are required to be completed each time a respirator is inspected. However, during field projects in which a field logbook is in use, personnel may enter the appropriate information into their field logbook as an alternative to the inspection form. A list of the items to be covered during an inspection are as follows:

- Air-Purifying Respirator (full or half-face)
  - Face Piece
    - -- Clean and sanitized?
    - -- Cracks, tears or holes absent?
    - -- Proper shape and flexibility retained?
    - -- Air-purifying element holders intact?
    - -- Stored properly, free from heat, dirt, and sunlight?
  - Headstraps or Headbands
    - -- Signs of wear or tears?
    - -- Buckles function properly?
  - Respirator Interior
    - -- Foreign material under valve seat?
    - -- Cracks or tears in valves/valve bodies?
    - -- Valve covers/bodies installed properly?
- Supplied Air Respirators
  - Cylinder undamaged?
  - Facepiece and hoses undamaged?
  - Connections undamaged?

- Apparatus complete?
- Facemask cleaned and sanitized?
- Hoses and connections cleaned?

Note: The date and the initials of the qualified individual performing the inspection must be entered into the field logbook.

2.10 FIT-TESTING

Each respirator wearer shall be provided with a respirator that can properly form a secure face-to-mask seal. Each wearer shall be fit-tested prior to issuance of the respirator using either an irritant smoke or odorous vapor, or other suitable test agent (see example of form at end of text). Retesting shall be performed, at a minimum, on an annual basis or if a different model respirator, other than the model the wearer was previously fit-tested for, is to be used. Air-purifying respirators fit-tested qualitatively will be assigned a protection factor of 10 (APF = 10). A copy of Baker's Fit-Test Form is attached.

Facial hair, which interferes with the normally effective face to mask seal, is prohibited. Each respirator wearer shall be required to check the seal of the respirator by negative and positive pressure checks prior to entering a harmful atmosphere.

2.11 MEDICAL SURVEILLANCE

Personnel who are or may be assigned to tasks requiring use of respirators shall participate in a medical surveillance program on an annual basis. The medical surveillance program shall include, but may not be limited to, a history of respiratory disease, work history, a physical exam, and spirometry conducted by the company's physician and at the expense of the company. These parameters are conducted prior to fit testing an employee on a negative pressure respirator. Test parameters included in Baker's medical surveillance program are in each site-specific HASP.

2.12 LIMITATIONS

Wearing any respirator, alone or in conjunction with other types of protective equipment, will impose some physiological stress on the wearer. Therefore, selection of respiratory protective devices will be based on the breathing resistance, weight of the respirator, the type and amount of protection needed as well as the individual's tolerance of the given device. Additional concerns regarding the limitations of different types of PPE and the monitoring requirements for heat stress/strain will be addressed in the "Heat Stress" SOP.

2.13 SUBCONTRACTOR REQUIREMENTS

In compliance with Baker's respiratory protection program, all subcontractors under the direction of Baker personnel will be expected to comply with pertinent sections of OSHA Standards 1910.134 and 1926.103. Additionally, the subcontractor will be required to:

- Provide documentation that their employees have been fit-tested on the air-purifying respirator the employee is expected to use.

- Provide documentation that their employees have been medically certified to wear a respirator.

3.0 - CARE AND CLEANING OF PERSONAL PROTECTIVE EQUIPMENT

3.1 INTRODUCTION

The following procedures cover the care and cleaning of Levels D, D+, C, and B personal protective equipment (PPE). Note: These are general procedures that apply to most situations and are not all inclusive. Procedures are subject to change at the direction of the Site Health and Safety Officer (SHSO).

3.2 INSPECTION

Proper inspection of personal protective equipment (PPE) features several sequences of inspection depending on articles of PPE and its frequency of use as follows:

- Inspection and operational testing of PPE received from the factory or distributor.
- Inspection of PPE as it is issued to workers.
- Inspection after use or training, and prior to maintenance.
- Periodic inspection of stored equipment.
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

The primary inspection of PPE in use for activities at the site will occur prior to immediate use, will be conducted by the user to ensure that the specific device or article has been checked out by the user, and that the user is familiar with its use.

3.2.1 Chemical Resistant Suit (Levels D+ through B)

- Determine if suit is the one specified in the Site Health and Safety Plan (HASP)
- Before donning, inspect suit for holes or tears; check to see that zippers are operable and look for signs of suit degradation.
- When wearing, avoid contact with contaminated material where possible; be aware of sharp objects that can tear suit; periodically look over suit to check for major rips or tears.
- While decontaminating, remove gross excess of material from suit; remove suit so that material does not contact inner suit; place clothing in properly labeled disposal containers.

3.2.2 Inner/Outer Gloves (Levels D+ through B)

- Determine if gloves meet the specifications in the site HASP.
- Look for rips, tears, or degradation of material. Replace as necessary or at the direction of the SHSO.

3.2.3 Chemically Resistant Boots (Levels D+ through B)

- Determine if boots meet the specifications in the site HASP.
- Nondisposable boots are to be examined on a daily basis before and after use. Disposable boots should be examined prior to donning and while in use, and disposed according to site procedures.

3.2.4 Safety (Steel Toe and/or Shank) Boots (Levels D through B)

- Examine daily for gouges, open seams, etc., anything that would lessen the integrity of the boot. Replace as boot becomes worn.

3.2.5 Hard Hats (Levels D through B)

- Should be visually inspected before donning for fit, cracks, and overall condition.

3.2.6 Safety Glasses/Goggles (Levels D through C)

- Should be visually inspected before donning for cracks, deteriorated parts, and overall condition. Replace as necessary.

3.2.7 Respirators (Levels D+ through B)

- Procedures for care of respiratory protective equipment are covered in Baker's SOP for Respiratory Protection.

3.2.8 Hearing Protection (Levels D through B)

- Disposable - Replace daily, or as material becomes worn or dirty.
- Reusable - Inspect before use, clean regularly, replace parts as necessary.

3.3 EQUIPMENT CLEANING

General procedures for cleaning of equipment are listed below. Site-specific concerns will be addressed by the SHSO prior to and during site activities. Cleaning of respiratory equipment is covered under the "Respiratory Protection Program" SOP.

3.3.1 Gross Physical Removal

Remove large amounts of contaminated soil or sediment by scraping off with a tongue depressor or other suitable instrument, then wipe off using a disposable wipe/paper towel.

3.3.2 Physical/Chemical Removal

Remove residual contamination with a soft-bristled, long-handled brush or equivalent using a nonphosphate detergent solution.

3.3.3 Rinsing/Dilution

The detergent solution and residual contaminants will be rinsed with distilled/tap water using a pressurized sprayer, a tub filled with clean wash water, or equivalent.

3.4 EQUIPMENT STORAGE

Storage of PPE is an important aspect to the daily care and cleaning therefore, the following considerations should be observed:

- Different types of PPE shall be stored in a clean and dry environment, free from elements that could damage PPE.
- PPE shall be stored and labeled so that site personnel can readily select the specified PPE.
- Contaminated, nondisposable PPE shall be decontaminated before returning to the storage area.
- Contaminated, disposable PPE shall not be returned to the storage trailer, but disposed according to the provisions identified in the Site Work Plans.

Baker

Baker Environmental, Inc.

4.0 - BLOODBORNE PATHOGENS (Safe Handling of First Aid Incidents)

4.1 PURPOSE

The purpose of the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard, Title 29 CFR Part 1910.1030, is to protect workers from bloodborne pathogens such as the (HIV) and (HBV) by reducing or eliminating workers' exposure to blood and other potentially infectious materials. Although HIV and HBV are specifically mentioned by OSHA, the standard includes any bloodborne pathogen, such as Hepatitis C, malaria, and syphilis. The standard requires the employer to develop a written exposure control plan that will reduce or eliminate employee exposure, thus reducing their risk of infection.

The purpose of the Baker Environmental (Baker) exposure control plan is to minimize the possibility of transmission of bloodborne pathogens in the workplace by establishing procedures for the safe handling of first aid incidents that may expose personnel to blood or other potentially infectious materials.

4.2 SCOPE

All Baker SRN personnel who may be exposed to blood or other potentially infectious materials as part of their job duties (e.g., those certified in Standard First Aid) are required to follow the guidelines set forth in this SOP. The exposure control plan shall be reviewed and updated at least annually, to reflect new or modified tasks and procedures that affect occupational exposure, and to reflect new or revised employee positions with occupational exposure.

4.3 RESPONSIBILITY

The Baker Project Health and Safety Office (PHSO) and Project Manager are responsible for providing support and administering this exposure control plan as necessary, from the corporate office. The Baker Site Health and Safety Officer and Site Manager are responsible for implementing this exposure control plan at project sites for their employees.

4.4 DEFINITIONS

Bloodborne Pathogens - Pathogenic microorganisms that may be present in human blood, having the potential to cause disease in humans. Two examples of bloodborne pathogens include, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Contaminated - Means the presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Decontamination - Physically or chemically removing, inactivating, or destroying bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles, so that the surface or item is rendered safe for handling, use, or disposal.

Exposure Incident - A specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that result from the performance of an employee's duties.

Occupational Exposure - Reasonably anticipated skin, eye, mouth, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

Other Potentially Infectious Materials - Includes the following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; any unfixed tissue or organ (other than intact skin) from a human; and HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Parenteral - Piercing of the mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

Regulated Waste - OSHA defines a regulated waste as a liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid state if compressed; items caked with dried blood or other potentially infectious materials that are capable of release of these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials.

4.5 PROCEDURES FOR EXPOSURE TO BLOODBORNE PATHOGENS

The sections below will discuss the means by which Baker personnel can determine exposure potential, modes of transmission, methods of compliance, medical monitoring, and post exposure procedures.

4.5.1 Exposure Determination

The exposure determination is based upon the job classifications with occupational exposure potential, and the activities in which these exposures can occur, as follows.

Job Classifications

- Site Manager/Site Safety and Health Officer
- Environmental Scientists
- Geologists
- Other Baker Field Personnel

Exposure Activities

- Response to first aid incidents involving site personnel
- Decontamination of personnel, personal protective equipment, work surfaces, and equipment potentially exposed to blood or other potentially infectious materials

4.5.2 Modes of Virus Transmission in the Workplace

Modes of virus transmission are similar for the viruses of concern. Primarily, virus transmission occurs as the result of direct blood contact from percutaneous inoculation, contact with an open wound, non-intact skin (e.g. chapped, abraded, or dermatitis), or mucous membranes to blood, blood-contaminated body fluids, or concentrated virus. Protective measures for workers will focus on preventing exposure to blood and other body fluids that can result from an injury or sudden illness.

4.5.3 Methods of Compliance

4.5.3.1 Universal Precautions

The unpredictable and emergent nature of exposures likely to be encountered on a site may make differentiation between hazardous body fluids and those that are not hazardous very difficult. Thus, all employees will observe "Universal Precautions" to prevent contact with blood or other potentially infectious materials. These "Universal Precautions" stress that all blood or other potentially infectious materials will be treated as if they are known to be infectious.

The universal precautions will include:

(1) Cover the skin, especially open cuts, scrapes, skin rashes, or other broken skin.

(2) Don't touch objects that could be contaminated, such as blood-covered surfaces, clothing or linens.

(3) Cover mucous membranes (i.e., mouth, nose, and eyes).

(4) Prevent direct contact with sharps, such as needles, scalpels, or broken glass that could pierce or puncture your skin.

(5) Clean and decontaminate surfaces, containers, and equipment that may have been exposed to blood or other body fluids.

4.5.3.2 Standard Work Practices

Standard work practices are to be implemented at all times by all employees who may be exposed to blood or other potentially infectious materials. Work practices are defined as specific policies or procedures whose purpose is to reduce the potential for employee exposure to bloodborne pathogens. Work practices for use by site personnel are described in the balance of this section.

Personal Hygiene

All exposed employees will observe the following hygienic practices:

- During or immediately after exposure to blood or other potentially infectious materials; do not eat, drink, chew gum, chew tobacco, smoke, apply cosmetics, balms or medications, or any other activity that increases the potential for hand-to-mouth, mucous membrane, or skin contact.

- Following exposure to blood or other potentially infectious materials, personnel will wash their hands and any other exposed skin with a disinfectant soap and water after removal of chemical-protective gloves or other personal protective equipment (PPE). This will be performed before eating, urinating, defecating, applying make-up, smoking or undertaking any activity that may result in increased potential for hand to mouth, mucous membrane, or skin contact.

Personal Protective Equipment

The basic premise for wearing the appropriate PPE is that site personnel must be protected from exposure to blood and other potentially infectious materials. Appropriate PPE is available to all site personnel.

Responders to a medical emergencies will have access to the appropriate PPE. The PPE will be present in the site trailer and field vehicles. The PPE should be used in accordance with the level of exposure encountered. Minor lacerations or small amounts of blood do not merit the same extent of PPE use as required for massive arterial bleeding. Management of the patient who is not bleeding, and has no bloody body fluids, should not routinely require the use of PPE.

The following PPE will be present in each Baker Field Vehicle and/or the Baker Site Trailer.

1. Disposable chemical-protective gloves (i.e, nitrile or latex)
2. Resuscitation equipment*
3. Safety glasses, goggles, or faceshields
4. Tyvek® coveralls

* Resuscitation Equipment - Because the risk of salivary transmission of infectious disease during artificial ventilation of trauma victims, pocket mouth-to-mouth resuscitation masks will be present in the first aid kits. The pocket mouth-to-mouth resuscitation masks are designed to isolate response personnel from contact with the victims' blood and blood-contaminated saliva, respiratory secretions, and vomitus.

Decontamination procedures will follow those outlined in each site HASP.

Handling Regulated Wastes

With the exception of contaminated sharps, all other regulated wastes must be placed in closable, color-coded, labeled containers that prevent leakage of fluids. All applicable federal and state regulations must be followed for transporting and disposing of the wastes.

Training and Education

All employees with the potential for occupational exposure will receive initial training on the safe handling of first aid incidents during first aid/CPR Instruction, and subsequently during HASP briefings. See Appendix A for the suggested Bloodborne Pathogens Training Outline.

4.5.4 Medical Monitoring

All Baker personnel will follow the guidelines established by Baker's Board Certified Occupational Health Physician in association with EMR, Inc.

4.5.5 Post-Exposure Procedures and Follow-Up management

The following subsections presents the procedures to follow when a first aid incident occurs involving the presence of blood or other potentially infectious material; specific steps need to be taken to safeguard the health of Baker site personnel.

4.5.5.1 First Aid Incident Report

If there is a reasonable cause to believe that a potential exposure to blood or other potentially infectious materials has been experienced, the employee must complete the steps listed below. These steps are required when non-HBV vaccinated first aid responders participate and regardless of whether an actual "exposure incident" occurred.

1. Immediately notify the SHSO. The SHSO will determine whether an "exposure incident" occurred.

2. Wash area of contamination and remove contaminated clothing to ensure that no further contamination will occur.

3. All parties involved will complete the Supervisors Incident Report Form and the incident will be reported to Baker's Human Resources office.

Baker employees who render first aid where blood or other potentially infectious materials are present must be seen by a designated EMR physician within 24 hours of the incident. The employee must take a copy of the Supervisors Incident Report Form and a copy of OSHA Standard 1910.1030 to the physician.

Employees who respond to first aid incidents involving the presence of blood or other potentially infectious materials where the determination was made that an "exposure incident" occurred, have 90 days following baseline blood level collection to decide if they wish to have their blood tested for HIV.

The confidential medical evaluation and follow-up will include:

1. The circumstances of the exposure.

2. If consent has been obtained testing of the source individual's blood in order to determine HIV and/or HBV infectivity. If consent is not obtained this will be documented in writing.

3. If consent has been obtained, the exposed employee's blood will be tested.

The occupational health physician will provide the employer with a confidential written opinion that includes verification that the employee has been informed of the results of the evaluation and also includes a recommendation for further evaluation or treatment. A copy of this written opinion will be provided within 15 days following the medical evaluation.

4.5.5.2 "Good Samaritan" Behavior

The OSHA standard does not cover "good samaritan" behavior. However, employees who provide first aid as "good samaritans" should receive the same post incident evaluation either through an EMR designated physician or their personal physician.

4.6 REFERENCES

OSHA Title 29 CFR Part 1910.1030

U.S. Department of Labor, U.S. Department of Health and Human Services. Joint Advisory Notice: protection against occupational exposure to Hepatitis B virus and human immunodeficiency virus. Federal Register 1987; 52:41818-24.

Centers for Disease Control. Update on hepatitis B prevention. MMWR 1987; 36:353-360,366.

Centers for Disease Control. Update: Acquired immunodeficiency syndrome and human immunodeficiency virus infection among health- care workers. MMWR 1988; 37:229-34, 239.

OSHA Instruction CPL 2-2.44, February 13, 1992, Enforcement Procedures for the Occupational Exposure to Bloodborne Pathogens Standard.

Appendix A

SUGGESTED BLOODBORNE PATHOGENS TRAINING OUTLINE

I. **Introduction**

- A. Purpose of the training program
- B. Overview: Bloodborne Pathogen Standard 29 CFR 1910.1030
  - 1. Applicability to Site Personnel
  - 2. General requirements
  - 3. Overview of Baker exposure control plan

II. **Bloodborne Diseases**

- A. Types
- B. Modes of Transmission

III. **Baker Exposure Control Plan**

- A. Purpose
- B. Plan availability
- C. Bloodborne pathogen hazard recognition steps
  - 1. Concept of universal precautions
  - 2. Blood and other potentially infectious materials
- D. Potential exposure minimization
  - 1. Work practices
  - 2. Personal protective equipment
  - 3. Hygienic practices
- E. Procedures for decontamination
  - 1. Personnel
  - 2. Personal protective equipment (PPE)
    - a. Tasks and procedures requiring PPE
    - b. Location of PPE
    - c. Disposal of PPE
  - 3. Equipment
  - 4. Work surfaces
- F. Medical monitoring
  - 1. Baker medical monitoring program
  - 2. Post exposure evaluation procedures
    - a. First aid incident report
    - b. HBV and non-HBV vaccinated responders
    - c. Exposure incidents (defined)
    - e. Confidential medical evaluation
- G. Emergency Preparedness
  - 1. First aid kits
  - 2. Personal injury

5.0 - HEAT STRESS

5.1 INTRODUCTION

Heat stress in the hazardous waste industry usually is a result of protective clothing decreasing natural body ventilation, although it may occur at any time work is being performed at elevated temperatures. If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physiological reactions can occur, ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal.

5.2 CAUSES AND SYMPTOMS

The following heat stress causes and symptoms are provided for buddy monitoring purposes. Site personnel must realize that monitoring the physical condition of fellow personnel in Levels D+ through B protective ensembles will be more difficult.

1. *Heat rash* results from continuous exposure to heat or humid air and chafing clothes. The condition decreases the ability to tolerate heat. Symptoms include a mild red rash.

2. *Heat cramps* are caused by heavy sweating and inadequate fluid intake. Symptoms include muscle spasms and pain in the hands, feet, and abdomen.

3. *Heat exhaustion* occurs when body organs attempt to keep the body cool, due to inadequate fluid intake and personnel not acclimated to the environment. Symptoms include pale, cool, moist skin; heavy sweating; dizziness, headaches, and vomiting.

4. *Heat stroke* is the most serious form of heat stress. It is a MEDICAL EMERGENCY. Symptoms are red, hot, dry skin; lack of perspiration; nausea; dizziness and confusion; strong, rapid pulse rate; and coma.

The need to seek medical attention and the urgency in seeking medical attention depends on the symptoms and the severity of the symptoms displayed by the affected individual. If *heat stroke* is noted or suspected, medical attention must be sought IMMEDIATELY. Efforts should be taken to cool the body to prevent serious injury or death.

5.3 PREVENTION

Because heat stress is one of the most common and potentially serious illnesses at hazardous waste sites, regular monitoring and other preventive measures are vital. Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventive heat stress management. In general:

- Monitor for signs of heat stress.

- Fluid intake should be increased during rest schedules to prevent dehydration. Drinking cool water (maintained at 50 to 60°F) is satisfactory when light sweating occurs and temperatures are moderate to cool; however, diluted electrolyte solutions (i.e., Gatorade, Sqwincher, or equivalent) must be used in addition to water under one or all of the following conditions: continued or heavy sweating, moderate to high ambient temperatures, or heavy work loads. The intake of coffee during working hours is discouraged.

- Acclimate workers to site work conditions by slowly increasing workloads (i.e., do not begin site work activities with extremely demanding activities).

- Use cooling devices to aid natural body ventilation. These devices, however, add weight and their use should be balanced against worker efficiency. An example of a cooling aid is a cooling vest that can be worn under clothing, but not against the skin.

- In extremely hot weather, conduct field activities in the early morning and evening.

- Ensure that adequate shelter is available to protect personnel against heat that can decrease physical efficiency and increase the threat of heat stress. If possible, set up the command post in a shaded area, and encourage breaks in shaded areas.

- In hot weather, rotate shifts of workers wearing impervious clothing.

- Good hygienic standards must be maintained by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult the SHSO.

5.4 MONITORING

Provisions for monitoring for heat stress will be determined by the SHSO and performed as outlined below. Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

5.4.1 Monitoring for Permeable Clothing

For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If the actual clothing work differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.

The guidelines to follow for workers above as determined by the SHSO are as follows:

1. Increased awareness of heat stress symptoms and buddy monitoring.

2. Fluid intake discipline.

3. Self monitoring of urine output quantities to prevent dehydration.

4. Attention to work-rest intervals.

5. Calculate the Heat Exposure Threshold Limit Value (TLV) for work-rest intervals using the following steps:

   a. Determine the Wet Bulb Globe Temperature (WBGT) Index using the Quest® Heat Stress Monitor.

   b. Estimate the work load using the following guidelines:

      (1) Light work = sitting or standing to control machines, performing light hand or arm work.

      (2) Moderate work = walking about with moderated lifting and pushing.

      (3) Heavy work = pick and shovel work.

   c. Evaluate the calculations against the following Heat Exposure TLVs* in °C or (°F).

Work - Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% work - 25% rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% work - 50% rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% work - 75% rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

Special Considerations

- Acclimatization - After approximately one to two weeks, workers should be acclimated to their environment.

- Fitness - Physically fit workers will adjust more readily to a change in environment.

- Medication - Some medications can predispose individuals to heat-induced illnesses.

5.4.2 Semipermeable/Impermeable Clothing Monitoring

For workers wearing semipermeable or impermeable clothing encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C).

To monitor the worker, use one or more of the following methods:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
  - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
  - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
  - If oral temperatures still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
  - Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss. Measure weight on a scale accurate to ±0.25 pound at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or preferably in underwear only. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work. The length of work cycle will be governed by the frequency of the required physiological monitoring.

5.5 CARING FOR HEAT-RELATED ILLNESS

To care for heat-related illness provide the following:

- Remove victim from heat.
- Loosen tight clothing.

- Apply cool, wet cloths to the skin.
- Fan the victim.
- If victim is conscious, give cool water to drink.
- Call for an ambulance or transport to hospital if heat stroke is suspected, victim refuses water, vomits, or starts to lose consciousness.

7.0 – SAFE BOAT OPERATIONS

This Safe Boating Operations Program presents the Baker Environmental, Inc. (Baker) safe boat operating procedures. The elements addressed in this procedure include purpose, scope, responsibilities, equipment, terms, and general safe practices.

7.1 PURPOSE

The intent of the Baker Safe Boating Operations Program is to establish requirements for safe boat operating procedures to protect personnel from potential hazardous situations. This program is also designed to address elements of the United States (U.S.) Department of Transportation, U.S. Coast Guard Federal Requirements for Recreational Boats.

7.2 SCOPE

This program applies to Baker SRN projects in which Baker personnel may be involved with sampling activities from boats as part of their job duties. This program contains requirements for practices and procedures to protect these employees from the hazards of boating operations.

7.3 RESPONSIBILITY

The Baker SRN Project Health and Safety Officer (PHSO) and Project Manager are responsible for implementing and administering this Safe Boat Operations Program at project sites. The Baker Site Health and Safety Officer (SHSO), Site Manager, and field personnel are responsible to adhere to these procedures.

7.4 TERMS

Bailer – manual device (portable bilge pump, bucket scoop, etc.) for bailing water.

Bow – The forward part of a boat.

Port – The left side of a vessel as one faces the front or bow.

Starboard – The right hand side of a vessel as one faces the front or bow.

Stern – The rear or aft part of a boat.

Type I PFD – personal flotation device rating; it is effective for all waters, especially open, rough or remote waters where rescue may be delayed. It is designed to turn most unconscious wearers in the water to a faceup position.

Type II PFD – personal flotation device rating; intended for calm, inland water or where there is a good chance of quick rescue.

Type III PFD - personal flotation device rating, good for calm, inland water, or where there is a good chance of quick rescue. It is designed so wearers can place themselves in a face-up position in the water.

Type IV PFD - personal flotation device rating; throwable device intended for inland water with heavy boat traffic, where help is always present. It is designed to be thrown to a person in the water and grasped and held by the user until rescued. Type IV devices include buoyant cushions, ring buoys, and horseshoe buoys.

7.5 GENERAL SAFE PRACTICES

The following list consists of general safe practices during sampling activities from a boat. These safe practices are intended as a guideline for field personnel to recognize.

1. Safe boat operation training can be conducted during the site health and safety plan (HASP) pre-entry briefing. Training procedures for personal who will use a boat to conduct sampling at a minimum consist of the following dot listed items.

   - Fire safety - including fire extinguisher use
   - Distribution of weight and movement of personal inside the boat
   - Sounding distress or warning signals
   - Engine operation and mixing of fuel
   - Heat exposure
   - Rescue techniques
   - Sampling procedures

2. Personnel must be cognizant of current weather conditions by checking weather reports before leaving shore and watchful for signs of bad weather. Sampling from boats should not be conducted during inclement weather conditions, such as, heavy rains, electrical storms or flooding.

3. A minimum of two people should comprise the sampling crew, however, the maximum capacity rating for the boat should not be exceeded. Only one person should move on the boat at any one time.

4. The motor should be turned off during sampling, anchoring, or when entry or exit from the boat takes place.

5. Each Baker boat should be inspected annually by a qualified individual. These inspections should be documented and any safety concerns addressed before the boat is used on any other projects.

6. Equipment listed in Section 7.6 of this program should be maintained of the boat and inspected to assure good operating conditions.

7. PFDs must be Coast Guard-approved, in good and serviceable condition, and of appropriate size for the intended user. Wearable PFDs must be readily accessible, meaning the crew must be able to put them on in a reasonable amount of time in an emergency (boat sinking, on-board fire, etc.). The PFDs should not be stowed in

plastic bags, in locked or closed compartments or have other gear stowed on top of them.

8. All boating accidents must be reported to the Baker PHSO and Project Manager as soon as possible.

7.6 EQUIPMENT

The following equipment is required to be available on each boat.

- 2-pound ABC type fire extinguisher
- First aid kit
- Minimum of two oars
- Knife
- Type I, Type II, or Type III PFD for each crew member
- Bailer
- One Type IV throw flotation device with 50 feet of line
- Anchor with 75 feet of line
- Waste containers
- Safety kill switch connected to driver
- Air horn, flashlight and orange flag
- Poly-coated tyvek or rainsuit
- Towels

7.7 HYPOTHERMIA

The effects of cold water can cause hypothermia to the body within minutes. Signs and symptoms of hypothermia are:

- Shivering
- Loss of coordination
- Lethargy
- Coma

A poly-coated tyvek or rainsuit can be used to help maintain body temperatures while transporting back to shore any individual who had fallen overboard.

Attachment B
Material Safety Data Sheets for Constituents Detected During Previous Sampling at Naval Station Roosevelt Roads

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

Issued: 11/78 **Revision: E, 8/90**

Section 1. Material Identification

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 4
S 2*
K 4
*Skin absorption

NFPA
3 / 2 / 0 / -

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8
Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
% Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	Autoignition Temperature: 928 °F (498 °C)	LEL: 1.3% v/v	UEL: 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.
Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."
Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection **References:** 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Section 1. Material Identification

1,2-Dichloroethylene Description: An industrial solvent composed of 60% cis- and 40% trans-isomers. Both isomers, cis and trans, are made by partial chlorination of acetylene. Used as a general solvent for organic materials, lacquers, dye extraction, thermoplastics, organic synthesis, and perfumes. The trans-isomer is more widely used in industry than either the cis-isomer or the mixture. Toxicity also varies between the two isomers.

Other Designations: CAS No. 0540-59-0; $C_2H_2Cl_2$; acetylene dichloride; *cis*-1,2-dichloroethylene; *sym*-dichloroethylene; *trans*-1,2-dichloroethylene, dioform.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[75] for a suppliers list.

R 1
I 2
S 2
K 1

NFPA

HMIS
H 2
F 3
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

1,2-Dichloroethylene, ca 100%

OSHA PEL
8-hr TWA: 790 mg/m³, 200 ppm

ACGIH TLV, 1989-90
TLV-TWA: 790 mg/m³, 200 ppm

NIOSH REL, 1987
790 mg/m³, 200 ppm

Toxicity Data*
Rat, oral, LD_{50}: 770 mg/kg; toxic effects not yet reviewed
Frog, inhalation, TC_{Lo}: 117 mg/m³ inhaled for 1 hr affects the peripheral nerve and sensation (flaccid paralysis without anesthesia); behavior (excitement); lungs, thorax, or respiration (respiratory depression)

* See NIOSH, *RTECS* (KV9360000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: 119 °F/48 °C
Melting Point: -56 to -115 °F/-49 to -82 °C
Vapor Pressure: 180 to 264 torr at 68 °F/20 °C
Vapor Density (Air = 1): 3.4
Molecular Weight: 96.95 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 1.27 at 77 °F/25 °C
Water Solubility: Insoluble

Appearance and Odor: A colorless, low-boiling liquid with a pleasant odor.

Section 4. Fire and Explosion Data

Flash Point: 37 °F/2.8 °C, CC	Autoignition Temperature: 860 °F/460 °C	LEL: 5.6% v/v	UEL: 12.8% v/v

Extinguishing Media: Use dry chemical, CO_2, halon, water spray, or standard foam. Water may be ineffective unless used to blanket the fire.

Unusual Fire or Explosion Hazards: This material's vapors are a dangerous fire hazard and moderate explosion hazard when exposed to any heat or ignition source or oxidizer.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit. Vapors may travel to heat or ignition sources and flash back. Stay upwind and out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: This material is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: This material is incompatible with alkalies, nitrogen tetraoxide, difluoromethylene, strong oxidizers, and dihypofluorite. When in contact with copper or copper alloys or by reaction with potassium hydroxide, explosive chloroacetylene may be released.

Conditions to Avoid: Addition of hot liquid to cold 1,2-dichloroethylene may cause sudden emission of vapor that could flash back to an ignition source.

Hazardous Products of Decomposition: Thermal oxidative decomposition of 1,2-dichloroethylene can produce highly toxic fumes of chlorine (Cl^-).

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists 1,2-dichloroethylene as a carcinogen.
Summary of Risks: 1,2-Dichloroethylene's most important effect is its irritation of the central nervous system (CNS) and narcosis. This material is toxic by inhalation, ingestion, and skin contact. It is also irritating to the eyes. The trans-isomer at 2200 ppm causes nausea, vertigo, and burning of the eyes. The trans-isomer is twice as potent as the cis-isomer. If renal effects occur, they are transient.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Central nervous system, eyes, respiratory system.
Primary Entry Routes: Inhalation, ingestion, skin and eye contact.
Acute Effects: Inhalation of 1,2-dichloroethylene causes narcosis, respiratory tract irritation, nausea, vomiting, tremor, weakness, central nervous depression, and epigastric (the abdomen's upper midregion) cramps. Contact with the liquid causes eye and skin (on prolonged contact) irritation. Ingestion causes slight depression to deep narcosis.
Chronic Effects: None reported.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Have trained personnel administer 100% oxygen, preferably with humidification.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Intravenous injections of calcium gluconate may relieve cramps and vomiting. Treat central nervous system effects symptomatically.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a 1,2-dichloroethylene spill control and countermeasure plan (SCCP).* Notify safety personnel, remove all heat and ignition sources, evacuate hazard area, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Absorb small spills on paper towels. After evaporating the 1,2-dichloroethylene from these paper towels in a fume hood, burn the paper in a suitable location away from combustible material. Collect and atomize large quantities in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 100 lb (45.4 kg) [* per RCRA, Sec. 3001, per Clean Water Act, Sec. 307(a)]†
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)
† Listed as 1,2-*trans*-dichloroethylene.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. 1,2-dichloroethylene attacks some forms of plastics, rubber, and coatings.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and oxidizing materials. Outside or detached storage is preferred. If stored inside, place containers in a standard flammable liquids storage cabinet or room. Protect containers from physical damage.
Engineering Controls: Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. 1,2-dichloroethylene is a dangerous fire hazard. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement questionnaires which emphasize detecting a history of chronic respiratory disease.
Transportation Data (49 CFR 172.101, .102): Not listed

***MSDS Collection* References:** 7, 26, 38, 73, 84, 85, 87, 88, 100, 101, 103, 109, 126, 127, 136, 137
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:
Sheet No. 385
Ethylbenzene
Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA
3 / 2 / 0 / -

HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta* & *para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 125 ppm (545 mg/m^3)
Action Level: 50 ppm (217 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.[179]

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm

Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0768 lb/ft^3 or 1.2298 kg/m^3

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	Autoignition Temperature: 810 °F (432 °C)	LEL: 1.0% v/v	UEL: 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was intolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm^2/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 µg/cm^2/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, test for EB in expired air for confirmation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detatched storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
DOT Packing Group: II
DOT Label: Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: —

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179
Prepared by: M Gannon, BA; Industrial Hygiene Review: D Wilson, CIH; Medical Review: W Silverman, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 317
Toluene

Issued: 8/79 Revision: E, 9/92

Section 1. Material Identification

Toluene ($C_6H_5CH_3$) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.
Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA

HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

1991 OSHA PELs
8-hr TWA: 100 ppm (375 mg/m^3)
15-min STEL: 150 ppm (560 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH RELs
TWA: 100 ppm (375 mg/m^3)
STEL: 150 ppm (560 mg/m^3)

1992-93 ACGIH TLV (Skin)
TWA: 50 ppm (188 mg/m^3)

1990 DFG (Germany) MAK*
TWA: 100 ppm (380 mg/m^3)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D

Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0797 lb/ft^3 or 1.2755 kg/m^3
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	Autoignition Temperature: 896 °F (480 °C)	LEL: 1.27% v/v	UEL: 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm^2/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. Death may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, transient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and alcohol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and kidney dystrophy (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend. **FIRST AID** Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: hippuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and fluorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Blue gill, LC_{50} = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), LC_{50} = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 36.2 mg/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **Disposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon absorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
Listed as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 100 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 200 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric and thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Toluene
DOT Hazard Class: 3
ID No.: UN1294
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 150
b) Non-bulk Packaging: 202
c) Bulk Packaging: 242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
Vessel Stowage: B
Other: --

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; Industrial Hygiene Review: PA Roy, CIH, MPH; Medical Review: AC Darlington, MD, MPH

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 757
Coal Tar Creosote

Issued: 7/91

Section 1. Material Identification

Coal Tar Creosote (molecular formula varies with purity) Description: Three main derivations: by distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking. It typically contains up to 160 chemicals, mainly aromatic compounds such as phenol, pyrol and pyridine. Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, hop defoliant, and lubricant for die molds; in manufacturing chemicals; and in medicine as an antiseptic, disinfectant, antipyretic, astringent, germicide, and styptic.
Other Designations: CAS No. 8001-58-9, Awpa,* brick oil, Caswell No. 225,* coal tar oil, creosote, creosote oil, creosotum, cresylic creosote, heavy oil, liquid pitch oil, naphthalene oil, Preserv-o-sote,* Sakresote,* tar oil, wash oil.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(TM) for a suppliers list.
Cautions: Flammable, liquid coal tar creosote is toxic by inhalation, ingestion, and skin contact. The IARC and NTP classify it as *a human carcinogen.*

R 1
I 4
S 4*
K 2
* Skin absorption

NFPA
2 / 2 / 0 / -

HMIS
H 2
F 2
R 0
PPG†
† Sec. 8

* Skin absorption can occur with phenol, a major component of coal tar creosote.

Section 2. Ingredients and Occupational Exposure Limits

Coal tar creosote, ca 100%

1990 OSHA PEL
8-hr TWA: 0.2 mg/m³*

1990-91 ACGIH TLV
TWA: 0.2 mg/m³*

1987 IDLH Level
700 mg/m³

1990 NIOSH REL
0.1 mg/m³ (cyclohexane extractable portion)

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 725 mg/kg; toxic effects not yet reviewed
Dog, oral, LD_{Lo}: 600 mg/kg; toxic effects not yet reviewed
Rat, TD_{Lo}: 52,416 mg/kg administered during 91 days prior to mating produces reproductive effects on fallopian tubes and ovaries
Mouse, skin, TD_{Lo}: 99 g/kg produces tumors in skin and appendages

* As coal tar pitch volatiles.
† See NIOSH, *RTECS* (GF8615000), for additional mutation, reproductive, tumorigenic, and other toxicity data.

Section 3. Physical Data

Boiling Point: 381 to 752 °F (194 to 400 °C)
Distillation Range: 446 to 554 °F (230 to 290 °C)
Heat of Combustion: -12,500 Btu/lb
Heat of Vaporization: 107 Btu/lb
Molecular Weight: Varies with purity
Density/Specific Gravity: 1.07 to 1.08 at 68 °F (20 °C)
Water Solubility: Slightly soluble

Appearance and Odor: Pure coal tar creosote is colorless, but the industrial product is a yellow to black oily liquid with an aromatic smoky smell and a burning caustic taste.

Section 4. Fire and Explosion Data

Flash Point: 165.2 °F (74 °C), CC	Autoignition Temperature: 637 °F (336 °C)	LEL: None reported	UEL: None reported

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog or regular foam. Since water is least effective, use it as an extinguishing agent only when the preferred measures are unavailable. However, use water spray to cool fire-exposed containers.
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Containers may explode in heat of fire. Coal tar creosote presents a vapor explosion hazard indoors, outdoors, and in sewers.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Fully decontaminate or properly dispose of personal protective clothing.

Section 5. Reactivity Data

Stability/Polymerization: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.
Conditions to Avoid: Avoid excessive heat and contact with chlorosulfonic acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of coal tar creosote can produce oxides of carbon and thick, black, acrid smoke.

Copyright © 1991 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA list coal tar creosote as a carcinogen.
Summary of Risks: Coal tar creosote is toxic by inhalation, ingestion, and skin contact. It contains a variety of hydrocarbons such as phenol and polycyclic aromatic hydrocarbons such as benzo[a]pyrene, benzanthracene, and phenol derivatives. The range of toxicity depends on the exposure concentration, amount, and duration. Effects may include irritation, burns, and several forms of cancer.
Medical Conditions Aggravated by Long-Term Exposure: Chronic respiratory or skin diseases.
Target Organs: Eyes, skin, bladder, kidneys, and respiratory system.
Primary Entry Routes: Inhalation, ingestion, and skin contact.
Acute Effects: Skin contact may cause irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and small bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur. Inhalation may be irritating to the respiratory tract. Eye contact may cause conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. Ingestion may result in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress, and shock. Systemic absorption by any route (including skin absorption) may cause trouble breathing, thready (continuous or drawn out) pulse, dizziness, headache, nausea, vomiting, salivation, and convulsions. Exposure to large doses (particularly by ingestion) may be fatal.
Chronic Effects: Dermatitis, skin cancer, and lung cancer.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* let victim rub eyes or keep them tightly closed. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Wash affected area with soap and flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of milk or water. *Do not induce vomiting!*
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Cresol may be detected in urine.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources–no flares, smoking, or flames in hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If possible with no risk, stop leak. Water spray may be used to reduce vapor but it may not prevent ignition in closed spaces. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of liquid spill for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: Coal tar creosote is fouling to shoreline. Ecotoxicity values are: TL_{50}, goldfish (*Carassius auratus*), 3.51 ppm/24 hr (60:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Material No. U051
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed (as coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact. Applying a layer of petroleum jelly or lanolin castor oil ointment to the face reduces vapor contact and penetration through skin. Frequent change of protective garments is an additional protective measure.
Ventilation: Provide general and local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Take particular care to avoid any contamination of drains or ventilation ducts. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area. Store coal tar creosote as close to area of use as possible to minimize transporting distance.
Engineering Controls: Use engineering controls to keep airborne concentrations below the OSHA PEL. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Always perform synthesis and purification procedures under a vertical ventilation hood and make regular operational safety checks. Label doors to rooms where coal tar creosote is produced, used, or stored as containing a carcinogen. Locate emergency equipment at well-marked and clearly identified stations in case emergency escape is necessary.
Other Precautions: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about coal tar creosote's carcinogenicity and proper handling procedures to avoid exposure.
Other Comments: Caution is in order when handling or sawing old creosote-treated lumber since it retains a considerable portion of creosote for up to 25 to 30 years.
Transportation Data (49 CFR 172.101)
DOT Shipping Name: Creosote
DOT Hazard Class: Flammable liquid
ID No.: UN1136
DOT Label: Flammable liquid

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 142, 143, 146, 148, 153, 159
Prepared by: M Gannon, BA; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: Mark Upfal, MD, MPH; Edited by: JR Stuart, MS

Copyright © 1991 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

39

Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA
1
2 0
–

HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m^3)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift

TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m^3)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m^3

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19°C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10^{-6} to 10^{-3} mm at 20 °C
Molecular Weight: 188.7 to 398.5

Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 °F (141-196 °C) OC*	Autoignition Temperature: 464 °F (240 °C)	LEL: None reported	UEL: None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 °F (600-650 °C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] and NTP[169] list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through unbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. Ecotoxicity: Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Polychlorinated biphenyls
DOT Hazard Class: 9
ID No.: UN2315
DOT Packing Group: II
DOT Label: CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180
Prepared by: MJ Wurth, BS; Industrial Hygiene Review: PA Roy MPH, CIH; Medical Review: AC Darlington, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ALDRIN

POTENTIAL HUMAN CARCINOGEN

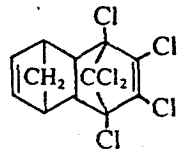
INTRODUCTION

This guideline summarizes pertinent information about aldrin for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

NOTE: Most uses of aldrin were suspended by the U.S. Environmental Protection Agency, effective October 18, 1974. The only uses allowed are direct soil application, seed treatment if labeled "not for food use," dipping of plant roots and tops, subsurface termite control, and hot-caps.

SUBSTANCE IDENTIFICATION

- **Formula:** $C_{12}H_8Cl_6$
- **Structure:**



- **Synonyms:** Aldrex; aldrine; aldrosol; octalene; 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-exo-1,4-endo-5,8-dimethanonaphthalene
- **Identifiers:** CAS 309-00-2; RTECS 102100000; DOT 2761, label required: "Poison"
- **Appearance and odor:** Light to dark brown crystals with a mild chemical odor

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 364.90
2. Boiling point (at 760 mmHg): Decomposes
3. Specific gravity (water = 1): 1.6
4. Melting point: 104°C (219°F)
5. Vapor pressure at 20°C (68°F): 6.0 x 10^{-6} mmHg
6. Solubility in water: 0.027 mg/l at 27°C (80.6°F)

- **Reactivity**

1. Incompatibilities: Aldrin may react with concentrated mineral acids, acid catalysts, acid oxidizing agents, phenols, or reactive metals.
2. Hazardous decomposition products: Hydrochloric acid fumes and other chlorinated decomposition products may be released in a fire involving aldrin.
3. Caution: Aldrin should be stored in tightly closed containers in a well-ventilated area.

- **Flammability**

Aldrin is nonflammable.

- **Warning properties**

Evaluation of warning properties for respirator selection: Warning properties are not considered in recommending respirators for use with carcinogens.

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for aldrin is 0.25 milligrams of aldrin per cubic meter of air (mg/m³) as a time-weighted average (TWA) concentration over an 8-hour workshift (Skin). The notation "Skin" refers to the potential contribution to overall exposure by the cutaneous route including the mucous membranes and eyes. The National Institute for Occupational Safety and Health (NIOSH) recommends that aldrin be controlled and handled as a potential human carcinogen in the workplace and that exposure be minimized to the lowest feasible limit. The NIOSH recommended exposure limit (REL) is 0.15 mg/m³ as a TWA for up to a 10-hour workshift, 40-hour workweek. The NIOSH REL is the lowest concentration detectable by current NIOSH-validated sampling and analytical methods. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV®) is 0.25 mg/m³ (Skin) as a TWA for a normal 8-hour workday and a 40-hour workweek (Table 1).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

Table 1.—Occupational exposure limits for aldrin

	Exposure limits mg/m³
OSHA PEL TWA (Skin)*	0.25
NIOSH REL TWA (Ca)†	§0.15
ACGIH TLV® TWA (Skin)	0.25

* (Skin): Potential contribution to overall exposure by the cutaneous route including mucous membranes and eyes.
† (Ca): NIOSH recommends treating as a potential human carcinogen.
§ Lowest reliably detectable level.

HEALTH HAZARD INFORMATION

• Routes of exposure

Aldrin may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact. Dermal absorption is substantially increased when aldrin is dissolved in organic solvents.

• Summary of toxicology

1. *Effects on animals:* Acute or chronic oral administration of aldrin to dogs and rats produced liver and kidney degeneration; chronic oral administration produced liver cancer in mice and thyroid cancer in rats. Aldrin fed to pregnant hamsters and mice caused increased fetal deaths, as well as congenital anomalies and growth retardation in the offspring.
2. *Effects on humans:* Aldrin is a neurotoxin and has caused electroencephalogram abnormalities following short-term or long-term oral, dermal, or inhalation exposure.

• Signs and symptoms of exposure

1. *Short-term (acute):* Exposure to aldrin can cause hyperirritability, headache, dizziness, nausea, vomiting, blood in the urine, tremors, convulsions, and coma.
2. *Long-term (chronic):* Exposure to aldrin can cause redness of the skin and dermatitis, weight loss, muscular twitching, and convulsions.

RECOMMENDED MEDICAL PRACTICES

• Medical surveillance program

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies.

• Preplacement medical evaluation

Prior to placing a worker in a job with a potential for exposure to aldrin, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, liver, kidneys, endocrine glands, and hematopoietic (blood-cell-forming), reproductive, and nervous systems.

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to aldrin at or below the NIOSH REL.

The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include: preexisting chronic diseases of the skin, liver, kidneys, endocrine glands, and hematopoietic, reproductive, and nervous systems. Workers should inform their physicians of their potential for exposures to aldrin because internal absorption of this chemical pathologically increases the liver's ability to metabolize and eliminate medications which may be prescribed or taken "over the counter." The physician should obtain baseline values for liver function tests and a complete blood count with reticulocyte count.

• Periodic medical screening and/or biologic monitoring

Occupational health interviews and physical examinations should be performed at regular intervals. Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to aldrin. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the integrity and physiologic function of the skin, eyes, liver, kidney, and hematopoietic, reproductive, and nervous systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population.

• **Medical practices recommended at the time of job transfer or termination**
The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to aldrin may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

• **Sentinel health events**
1. Acute SHE's include: Non-autoimmune hemolytic anemia.
2. Delayed-onset SHE's include: Cataract, toxic hepatitis, and non-autoimmune hemolytic anemia.

MONITORING AND MEASUREMENT PROCEDURES

• **TWA exposure evaluation**
Measurements to determine worker exposure to aldrin should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of consecutive samples collected during the entire workshift. Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

• **Method**
Sampling and analysis may be performed by collecting aldrin with a glass-fiber filter and a midget impinger containing isooctane. The filter is extracted using isooctane, and analysis is performed using a gas chromatograph with an electrolytic conductivity detector. A detailed sampling and analytical method for aldrin may be found in the *NIOSH Manual of Analytical Methods* (method number 5502).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with aldrin.

SANITATION

Clothing which is contaminated with aldrin should be removed immediately and placed in sealed containers for storage until it can be discarded or until provision is made for the removal of aldrin from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of aldrin's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with aldrin should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle aldrin should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to aldrin may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for aldrin

Operations	Controls
During formulation and handling of insecticide	Personal protective equipment, local exhaust ventilation
During maintenance of equipment and storage containers	Personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

• **Eye exposure**
Where there is any possibility of a worker's eyes being exposed to aldrin, an eye-wash fountain should be provided within the immediate work area for emergency use.

If aldrin gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• **Skin exposure**
Where there is any possibility of a worker's body being exposed to aldrin, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If aldrin gets on the skin, wash it immediately with soap and water. If aldrin penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

• **Rescue**

If a worker has been incapacitated, move the affected worker from the hazardous exposure. Put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

If aldrin is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Aldrin solid may be collected and placed in an appropriate container.
3. Aldrin solid or liquid may be collected by vacuuming with an appropriate high-efficiency filtration system.
4. For small quantities of liquids containing aldrin, absorb on paper towels and place in an appropriate container.
5. Large quantities of liquids containing aldrin may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container.

WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure: when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations including those requiring confined-space entry (Table 3).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used. **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

BIBLIOGRAPHY

• American Conference of Governmental Industrial Hygienists: *TLVs® Threshold Limit Values and Biological Exposure Indices for 1987-88*, Cincinnati, 1987.

• American Lung Association of San Diego and Imperial Counties: "Taking the Occupational History," *Annals of Internal Medicine*, 99:641-651, November 1983.

• Clayton, G.D., and Clayton, F.E. (eds.): *Toxicology*, Vol. IIA of *Patty's Industrial Hygiene and Toxicology* (3rd rev. ed.), John Wiley & Sons, Inc., New York, 1981.

• *Code of Federal Regulations*, U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1910.134, 1910.1000, OSHA 2206, revised July 1, 1986.

• *Code of Federal Regulations*, U.S. Department of Transportation, 49 CFR 172.101, Transportation 49, revised October 1, 1982.

• *Federal Register*, Vol. 39, No. 203, pp. 37246-37272, October 18, 1974.

• Goldman, R.H., and Peters, J.M.: "The Occupational and Environmental Health History," *Journal of the American Medical Association*, 246:2831-2836, 1981.

• Halperin, W.E., Ratcliffe, J., Frazier, T.M., Wilson, L., Becker, S.P., and Shulte, P.A.: "Medical Screening in the Workplace: Proposed Principles," *Journal of Occupational Medicine*, 28(8): 547-552, 1986.

• Hankinson, J.L.: "Pulmonary Function Testing in the Screening of Workers: Guidelines for Instrumentation, Performance, and Interpretation," *Journal of Occupational Medicine*, 28(10):1081-1092, 1986.

• International Agency for Research on Cancer: *IARC Monographs on the Carcinogenic Risk of Chemicals to Man, Some Organochlorine Pesticides*, Vol. 5, Lyon, France, 1974.

• Levy, B.S., and Wegman, D.H. (eds.): *Occupational Health: Recognizing and Preventing Work-Related Disease*, Little, Brown and Company, Boston, 1983.

• Mark, H.F., Othmer, D.F., Overberger, C.G., Seaborg, G.T., Grayson, M., and Eckroth, D. (eds.): *Kirk-Othmer Encyclopedia of Chemical Technology* (3rd ed.), John Wiley & Sons, Inc., New York, 1981.

• National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: *Criteria for a Recommended Standard. . . .Occupational Exposure During the Manufacture and Formulation of Pesticides*, DHEW (NIOSH) Publication No. 78-174, 1978.

• National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: "Special Occupational Hazard Review for Aldrin/Dieldrin," DHEW (NIOSH) Publication No. 78-201, Rockville, 1978.

• National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *NIOSH Manual of Analytical Methods* (3rd ed., Vol. 1), Eller, P.M. (ed.), DHHS (NIOSH) Publication No. 84-100, Cincinnati, 1984.

• National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *Registry of Toxic Effects of Chemical Substances* (Microfiche Edition), Sweet, D. V., and Lewis, R.J. (eds.), Cincinnati, April 1985.

• Proctor, N.H., and Hughes, J.P.: *Chemical Hazards of the Workplace*, J.B. Lippincott Company, Philadelphia, 1978.

• Rom, W.N. (ed.): *Environmental and Occupational Medicine*, Little, Brown and Company, Boston, 1983.

• Rothstein, M.A.: *Medical Screening of Workers*, Bureau of National Affairs, Washington, DC, 1984.

• Rutstein, D.D., Mullan, R.J., Frazier, T.M., Halperin, W.E., Melius, J.M., and Sestito, J.P.: "Sentinel Health Events (Occupational): A Basis for Physician Recognition and Public Health Surveillance," *American Journal of Public Health*, 73:1054-1062, 1983.

• Sax, N.I. (ed.), *Dangerous Properties of Industrial Materials* (6th ed.), Van Nostrand Reinhold Company, New York, 1984.

• Scientific Assembly on Environmental and Occupational Health: "Evaluation of Impairment/Disability Secondary to Respiratory Disease," *American Review of Respiratory Diseases*, 126:945-951, 1982.

• Scientific Assembly on Environmental and Occupational Health: "Surveillance for Respiratory Hazards in the Occupational Setting," *American Review of Respiratory Diseases*, 126:952-956, 1982.

• *Toxic and Hazardous Industrial Chemicals Safety Manual*, The International Technical Information Institute, Tokyo, Japan, 1976.

• U.S. Department of Transportation, Coast Guard: *CHRIS Hazardous Chemical Data*, GPO Stock No. 050-012-00147-2, 1978.

• Windholz, M. (ed.): *The Merck Index* (10th ed.), Merck & Co., Inc., Rahway, New Jersey, 1983.

Table 3.—Respiratory protection for aldrin

Condition	Minimum respiratory protection*
Any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
	Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown or any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
	Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter
	Any appropriate escape-type self-contained breathing apparatus

* Only NIOSH/MSHA-approved equipment should be used.

BENZENE HEXACHLORIDE

BHC

Common Synonyms
1, 2, 3, 4, 5, 6-Hexachloro-cyclohexane
Lindane
BHC
Gammexane
Tri-6

Solid crystals or powder, or solution — Solid is light to dark brown — Musty odor

Solid sinks in water. Solution generally floats on water.

Avoid contact with liquid and solid. Keep people away
Wear goggles and self-contained breathing apparatus
Stop discharge if possible
Call fire department
Stay upwind and use water spray to "knock down" vapor
Isolate and remove discharged material
Notify local health and pollution control agencies

Fire

Solid not flammable, but usually dissolved in combustible liquid.
POISONOUS GASES ARE PRODUCED WHEN SOLID IS HEATED OR WHEN SOLUTION BURNS.
Wear goggles and self-contained breathing apparatus
Extinguish with foam, dry chemical, or carbon dioxide

Exposure

CALL FOR MEDICAL AID

SOLID OR SOLUTION
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.
Remove contaminated clothing and shoes
Flush affected areas with plenty of water
IF IN EYES, hold eyelids open and flush with plenty of water
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and pollution control officials.
Notify operators of nearby water intakes

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-water contaminant, poison
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $C_6H_6Cl_6$
3.3 IMO/UN Designation: 6.1/2761
3.4 DOT ID No.: 2761
3.5 CAS Registry No.: 58-89-9

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Color: Light tan to dark brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Data not available
5.2 Symptoms Following Exposure: Hyperirritability and central nervous excitation: notably vomiting, restlessness, muscle spasms, ataxia, and clonic and tonic convulsions. Subsequent central nervous depression leading to respiratory failure. Occasional dermatitis and urticaria.
5.3 Treatment of Exposure: Gastric lavage and saline cathartics (not oil laxatives because they promote absorption). Sedatives: pentobarbital or phenobarbital in amounts adequate to control convulsions. Calcium gluconate intravenously may be used in conjunction with sedatives to control convulsions. Rest and quiet. Do NOT use epinephrine because ventricular fibrillation may result.
5.4 Threshold Limit Value: 0.5 mg/m³
5.5 Short Term Inhalation Limits: 1 mg/m³ for 30 min.
5.6 Toxicity by Ingestion: Gamma isomer (Lindane): Grade 3; LD_{50} 50 to 500 mg/kg (rat) Technical mixture: Grade 2; LD_{50} 0.5 to 5 g/kg
5.7 Late Toxicity: Mutagen to human lymphocytes.
5.8 Vapor (Gas) Irritant Characteristics: Moderately irritating. Personnel will not usually tolerate moderate or high concentrations.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 1,000 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic gases are generated when solid is heated or when solution burns.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity:
0.77 ppm/96 hr/bluegill/TL_m/fresh water
0.138 ppm/96 hr/guppy/TL_m/fresh water
0.034 ppm/10 hr/coho fry/100% lethal/salt water
8.2 Waterfowl Toxicity: 2000 mg/kg
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: High

9. SHIPPING INFORMATION

9.1 Grades of Purity: Fortified grade: 40-45% gamma isomer Lindane: pure gamma isomer
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Data not available
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
II

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Not listed
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 290.83
12.3 Boiling Point at 1 atm: Not pertinent
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.891 at 19°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

BHC	BENZENE HEXACHLORIDE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.001		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Chlordane **MSDS No. 877**

Date of Preparation: 10/93

Section 1 - Chemical Product and Company Identification 42

Product/Chemical Name: Chlordane
Chemical Formula: $C_{10}H_6Cl_8$
CAS No.: 57-74-9 (pure), 12789-03-6 (technical)
Synonyms: Chlor Kil; Chlortox; dichlorochlordene; Dowchlor; NCI-C00099; Octachlor; octachlorodihydrodicyclopentadiene; 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene; octachloro-4,7-methanohydroindane; octachloro-4,7-methanotetrahydroindane; Topichlor 20; Velsicol 1068.
Derivation: By Diels-Alder addition of hexachlorocyclopentadiene to cyclopentadiene, followed by reaction with chlorine. Pure chlordane is a solid but in its commercial form it is mixed with a variety of solvents, namely deodorized kerosine. Typical concentrations are 2 to 80% chlordane.
General Use: Chlordane was used as an insecticide until its ban by the EPA in 1988. Its primary use was for termites, but was also effective on insects such as ants, cutworms, rose beetles, and grubs. A single application would provide termite protection for > 26 yr.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Chlordane, 60 to 75% vol (technical grade, alpha and gamma isomers).
Impurities: Because chlordane is found in solution, there is a mixture (25 to 40%) of ~ 26 organochlorine compounds, including heptachlor (4 to 10%), nonachlor, Diels-Alder adduct of cyclopentadiene and pentachlorocyclopentadiene, hexachlorocyclopentadiene, and octachlorocyclopentene.

OSHA PEL
8-hr TWA: 0.5 mg/m^3(skin)

ACGIH TLV
TWA: 0.5 mg/m^3(skin)

NIOSH REL
10-hr TWA: 0.5 mg/m^3(skin)

IDLH Level
Ca. 500 mg/m^3

DFG (Germany) MAK
TWA: 0.5 mg/m^3(skin)
Category III: substances with systemic effects
Onset of Effect: > 2 hr
Half-life: > shift length (strongly cumulative)

Peak Exposure Limit: 5 mg/m^3, 30 min. average value, 1/shift

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Chlordane is an organochlorine insecticide. It is a solid or a colorless to amber, viscous liquid with a pungent, chlorine odor. It was banned in 1988 by the EPA because of its toxicity and persistency and bioconcentration in the environment. Inhalation does not appear to be a significant problem at normal use levels, but high concentrations would produce effects. However, skin absorption and ingestion of even small amounts can adversely affect the central nervous system, liver, and kidneys. Numerous deaths have been associated with exposure to chlordane. The pure compound is noncombustible, but because it was produced as a solution, its flammability is dependent on the solvent used.

Wilson Risk Scale
R 1
I 3
S 2*
K 0
*Skin absorption

HMIS
H 2
F 1†
R 0

† Varies depending on the solvent(s) present. Doesn't burn when pure.
PPE‡
‡Sec. 8

Potential Health Effects

Primary Entry Routes: Skin absorption, ingestion, inhalation.
Target Organs: Skin, liver, kidneys, blood, central nervous system, respiratory system.
Acute Effects
Inhalation: Acute toxic exposures via inhalation would cause symptoms similar to those via ingestion.
Eye: Contact can be irritating.
Skin: Contact may produce irritation. This appears to have been more common prior to 1951 when a greater proportion of hexachlorocyclopentadiene was added. Chlordane can be absorbed through the skin in concentrations high enough to cause death. In one case, an accidental application caused death via respiratory failure within 40 minutes post exposure. (See ingestion symptoms)
Ingestion: Chlordane primarily affects the CNS by increasing excitability. Symptoms include confusion, agitation, tremor, incoordination, delirium, convulsions ranging from myoclonic jerking to violent seizures, and coma. Liver (enlargement) and kidney damage (no urine output due to degeneration of kidney tubules) is possible. Blood dyscrasias (imbalance in blood components) are common. Death is possible from respiratory or kidney failure.

Copyright © 1993 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Carcinogenicity: Chlordane is listed by the following agencies in regard to carcinogenicity: EPA-B2 (Probable human carcinogen, sufficient animal and insufficient human evidence), IARC-2B (Possible human carcinogen, limited human evidence in absence of sufficient animal evidence), DFG MAK-B (Justifiably suspected as having carcinogenic potential), and NIOSH-X (Carcinogen defined without further categorization). In animal studies there is numerous evidence that chlordane is cancerous in mice, but these studies have not been reproduced in other animal species.

Medical Conditions Aggravated by Long-Term Exposure: Liver and kidney disorders.

Chronic Effects: Because chlordane is retained in fat cells, chronic toxicity is a problem. A survey of homeowners who had their homes treated for termites with chlordane reported symptoms such as sinusitis, bronchitis, migraine, asthma, neuritis and neuralgia (pain with or without nerve degeneration, respectively) and ovarian and uterine diseases. However, it cannot be determined which and how many of these effects were due solely to exposure to chlordane.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. *Gently* lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. *Do not* scrub! Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Do not* scrub because this will increase absorption risk. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting (most effective if done within 30 min. of ingestion).

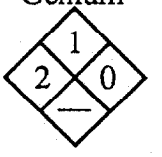
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Chlordane's metabolites oxychlordane and heptachlor epoxide are indicators useful for biological monitoring. Dialysis, exchange transfusion, and hemoperfusion are ineffective. Oral administration of cholestyramine may enhance excretion.

Special Precautions/Procedures: Do not administer adrenergic amines which may further increase myocardial irritability and produce refractory ventricular arrhythmias. For seizures: Diazepam IV bolus - 5 to 10 mg, repeated every 15 min. PRN up to 30 mg. If seizures cannot be controlled or recur, administer phenytoin or phenobarbital.

Section 5 - Fire Fighting Measures

Genium



Flash Point: 225°F (107.2 °C), in kerosine solvent. Flash point may be <100 °F (212 °C) depending on solvent. Pure chlordane is a noncombustible solid.

Flash Point Method: OC

Autoignition Temperature: 410°F (210°C) in kerosine solvent

LEL: 0.7% v/v (kerosine solvent)

UEL: 5% v/v (kerosine solvent)

Flammability Classification: Class IIIB Combustible liquid (in kerosine solvent).

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or alcohol-resistant foam.

Unusual Fire or Explosion Hazards: Container may explode in heat of fire. Vapors may travel to ignition source and flash back. Chlordane solutions pose a vapor explosion hazard indoors, outdoors, and in sewers.

Hazardous Combustion Products: Include chlorine, hydrogen chloride, phosgene, and carbon oxide gases.

Fire-Fighting Instructions: If possible without risk, move container from fire area. Apply cooling water to container sides until well after fire is out. Stay away from ends of tanks. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is not effective for fires involving chlordane.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against exposure.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material.

Large Spills

Containment: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.

Cleanup: Mop any residue with a mild alkali solution (will release the chlorine).

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use non-sparking tools to open containers.

Storage Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10). Containers should be aluminum, aluminum clad, or high-bake phenolic enamel-lined metal.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically bond and ground all equipment used with and around chlordane.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin, liver, kidneys, blood, CNS and respiratory system.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable levels, use a SCBA or supplied-air respirator (with auxiliary SCBA) with a full facepiece and operated in pressure-demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Teflon has a breakthrough time of > 4 hr and is a suitable material for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid (pure), liquid (technical)
Appearance and Odor: Colorless to amber, viscous liquid with a pungent, chlorine odor.
Odor Threshold: 5×10^{-4} ppm
Vapor Pressure: 0.00001 mm Hg at 25 °F (77 °C)
Formula Weight: 409.8
Specific Gravity (H_2O=1, at 4 °C): 1.56 at 25 °C (77 °F)
Water Solubility : 9 µg/L at 77 °F (25 °C)
Octanol/Water Partition Coefficient: log Kow = 2.78
Other Solubilities: Soluble in aliphatic and aromatic hydrocarbons including deodorized kerosine. Decomposes in alkalis.
Boiling Point: 347 °F (175 °C) at 2 mm Hg
Melting Point: 203 to 204.8 °F (95 to 96 °C), *pure* solid
Viscosity: 69 P at 77 °F (25 °C)
Refraction Index: 1.56 to 1.57 at 77 °F (25 °C)
Surface Tension: 25 dyne/cm at 68 °F (20 °C)

Section 10 - Stability and Reactivity

Stability: Chlordane is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Include oxidizers and alkalis. Corrosive to iron and zinc. Attacks some forms of plastics, rubber, and coatings.
Conditions to Avoid: Exposure to heat, ignition sources, and incompatibles.
Hazardous Decomposition Products: Thermal oxidative decomposition of chlordane can produce toxic chlorine, phosgene, hydrogen chloride, and carbon oxide gases.

Section 11- Toxicological Information

Toxicity Data:*

Acute Inhalation Effects:
Cat, inhalation, LC_{50}: 100 mg/m^3/4 hr caused somnolence, excitement and convulsions or effect on seizure threshold.

Carcinogenicity: Mouse, oral: 2020 mg/kg given for 80 continuous weeks caused liver tumors.

Mutagenicity: Human, lymphocyte cell: 10 µmol/L caused mutation.

Teratogenicity: Mouse, oral: 152 mg/kg given for 1 to 19 days of pregnancy caused developmental abnormalities of the immune and reticuloendothelial systems.

Acute Oral Effects:
Man, oral, TD_{Lo}: 3071 µg/kg produced coma, difficulty breathing, and nausea or vomiting.
Human, oral, LD_{Lo}: 29 mg/kg caused fatty liver degeneration.
Human, skin, LD_{Lo}: 428 mg/kg caused tremor, ataxia, and convulsions or effect on seizure threshold.
Rat, oral, LD_{50}: 200 mg/kg

* See NIOSH, *RTECS* (PB9800000), for additional toxicity data.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 12 - Ecological Information

Ecotoxicity: Goldfish, TLm = 0.5 ppm/96 hr; bluegill, LC_{50} = 57 to 74.8 µg/L/96 hr; brown trout, LC_{50} = 11.1 µg/L/96 hr; mallard duck, LD_{50} = 858 ppm; pheasant, LD_{50} = 430 ppm.
Bioconcentration: Pinfish (*Lagodon rhomboides*), 96 hr BCF = 6227; frogs (*Xenopus laevis*), 96 hr BCF = 108
Environmental Degradation: Chlordane is not very mobile in soil and is not likely to leach. The degradation rate is estimated at 4.05 to 28.33%/yr with a mean half-life of 3.3 yr. It can volatilize from the surface (especially if soil is moist). In water, chlordane is not expected to hydrolyze oxidize, or undergo direct photolysis. It volatilizes with an estimated half-life of 7.3 to 7.9 hr from a river 1 m deep, glowing 1 m/sec, with a wind velocity of 3 m/sec at 73.4 °F (23 °C). In air, chlordane will react in the vapor phase with photochemically produced hydroxyl radicals with an estimated half-life of 6.2 hr.

Section 13 - Disposal Considerations

Disposal: Chlordane is a good candidate for liquid injection incineration or rotary kiln incineration. Although chlordane is decomposed by alkalis, the basic objection to this treatment is time. It could take several days to weeks to ensure complete hydrolysis. If spilled in water at > 10 ppm, apply activated carbon at 10 X spilled amount. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Container Cleaning and Disposal: Triple rinse containers and dispose of rinse water as you would other chlordane waste. If possible, return to supplier for reuse or if this is not in accordance with 49 CFR 173.28, puncture container and either ship to scrap metal facility for recycling or send to landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Organochlorine pesticides liquid, flammable, toxic, n.o.s. flash point less than 23 °C*
Shipping Symbols: –
Hazard Class: 3
ID No.: UN2762
Packing Group: II
Label: Flammable liquid, Poison
Special Provisions (172.102): –

Packaging Authorizations
a) Exceptions: None
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.243

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 1 L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: –

* Depending on the flash points of the solvent involved, if greater than 73 °F (23 °C), the UN No. will be 2995.

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste Number (40 CFR 261.33): U036
RCRA Hazardous Waste Classification (40 CFR 261.33): Not classified
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per CWA, Sec. 311 (b)(4)
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA 311/312 Codes: 1, 2
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Threshold Planning Quantity (TPQ): 1,000 lb
OSHA Regulations:
Listed as a Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 126, 127, 132, 133, 136, 148, 153, 168, 183, 186

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... DJ Wilson, CIH
Medical Review ..... J Brent, MD, PhD

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheets Collection

DDT (Dichlorodiphenyltrichloroethane)
MSDS No. 155
Date of Preparation: 10/93

Section 1 - Chemical Product and Company Identification 42

Product/Chemical Name: .... DDT (Dichlorodiphenyltrichloroethane)
Chemical Formula: ..... $(ClC_6H_4)_2CHCCl_3$
CAS No.:..... 50-29-3
Synonyms: Agritan; 2,2-bis(*p*-chlorophenyl)-1,1,1-trichloroethane; chlorophenothan; Citox; dichlorodiphenyltrichloroethane; Dicophane; diphenyltrichloroethane; Genitox; Kopsol; NCI-C00464; Neocid; Pentech; trichlorobis (4-chlorophenyl) ethane; 1,1'-(2,2,2-trichloroethylidene)bis(4-chlorobenzene), Zerdane.
Derivation: Prepared by condensing chloral or chloral hydrate with chlorobenzene in presence of sulfuric acid.
General Use: One of the most widely used contact insecticides from 1945 until its ban in 1972. Although banned in the U.S. (except for such uses as emergency health situations and for controlling body lice), it is still widely used in the tropics for control of vector-carrying diseases such as malaria, yellow fever, dengue, filariasis, louse-borne typhus, and louse-borne relapsing fever.

Section 2 - Composition / Information on Ingredients

DDT: *p'p'*DDT 70% wt + *o'p'*DDT 30% wt (technical grade)
Trace Impurities: DDD, DDE

OSHA PELs
8-hr TWA: 1 mg/m^3 (skin)

ACGIH TLVs
TWA: 1 mg/m^3

NIOSH REL
10-hr TWA: 0.5 mg/m^3
Ca*: (Limit of quantitation: 0.1 mg/m^3)

IDLH Level
Ca*

DFG (Germany) MAK (skin)
TWA: 1 mg/m^3 (total dust)
Category III: Substances with systemic effects
Onset of effect: > 2 hr.
Peak Exposure Limit: 10 mg/m^3, 30 min. average value, 1/shift

* Ca = Carcinogen

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

DDT is a white to gray, crystalline solid. Although it has been banned in the U.S. because of its persistence in the environment and potential for bioaccumulation, DDT has not produced toxicity in workers who either manufactured or used it (even over many years). However, this lack of toxicity is based on inhalation and skin absorption. If DDT is ingested, especially in large amounts, central nervous system effects will occur with possible liver damage. DDT is considered a confirmed animal carcinogen and a suspected human carcinogen.

Wilson Risk Scale	
R	1
I	3
S	1*
K	2

*Skin absorption

HMIS	
H	2†
F	2
R	0

†chronic effects
PPE‡
‡Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin contact.
Target Organs: Central nervous system, liver, skin, peripheral nervous system.
Acute Effects
Inhalation: Inhalation does not appear to cause toxicity beyond that of minor mechanical irritation.
Eye: Exposure to 423 mg/m^3/1 hr/day for 6 days caused eye irritation.
Skin: Skin absorption may occur from some DDT solutions, but degree of absorption will depend on the solvent involved. Aqueous solutions and the powder or crystals are not easily absorbed.
Ingestion: DDT can cause a variety of central nervous system effects if ingested. Large doses generally result in vomiting, while smaller doses cause symptoms within 2 to 3 hr post-ingestion. Symptoms include tingling of the lips, tongue, and face; malaise; headache; sore throat; fatigue; tremors of the head, neck, and eyelids; apprehension; ataxia; and confusion. Convulsions and paralysis of the hands is possible in severe exposures (if vomiting does not occur). Vital signs are usually normal, but in severe poisonings, the pulse may be irregular and abnormally slow. Based on animal studies, it is expected that ventricular fibrillation and sudden death can occur at any time during acute poisoning. Recovery from acute poisoning generally occurs within 24 hr except in the most serious cases.
Carcinogenicity: DDT is considered a suspected human carcinogen by several governmental agencies. IARC-2B (possibly carcinogenic to humans, limited evidence in humans in the absence of sufficient evidence in experimental animals), NTP-2 (reasonably anticipated to be a carcinogen: limited human evidence or sufficient animal evidence), EPA-B2 (sufficient animal evidence; inadequate human evidence), and NIOSH-X (carcinogen defined without further categorization)
Medical Conditions Aggravated by Long-Term Exposure: Possibly, disorders of the central nervous system and liver.

Copyright © 1993 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Chronic Effects: There are conflicting reports on whether or not DDT produces chronic effects in humans. Although it is well established that chronic exposure in experimental animals produces effects including liver damage, CNS degeneration, dermatitis, weakness, convulsions, coma, and death, these effects are not confirmed in humans. Liver cancer is confirmed in animals, but has not been documented in humans. These conflicting reports appear due to the lack of documented chronic toxicity in workers and data showing that DDT and its metabolites are retained in the body fat for long time periods, thus providing a basis for the *possibility* of chronic toxicity.

Other: Solvents such as kerosine are added to DDT as a vehicle and, depending on the type involved, may be more toxic than DDT itself.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse away any loose material and wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing because it may pose a fire hazard.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting. Gastric lavage should be performed promptly.

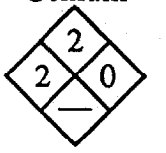
After first aid, get appropriate in-plant, paramedic, or community medical support.

Notes to Physicians: Effects may be delayed; keep under observation.

Special Precautions/Procedures: Amobarbital or pentobarbital is recommended for the relief of central neurological manifestations; tribromoethanol and paraldehyde are recommended for allaying prolonged convulsions.

Section 5 - Fire-Fighting Measures

Genium



Flash Point: DDT itself is noncombustible but is dissolved in a variety of solvents. The average quoted Flash Point is 162 °F (72.2 °C) although the specific vehicle is not identified.

Flash Point Method: CC

Autoignition Temperature: None reported

LEL: None reported

UEL: None reported

Flammability Classification: Class IIIA Combustible Liquid (varies depending on vehicle)

Extinguishing Media: For small fires, use dry chemical, water spray, or regular foam. For large fires, use water spray, fog, or regular foam.

Unusual Fire or Explosion Hazards: Container may explode in heat of fire.

Hazardous Combustion Products: Chloride fumes and carbon oxide gases.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Fight fire from maximum distance. Stay away from ends of tanks.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural fire fighters' protective clothing is *not* effective.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against contamination.

Small Spills: For dry spills, carefully scoop up material or vacuum (with an approved filter). Damp mop any residue. For small solution spills, take up with earth, sand, vermiculite, or other absorbent material and place in suitable containers for disposal.

Large Spills

Containment: Dike far ahead of liquid spill for later reclamation or disposal. Do not release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use non-sparking tools to open containers. Keep dry chemical extinguishers on hand in case of fire.

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10). *Do not* store in aluminum or iron containers.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around DDT.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the liver and central nervous system.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use a SCBA with a full facepiece and operated in pressure demand or other positive-pressure mode, or any supplied-air respirator with a full facepiece and operated in pressure demand or other positive-pressure mode with an auxiliary SCBA. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets made of butyl rubber to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid

Appearance and Odor: White to gray crystals or powder which is odorless or has a slight aromatic odor.

Odor Threshold: 5.0725 mg/m^3

Vapor Pressure: 5.5 x 10^{-6} mm Hg at 68 °F (20 °C)

Formula Weight: 354.48

Specific Gravity (H_2O=1, at 4 °C): 0.98 to 0.99

Water Solubility : 0.0012 ppm

Other Solubilities (g DDT/100 mL): acetone 58, 95% alcohol 2, benzene 78, benzyl benzoate 42, carbon tetrachloride 45, chlorobenzene 74, cyclohexanone 116, dibutyl phthalate 33, o-dichlorobenzene 68, dichlorodifluoromethane 2, dioxane 100, ethyl ether 28, gasoline 10, isopropanol 3, kerosine 8 to 10, methylated naphthalenes 40 to 60, mineral oil 5, morpholine 75, peanut oil 11, pine oil 0 to 16, tetralin 61, tributyl phosphate 50, and xylene 60.

Boiling Point: 365 °F (185 °C)

Melting Point: 227 °F (108.3 °C)

Section 10 - Stability and Reactivity

Stability: DDT is stable at room temperature in closed containers under normal storage and handling conditions. It biodegrades very slowly.

Polymerization: Hazardous polymerization does not occur.

Chemical Incompatibilities: Strong oxidizers, alkaline materials, iron and aluminum salts.

Conditions to Avoid: Exposure to heat, ignition sources, and incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of DDT can produce carbon dioxide.

Section 11- Toxicological Information

Toxicity Data:*

Eye Effects: None reported.

Skin Effects: None reported.

Acute Oral Effects:
Human, oral, LD_{Lo}: 500 mg/kg caused convulsions, cardiac arrhythmias, and respiratory changes.
Rat, oral, LD_{50}: 87 mg/kg; details not reported

Carcinogenicity: Rat, oral, TD_{Lo}: 1225 mg/kg given for 7 continuous weeks caused liver tumors.

Mutagenicity: *E. coli*: 15 µmol/L caused DNA damage.

Teratogenicity: Rat, oral, TD_{Lo}: 112 mg/kg given to a 56 day old male caused paternal effects (spermatogenesis, testes, epididymis, sperm duct).

* See NIOSH, *RTECS* (KJ3325000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Glass shrimp (*Palaemonestes kadiakensis*), LC_{50} = 2.3 mcg/L/96 hr at 69.8 °F (21 °C); Japanese quail, 2 month old male, (*Coturnix japonica*), LD_{50} = 841 mg/kg; bluegill (*Lepomis macrochirus*), LC_{50} = 28.7 mcg/L/36 hr.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Environmental Degradation: In water, DDT will adsorb strongly to sediments, significantly bioconcentrate in fish, and will be subject to considerable evaporation with an estimated half-life of several hr to almost 50 hr from certain waters. It may biodegrade when high concentrations of required microbes (*Escherichia*, *Hydrogenomonas*, and *Saccharomyces*) are present. On land, DDT will adsorb strongly and should not appreciably leach to groundwater. It may evaporate (half-life of 100 days) and is subject to photooxidation from soil. DDT may significantly biodegrade in flooded soils or under anaerobic conditions provided high populations of the required microbes are present. Half-life ranges from 2 to >15 yr. In the air, DDT is subject to direct photooxidation and reaction with photochemically produced hydroxyl radicals (est. half-life = 2 days). Wet and dry deposition are significant mechanisms for removal from air.

Section 13 - Disposal Considerations

Disposal: DDT is a good candidate for rotary kiln or liquid injection incineration (furnace with afterburner and alkali scrubber). 60 to 80% removal of DDT from contaminated soils has been achieved in 10 min. by super critical-carbon dioxide extraction. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Container Cleaning and Disposal: Triple rinse containers. Containers in good condition should be returned to the manufacturer and those that are not reusable should be punctured and transported to a scrap metal facility for recycling, disposal, or burial in a designated landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Organochlorine pesticides, solid toxic, n.o.s.
Shipping Symbols: —
Hazard Class: 6.1
ID No.: UN2761
Packing Group: III
Label: Keep Away From Food
Special Provisions (172.102): —

Packaging Authorizations
a) **Exceptions:** 173.153
b) **Non-bulk Packaging:** 173.213
c) **Bulk Packaging:** 173.240

Quantity Limitations
a) **Passenger, Aircraft, or Railcar:** 100 kg
b) **Cargo Aircraft Only:** 200 kg

Vessel Stowage Requirements
a) **Vessel Stowage:** A
b) **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste Number (40 CFR 261.33): U061
Listed as a RCRA Hazardous Waste Classification (40 CFR 261.33)
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); and CWA, Sec. 307(a)
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 101, 103, 124, 126, 127, 132, 133, 136, 139, 148, 153, 167, 168, 169, 176, 180, 183

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... PA Roy, MPH, CIH
Medical Review ..... T Thoburn, MD, MPH

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

ENDOSULFAN

ESF

Common Synonyms			
Thiodan Malix Chlorthepin Cyclodan	Solid crystals or solution Sinks in water.	Brown	Sulfur dioxide

AVOID CONTACT WITH LIQUID OR SOLID. KEEP PEOPLE AWAY.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Fire data not available for solid, but usually it is dissolved in a combustible liquid.
POISONOUS GASES MAY BE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).

Exposure

CALL FOR MEDICAL AID.

SOLID OR SOLUTION
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Irritating to skin.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant.
Should be removed.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** Poison
2.2 **Class:** 6

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_9H_6Cl_6O_3S$
3.3 **IMO/UN Designation:** 6.1/2761
3.4 **DOT ID No.:** 2761
3.5 **CAS Registry No.:** 115-29-7

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid
4.2 **Color:** Brown
4.3 **Odor:** Sulfur dioxide

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Rubber gloves, mask, or respirator.
5.2 **Symptoms Following Exposure:** Ingestion, inhalation, and skin absorption will induce headache, dizziness, nausea, and vomiting. CNS symptoms: hyperirritability, convulsions, and/or coma. SKIN: In solution in oily media, surfactants, or emulsifiers, may result in skin irritation.
5.3 **Treatment of Exposure:** Call a doctor. EYES: Wash with water for at least 15 minutes. SKIN: Wash with soap and water. INGESTION: Remove by administration of syrup of ipecac, gastric lavage, and salt-based cathartics. OTHER: Get medical attention. For CNS symptoms phenobarbital may be used.
5.4 **Threshold Limit Value:** 0.1 mg/m³ (skin).
5.5 **Short Term Inhalation Limits:** 0.3 mg/m³
5.6 **Toxicity by Ingestion:** Grade 4; LD_{50} <50 mg/kg.
5.7 **Late Toxicity:** Occasional epileptiform convulsions of grand mal or petit mal type have occurred in workers from skin absorption. Neoplastic effects have been reported.
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** As a solution incorporated in oily media or with surfactants or emulsifiers. Minimum hazard. If spilled on clothing and allowed to remain may cause smarting and reddening of skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data Not Available

6. FIRE HAZARDS

6.1 **Flash Point:** Data not available
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Data not available
6.4 **Fire Extinguishing Agents Not to be Used:** Data not available
6.5 **Special Hazards of Combustion Products:** Data not available
6.6 **Behavior in Fire:** Decomposes to liberate SO_2
6.7 **Ignition Temperature:** Data not available
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data Not Available
6.11 **Stoichiometric Air to Fuel Ratio:** Data Not Available
6.12 **Flame Temperature:** Data Not Available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** Slowly hydrolyzes to give SO_2. Hydrolyzes more rapidly under alkaline conditions.
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable when dry.
7.4 **Neutralizing Agents for Acids and Caustics:** Data not available
7.5 **Polymerization:** Data not available
7.6 **Inhibitor of Polymerization:** Data not available
7.7 **Molar Ratio (Reactant to Product):** Data Not Available
7.8 **Reactivity Group:** Data Not Available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
0.0033 and 0.0037 ppm/96-hour/LC_{50}/Fathead minnows and guppy/fresh water
0.013 to 0.0032 ppm/24-hour/LC_{50}/Rainbow trout/fresh water
0.03 to 1.0 ppm/48-hour/LC_{50}/Pogge/salt water
8.2 **Waterfowl Toxicity:** Oral - LD_{50}, young mallards = 33 mg/kg
Oral - Mallards LD_{50} (5-day) = 900 to 1100 ppm
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** Will occur

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 35%, 50% (wettable powders); 17.5%, 35%, 50% (emulsifiable concen- trates); 2 lb/gal; 1%, 2%, 3%, 4%, 5%, and 6% (dusts)
9.2 **Storage Temperature:** >20°F (miscible)
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Poison, B
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 406.95
12.3 **Boiling Point at 1 atm:** Data not available
12.4 **Freezing Point:**
Technical grade: 158° to 212°F = 70° to 100°C = 343.2 to 373.2°K
Pure para isomer: 222.8° to 226.4°F = 106° to 108°C = 379.2° to 381.2°K
Pure ortho isomer: 406.4° to 410°F = 208° to 210°C = 481.2° to 483.2°K
12.5 **Critical Temperature:** Data not available
12.6 **Critical Pressure:** Data not available
12.7 **Specific Gravity:** 1.745 at 20°C
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** 14.0
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** Data not available
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Data not available
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data Not Available
12.26 **Limiting Value:** Data Not Available
12.27 **Reid Vapor Pressure:** Data Not Available

NOTES

ESF	ENDOSULFAN

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE	167	.000		DATA NOT AVAILABLE		DATA NOT AVAILABLE

ENDRIN

EDR

Common Synonyms	Solid or solution	Colorless to tan	Odorless
Hexadrin Mendrin	Sinks in water.		

AVOID CONTACT WITH LIQUID, SOLID AND DUST. KEEP PEOPLE AWAY.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible solution or non-flammable solid.
POISONOUS GASES ARE PRODUCED IN FIRE.
Extinguish with dry chemicals, foam or carbon dioxide.
Water may be ineffective on fire.

Exposure

CALL FOR MEDICAL AID.

DUST
POISONOUS IF INHALED OR IF SKIN IS EXPOSED.
Irritating to eyes, nose and throat.
Move victim to fresh air.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing is difficult, give oxygen.

LIQUID OR SOLID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Irritating to skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-poison, water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Poison
2.2 **Class:** 6

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_{12}H_8Cl_6O$
3.3 **IMO/UN Designation:** 6.1/2761
3.4 **DOT ID No.:** 2761
3.5 **CAS Registry No.:** 72-20-8

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid (Sometimes shipped as an emulsifiable concentrate in xylene solution)
4.2 **Color:** Colorless to tan
4.3 **Odor:** None

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Respirator for spray, fog, or dust; rubber gloves and boots.
5.2 **Symptoms Following Exposure:** Inhalation causes moderate irritation of nose and throat; prolonged breathing may cause same toxic symptoms as for ingestion. Contact with liquid causes moderate irritation of eyes and skin. Prolonged contact with skin may cause same toxic symptoms as for ingestion. Ingestion causes frothing of the mouth, facial congestion, convulsions, violent muscular contractions, dizziness, weakness, nausea.
5.3 **Treatment of Exposure:** Get medical attention after all exposures to this compound. INHALATION: remove from exposure. EYES: flush with water for at least 15 min. SKIN: wash with plenty of soap and water, but do not scrub. INGESTION: remove from the gastrointestinal tract, either by inducing vomiting (unless hydrocarbon solvents are involved and the amount of insecticide is well below the toxic amount) or by gastric lavage with saline solution; saline cathartics may also be beneficial; fats and oils should be avoided; sedation with barbituates is indicated if signs of CNS irritation are present; patient should have absolute quiet, expert nursing care, and a minimum of external stimuli to reduce danger of convulsions; epinephrine is contraindicated in view of the danger of precipitating ventricular fibrillation; if material ingested was dissolved in a hydrocarbon solvent, observe patient for possible development of hydrocarbon pneumonitis.
5.4 **Threshold Limit Value:** 0.1 mg/m³
5.5 **Short Term Inhalation Limits:** 0.5 mg/m³ for 30 min.
5.6 **Toxicity by Ingestion:** Grade 4; oral LD_{50} = 3 mg/kg (rat)
5.7 **Late Toxicity:** None known
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Data not available
5.10 **Odor Threshold:** Not pertinent (solid)
5.11 **IDLH Value:** 200 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** Non flammable solid or combustible solution > 80°F O.C. (xylene)
6.2 **Flammable Limits in Air:** 1.1%-7% (xylene)
6.3 **Fire Extinguishing Agents:** (Solution) Dry chemical, foam, carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective on solution fire.
6.5 **Special Hazards of Combustion Products:** Toxic hydrogen chloride and phosgene may be generated when solution burns.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 4 mm/min. (xylene)
6.10 **Adiabatic Flame Temperature:** Data Not Available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data Not Available
7.8 **Reactivity Group:** Data Not Available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 0.005 ppm/48 hr/carp/TL_m/fresh water
0.0025 ppm/48 hr/brown shrimp/TL_m/salt water
8.2 **Waterfowl Toxicity:** LD_{50} = 5.64 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** Probable

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical, 95-98%; Dry formulations, up to 75% endrin; liquid formulations, up to 25% in flammable xylene
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Poison, B
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification Solution	Dry
Health Hazard (Blue)	3	2
Flammability (Red)	1	0
Reactivity (Yellow)	0	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 380.92
12.3 **Boiling Point at 1 atm:** Not pertinent
12.4 **Freezing Point:** 392°F = 200°C = 573°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.65 at 25°C (solid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data Not Available
12.26 **Limiting Value:** Data Not Available
12.27 **Reid Vapor Pressure:** Data Not Available

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data Not Available
6.12 **Flame Temperature:** Data Not Available

EDR	ENDRIN

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

HEPTACHLOR

HTC

Common Synonyms	Solid	White to light tan	Camphor-like odor
1,4,5,6,7,8,8a-Heptachlorodicyclopentadiene E3314 Velsicol	Sinks in water.		

AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
Irritating gases may be produced when heated.

Exposure

DUST
POISONOUS IF INHALED.
If inhaled will cause headache or loss of consciousness.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

SOLID
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.
If swallowed will cause nausea and vomiting.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-water contaminant
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_{10}H_5Cl_7$
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** Data not available
3.5 **CAS Registry No.:** 76-44-8

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid
4.2 **Color:** White; light tan
4.3 **Odor:** Camphor-like

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Protective respirator; rubber gloves; clean clothes
5.2 **Symptoms Following Exposure:** Inhalation of dust causes irritability, tremors, and collapse. Ingestion causes nausea, vomiting, diarrhea, and irritation of the gastrointestinal tract. Contract with dust causes irritation of eyes and moderate irritation of skin.
5.3 **Treatment of Exposure:** Get medical attention following all overexposure to heptachlor. INHALATION: move to fresh air; if exposure to dust was severe, get medical attention. INGESTION: lavage stomach with warm tap water (unless convulsions are imminent); fats and oils should be avoided, as they increase the rate of absorption of all chlorinated hydrocarbons. EYES: wash repeatedly with water. SKIN: flush with water, then wash with soap and water.
5.4 **Threshold Limit Value:** 0.5 mg/m³
5.5 **Short Term Inhalation Limits:** 2 mg/m³ for 30 min.
5.6 **Toxicity by Ingestion:** Grade 4; oral LD_{50} = 40 mg/kg (rat)
5.7 **Late Toxicity:** Liver damage may develop.
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Data not available
5.10 **Odor Threshold:** 0.02 ppm
5.11 **IDLH Value:** 100 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Irritating hydrogen chloride fumes may form in fire.
6.6 **Behavior in Fire:** Data not available
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Data not available
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
0.1 ppm/24 hr/trout/80% kill/fresh water
0.230 ppm/96 hr/goldfish/TL_m/fresh water
0.25 ppm/48 hr/white shrimp/TL_m/salt water
8.2 **Waterfowl Toxicity:** 2000 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** Bioconcentration of up to 17,600 in oysters and 300 in bluegills. A spill could cause potential problem with shellfish.

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Commercial, 72+%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-E
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 373.5
12.3 **Boiling Point at 1 atm:** Not pertinent (decomposes)
12.4 **Freezing Point:** 115-165°F = 46—74°C = 319—347°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.66 at 20°C (solid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

HTC	HEPTACHLOR

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 296
Arsenic and Compounds

Issued: 4/90

Section 1. Material Identification 31

Arsenic Description: Obtained from flue dust of copper and lead smelters as white arsenic (arsenic trioxide). Reduction with charcoal and sublimation in an N_2 current yields pure arsenic. Metallic arsenic is used for hardening copper, lead, and alloys; as a doping agent in germanium and silicon solid-state products, special solders, and medicine; and to make gallium arsenide for dipoles and other electronic devices. Arsenic compounds are used in manufacturing certain types of glass; in textile printing, tanning, taxidermy, pharmaceuticals, insecticides and fungicides, pigment production, and antifouling paints; and to control sludge formation in lubricating oils. Arsenic trioxide is the source for 97% of all arsenic products.
Other Designations: CAS No. 7440-38-2; arsen; arsenic black; As; gray arsenic; metallic arsenic.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 4
S 2
K 0

Genium

HMIS
H 3
F 2
R 2
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Arsenic and soluble compounds, as As

OSHA PEL
8-hr TWA: 0.5 mg/m³,* 0.01 mg/m³†

ACGIH TLV, 1989-90
TLV-TWA: 0.2 mg/m³

NIOSH REL, 1987
Ceiling: 0.002 mg/m³

Toxicity Data‡
Man, oral, TD_{Lo}: 76 mg/kg administered intermittently over a 12-year period affects the liver (tumors) and blood (hemorrhage)
Man, oral: 7857 mg/kg administered over 55 years produces gastrointestinal (in the structure or function of the esophagus), blood (hemorrhage), and skin and appendage (dermatitis) changes
Rat, oral, TC_{Lo}: 605 µg/kg administered to a 35-week pregnant rat affects fertility (pre- and post-implantation mortality)

* Organic compounds.
† Inorganic compounds.
‡ See NIOSH, *RTECS* (CG0525000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: sublimes at 1134 °F/612 °C
Melting Point: 1497 °F/814 °C
Vapor Pressure: 1 mm at 702 °F/372 °C (sublimes)
Atomic Weight: 74.92
Density: 5.724 at 57 °F/14 °C
Water Solubility: Insoluble†

Appearance and Odor: A brittle, crystalline, silvery to black metalloid. Odorless.

* This data pertains to arsenic only.
† Arsenic is soluble in nitric acid (HNO_3).

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use dry chemical, CO_2, water spray, or foam to fight fires.
Unusual Fire or Explosion Hazards: Flammable and slightly explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Arsenic is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Arsenic can react vigorously on contact with powerful oxidizers such as bromates, peroxides, chlorates, iodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, and chromium (VI) oxide. This material is also incompatible with halogens, bromine azide, palladium, dirubidium acetylide, zinc, and platinum.
Hazardous Products of Decomposition: Thermal oxidative decomposition of arsenic and its compounds produces irritating or poisonous gases.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The IARC, NTP, and OSHA list arsenic as a human carcinogen (Group 1). This evaluation applies to arsenic and arsenic compounds as a whole, and not necessarily to all individual chemicals within the group. Studies report that both the trivalent and pentavalent compounds are strongly implicated as causes of skin, lung, and lymphatic cancers. Experimental studies have shown that arsenic has tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Arsenic compounds are irritants of the skin, mucous membranes, and eyes. The moist mucous membranes are most sensitive to irritation. Prolonged contact results in local hyperemia (blood congestion) and later vesicular or pustular eruption. Epidermal carcinoma is a reported risk of exposure. Peripheral neuropathy (degenerative state of the nervous system) is common after acute or chronic arsenic poisoning. Symptoms include decreased sensation to touch, pinprick, and temperature; loss of vibration sense; and profound muscle weakness and wasting. Other complications of acute and chronic arsenic poisoning are encephalopathy (alterations of brain structure) and toxic delirium.
Medical Conditions Aggravated by Long-Term Exposure: Damage to the liver, nervous, and hematopoietic (responsible for the formation of blood or blood cells in the body) system may be permanent. Pulmonary and lymphatic cancer may also occur.
Target Organs: Liver, kidneys, skin, lungs, lymphatic system.
Primary Entry Routes: Inhalation, ingestion of dust and fumes, via skin absorption.
Acute Effects: Acute industrial intoxication is more likely to arise from inhalation of arsine. However, with corrosive arsenical vapors, conjunctivitis, eyelid edema, and even corneal erosion may result. Inhalation may result in nasal irritation with perforation of the septum, cough, chest pain, hoarseness, pharyngitis, and inflammation of the mouth. If ingested, metallic or garlic taste, intense thirst, nausea, vomiting, abdominal pain, diarrhea, and cardiovascular arrhythmias (heartbeat irregularities) may occur. Symptoms generally occur within 30 minutes, but may be delayed for several hours if ingested with food. Acute poisoning may result in acute hemolysis (breakdown of red blood cells).
Chronic Effects: Chronic symptoms include weight loss, hair loss, nausea, and diarrhea alternating with constipation, palmar and plantar hyperkeratoses (thickening of the corneous layer of skin on palms and soles of feet), and skin eruptions, and peripheral neuritis (inflammation of the nerves). Leukemia, bone marrow depression, or aplastic anemia (dysfunctioning of blood-forming organs) may occur after chronic exposure.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: If emesis is unsuccessful after two doses of Ipecac, consider gastric lavage. Monitor urine arsenic level. Alkalinization of urine may help prevent disposition of red cell breakdown products in renal tubular cells. If acute exposure is significant, maintain high urine output and monitor volume status, preferably with central venous pressure line. Abdominal X-rays should be done routinely for all ingestions. Chelation therapy with BAL, followed by n-penicillamine is recommended, but specific dosing guidelines are not clearly established.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and contact with skin and eyes. Use nonsparking tools. With a clean shovel, scoop material into a clean, dry container and cover. Absorb liquid material with sand or noncombustible inert material and place in disposal containers. Do not release to sewers, drains, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance† (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [† per Clean Water Act, Sec. 307(a); per Clean Air Act, Sec. 112]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations‡
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

* Designations for arsenic only.
‡ Listed as arsenic organic compounds (as As).

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs, ACGIH TLVs, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed, properly labeled, containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and heat and ignition sources. Protect containers from physical damage.
Engineering Controls: Avoid inhalation or ingestion of dust and fumes, and skin or eye contact. Practice good personal hygiene and housekeeping procedures. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program with training, maintenance, inspection, and evaluation. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement and annual physical examination with emphasis on the skin, respiratory system, and blood.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Arsenic, solid
DOT Hazard Class: Poison B
ID No.: UN1558
DOT Label: Poison
DOT Packaging Requirements: 173.366
DOT Packaging Exceptions: 173.364

IMO Shipping Name: Arsenic, metallic
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1558

MSDS Collection References: 7, 26, 38, 53, 73, 85, 87, 88, 89, 100, 103, 109, 123, 124, 126, 127, 130, 136, 138
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD M4

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 297
Barium and Compounds

Issued: 4/90

Section 1. Material Identification

31

Barium and Compounds Description: Produced by reducing barium oxide with aluminum or silicon in a vacuum at high temperature. The minerals barite ($BaSO_4$) and witherite ($BaCO_3$) are the primary sources of barium. Used as lubricant for anode rotors in X-ray tubes; a deoxidizer for copper; an extender in paints; a loader for paper, soap, rubber, and linoleum; a carrier for radium; a fire extinguisher for uranium or plutonium fires; a rodenticide; a stabilizer and mold lubricant in the rubber and plastics industries; a flux for magnesium alloys; getter alloys in vacuum tubes; and in spark-plug alloys and Frary's metal. Important barium compounds include carbonate (ceramics, rodenticide), sulfate (pigment and filler), hydroxide (water treatment, ceramics), nitrate (pyrotechnics), chloride (chemicals), chromate (pigments), oxide (lubricants), and peroxide (bleach).
Other Designations: CAS No. 7440-39-3; Ba.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(TM) for a suppliers list.

R 2
I 3
S 2
K 4

Genium

HMIS
H 2
F 2
R 4
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Barium, ca 100%

OSHA PEL
8-hr TWA: 0.5 mg/m³ (Barium, soluble compounds, as Ba)

NIOSH REL, 1987
None established

Toxicity Data*
None listed

ACGIH TLV, 1989-90
TLV-TWA: 0.5 mg/m³ (Barium, soluble compounds, as Ba)

* Monitor *RTECS* (CQ8370000), for additional future data.

Section 3. Physical Data*

Boiling Point: 2984 °F/1640 °C
Melting Point: 1337 °F/725 °C
Vapor Pressure: 10 mm Hg at 1920 °F/1049 °C
Molecular Weight: 137.33 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 3.51 at 68 °F/20 °C
Water Solubility: Insoluble

Appearance and Odor: A silver white metal that is slightly lustrous and somewhat malleable.
Comment: Barium has a distinctive property of absorbing gases.

* Physcial data are for barium only.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: *Do not* use water or foam. For small fires, use dry chemical, soda ash, lime, or sand. For large fires, withdraw from area and let fire burn.
Unusual Fire or Explosion Hazards: In the powder form, barium is flammable at room temperature. It is also explosive in the form of dust when exposed to heat, flame, or by chemical reaction. The chlorate, peroxide, and nitrate compounds are reactive and may present fire hazards in storage and use.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and fully encapsulating suit. Barium may ignite itself if exposed to air. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Barium is stable at room temperature under special storage and handling conditions (Sec. 9). If the free metal is exposed to air, an explosion hazard exists because hydrogen is liberated. Barium compounds are more stable than elemental barium. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Barium reacts violently with water, carbon tetrachloride, trichloroethylene, fluorotrichloromethane, and tetrachloroethylene. This material is incompatible with acids, trichloroethylene and water, trichlorotrifluoroethane, 1,1,2-trichloro trifluoro ethane, and flurotrichloroethane. Barium is extremely reactive and reacts readily with halogens and ammonia. Barium compounds are not as reactive as elemental barium. See MSDSs 40, 119, 132, 173, 181, and 251 for specific chemical incompatibilities.
Conditions to Avoid: Avoid heating barium in hydrogen to about 392 °F/200 °C since it reacts violently and forms barium hydride (BaH_2). An explosion hazard exists if the free metal is exposed to moist air or cold water because hydrogen is liberated.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP, IARC, and OSHA do not list barium as a carcinogen, the IARC lists barium chromate (VI) as a carcinogen.
Summary of Risks: Barium presents mainly an explosion hazard. However, soluble compounds of barium by the oral route are highly toxic and the fatal dose of the chloride has been stated to be 0.8 to 0.9 g. Death may occur from a few hours to a few days. The soluble barium compounds exert a profound effect on skeletal, arterial, intestinal, bronchial, and particularly cardiac muscle. Effects on the hematopoietic system (responsible for the formation of blood or blood cells in the living body) and the cerebral cortex are also noted. Poisoning may also occur if the dust of soluble compounds is inhaled. Certain compounds of barium are irritants of the skin, eyes, and mucous membranes. Barium oxide and barium hydroxide, strongly alkaline in aqueous solution, cause severe skin irritation and burns of the eye. Inhalation of insoluble barium produces a benign pneumoconiosis (baritosis). The half-life of barium in bone has been estimated at 50 days.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, mucous membranes, lung, heart.
Primary Entry Routes: Inhalation of dust or fume, ingestion, skin or eye contact.
Acute Effects: Systemic absorption from ingestion causes gastroenteritis (inflammation of the stomach lining and the intestines), slow pulse rate (heart may stop while contracting), muscle spasm, and hypokalemia (potassium deficiency in the blood). Inhalation causes coughing, bronchial irritation, and pneumoconiosis. Contact with soluble salts causes dermatitis, irritation of the eyes and mucous membranes, and burns. During radiological examination, intraperitoneal (in the abdomen) or intrathoracic (in the chest) barium sulfate contamination resulting from a complication rupture may cause a significant inflammatory response.
Chronic Effects: Although baritosis (caused by inhaling barium sulfate) produces nodular opacities on chest X-rays, there is no evidence of clinical illness or bodily dysfunction.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Consider using calcium gluconate for muscular spasms. Consider gastic lavage followed by saline catharsis if soluble barium compounds are ingested. Institute cardiac monitoring for all significant ingestions of soluble barium salts.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill. Immediately shut off all heat and ignition sources and evacuate hazard area. Cleanup personnel should protect against dust inhalation and contact with skin, eyes, and mucous membranes. For small dry spills, use a clean shovel to place material into a clean, dry container with a cover. For a large dry spill, cover with a plastic sheet to minimize spreading. For liquid spills, cover with sand or other noncombustible material and place in disposal containers. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations*
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

*Designations for barium only.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store under inert gas, petroleum, or oxygen-free liquid in a cool, dry, well-ventilated area away from all incompatibles (Sec. 5).
Engineering Controls: Barium metal itself presents mainly an explosion hazard. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Use nonsparking tools. Proper storage is essential. Avoid dust inhalation and skin, eye, and mucous membrane contact. All processes should be enclosed and/or exhaust ventilation installed to keep the dust concentrations below the recommended levels. Practice good personal hygiene and housekeeping procedures. Preemployment and periodic medical examinations should be given to workers exposed to barite dust. Prevent exposing individuals with respiratory disorders.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Barium alloys, pyrophoric
IMO Hazard Class: 4.2
IMO Label: Spontaneously combustible
IMDG Packaging Group: II
ID No.: UN1854

MSDS Collection References: 7, 26, 38, 73, 85, 87, 89, 100, 103, 109, 123, 124, 126, 127, 133, 136, 138, 139
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 5
Chromic Acid and Chromates

Issued: 10/77 Revision: C, 7/91

Section 1. Material Identification

Chromic Acid (CrO_3) Description: Produced by roasting chromite ore with alkali or lime, leaching with calcium oxide, crystallizing the chromate or dichromate, and then treating it with an excess of sulfuric acid. Used in ceramic glazes, colored glass, dyes, batteries, explosives, water treatment, wood treatment and preservatives, refractories, copper stripping, aluminum anodizing, photomechanical processing, chromium metal plating, purifying oil and acetylene, hardening microscopic preparations, and manufacturing chromated copper arsenate; and as a corrosion inhibitor, a catalyst, an oxidizing agent in organic chemistry, and an etchant for plastics.

R 1
I 4
S 3*
K 0
* Percutaneous (broken skin)

NFPA
0
3 1
oxy

HMIS
H 3
F 0
R 1
PPG†
† Sec. 8

Other Designations: CAS No. 1333-82-0; chromic acid; chromic acid, solid (DOT); chromium anhydride; chromium (VI) oxide; chromium trioxide; chromium (6+) trioxide; monochromium trioxide; puratronic chromium trioxide. Chromic acid is the commonly used name, although true chromic acid (CrH_2O_4, CAS No. 7738-94-5) cannot be isolated from solution. Chromic acid and chromates (as CrO_3, CAS No. 7440-47-3).

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Caution: A powerful oxidizer, chromic acid may explode on contact with reducing agents and cause ignition on contact with organic materials. This poison and human carcinogen is corrosive to skin and irritating to mucous membranes. Eye contact may cause permanent blindness.

Section 2. Ingredients and Occupational Exposure Limits

Chromic acid, 99% CrO_3

1990 OSHA PEL
Ceiling: 0.1 mg(CrO_3)/m³

1987 IDLH Level
30 mg/m³

1990-91 ACGIH TLVs
TWA: 0.05 mg(Cr)/m³
Ceiling: 0.1 mg/m³

1990 NIOSH REL
TWA: 0.025 mg(Cr(VI))/m³
Ceiling: 0.05 mg/m³/15 min (Cr(VI))

1985-86 Toxicity Data*
Rat, oral, LD_{50}: 80 mg/kg
Mouse, oral, LD_{50}: 127 mg/kg
Human, inhalation, TC_{Lo}: exposed continuously to 110 µg over 3 years. Toxic effects include tumorigenic (carcinogenic by *RTECS* criteria); sense organs and special senses (olfaction tumors); lungs, thorax, or respiration (tumors).
Dog, subcutaneous, LD_{Lo}: 330 mg/kg

* See NIOSH, *RTECS* (GB6650000), for additional mutative, reproductive, toxicity and tumorigenic data.

Section 3. Physical Data*

Boiling Point: Decomposes at 482 °F (250 °C) to $Cr_2O_3 + O_2$
Melting Point: 385 °F (196 °C)
Molecular Weight: 99.98
Specific Gravity: 2.7
Water Solubility: Soluble
Heat of Fusion: 37.7 cal/g
Appearance and Odor: Dark, purplish-red, prismatic, deliquescent (absorbs all moisture from air) crystals, or a granular powder with no detectable odor.

* These physical data apply only to chromic acid (CAS No. 1333-82-0).

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Chromic acid is noncombustible, but accelerates burning of combustibles (wood, paper, oil). For small fires, *use only water*, not dry chemical, carbon dioxide (CO_2), or halon.

Unusual Fire or Explosion Hazards: A powerful oxidizer, chromic acid ignites on contact with acetic acid and alcohol. It may react rapidly enough with organic materials to cause ignition. Containers may explode if involved in fire.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool fire-exposed containers with flooding amounts of water since the decomposing material may form a hot, viscous foam that can cause containers to rupture and explode. *Use caution!* For large fires, flood area from a safe distance, and cool containers from the side with a water spray until after fire is well out. If possible without risk, move containers. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holder. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Chromic acid is generally stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: This material is incompatible with acetic acid, acetic anhydride, acetone, alcohols, alkali metals, ammonia, arsenic, anthracene, benzene, bromine penta fluorine, butyric acid, camphor, chromous sulfide, diethyl ether, glycerol, hydrogen sulfide, methyl alcohol, naphthalene, peroxyformic acid, phosphorus, potassium hexacyanoferrate, pyridine, selenium, sodium, and turpentine. Chromic acid ignites ethyl alcohol and many hydrocarbons.

Conditions to Avoid: Avoid excess heat and contact with combustible or organic materials.

Hazardous Products of Decomposition: Thermal oxidative decomposition of chromic acid can produce carbon dioxide, smoke, and irritating toxic fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC and NTP list chromic acid and other forms of hexavalent (VI) chromium as human carcinogens.

Summary of Risks: Chromic acid is a poison and a powerful irritant to skin, eyes, and respiratory tract. Skin or lung sensitization (allergic reactions) may occur. Exposure can cause dermatitis (skin rash), asthma, pulmonary edema (fluid in lungs), kidney damage, a "chrome hole," or a perforation of the nasal septum (tissue between nostrils).

Medical Conditions Aggravated by Long-Term Exposure: Any chronic lung or skin condition.

Target Organs: Skin, respiratory tract (including nose, throat, airways, and lungs), and kidney.

Primary Entry Routes: Eyes, skin contact, inhalation, and ingestion.

Acute Effects: Inhalation may cause irritation or burning of nose, throat, and air passages, cough, wheezing, and shortness of breath. Higher exposures may cause pulmonary edema (fluid in lungs). Skin exposure may cause dermatitis (skin rash), irritation, burning, itching, redness, and ulceration (skin destruction) which may penetrate. Eye contact can cause irritation, burning, lacrimation (watering), loss of sight and permanent blindness if not removed quickly.

Chronic Effects: Chronic inhalation of excessive levels may cause epistaxis (nosebleed), "chrome holes," nasal congestion, tooth enamel erosion, chest pain, asthma (via allergic sensitization), bronchitis, or respiratory tract cancer. Chronic eye exposure may cause conjunctivitis. Skin contact

Continue on next page

Copyright © 1991 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

can cause irritant or allergic contact dermatitis, or skin ulceration. Chronic systemic absorption could cause liver or kidney damage.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do not let victim rub eyes or keep them tightly shut. Consult a physician immediately.

Skin: Rinse with flooding amounts of water for at least 15 min, and wash with a gentle soap. Promptly remove contaminated clothing. For redness, blistering, or persistent irritation, consult a physician.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water. *Do not induce vomiting* since this worsens the victim's condition. *Do not* neutralize this acid.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: After decontamination and neutralization, treatment of acid burns is similar to that of thermal burns, although bullae and loose necrotic tissue should be debrided. Update tetanus status. *For severe acid burns,* fluid resuscitation is critical to prevent mortality from hypovolemia and renal failure. Monitor serial vital signs, urine output, electrolytes, blood count, and urinalysis as clinically indicated. Neurovascular compromise distal to a circumferential extremity burn may require escharotomy or fasciotomy. *For inhalation exposures to acids,* a CXR, EKG, ABGs, PFTs, SMA, and CBC may aid in treatment. Evaluate and treat as indicated for reactive airways, upper airway obstruction and noncardiogenic pulmonary edema (possibly delayed onset). Although literature documentation is inadequate, a burst of steroids may help prevent development of sequelae such as reactive airways dysfunction syndrome or bronchilitis obliterans. For ocular exposures to acids, ensure adequate decontamination. Determination of pH may be helpful. A Morgan Lens® and topical anesthesia may aid in irrigation. Perform fluorescein staining and slit lamp evaluation and consult an opthamalogist. Antibiotic ointments, mydriatic/cycloplegics, topical corticosteroids (after epithelial recovery), patching, and possibly anterior chamber paracentesis may be indicated depending on clinical presentation. Acutely and in follow-up, evaluate as indicated for intraocular pressure, lacrimal and lid function, corneal integrity and infection. Urinary chromium is of questionable value.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel. Cleanup personnel should protect against dust inhalation and eye contact. Do not handle broken packages unless wearing appropriate personal protective equipment. Keep combustibles (wood, paper, etc.) away from spilled material. Whenever possible, use wet cleanup methods; if not, use vacuum cleanup. Remove spills immediately to prevent dust dispersion. For a water spill, neutralize with agricultural lime, crushed limestone, or sodium bicarbonate. For a land spill, dig a pit, pond, or lagoon to contain material. If time permits, seal these with an impermeable, flexible membrane liner. Dike surface flow with soil, sand or foamed concrete. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Transport: If allowed contact with soil, chromic acid, solid, lowers pH and may leach into water sources, causing an effect similar to acid rain's on water sources. This material's carcinogenicity makes it hazardous to the environment in its hexavalent state.

Environmental Degradation: The recommended disposal means are reduction, precipitation, or ion exchange. Landfill disposal is not recommended since it raises soil acidity.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.22): Corrosive waste

RCRA Hazardous Waste (40 CFR 261.33): Not listed

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 10 lb (4.54 kg) [*per Clean Water Act, Sec. 311(b)(4)]†

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

† Chromic acid (CAS No. 7738-94-5) is listed.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For 0.5-g/m³ concentrations (if not fumes), use any dust and mist respirator except single-use and quarter-mask respirators. For 1.25-g/m³ concentrations, use any powered air-purifying respirator with a high-efficiency particulate filter. For 2.5-m/m³ concentrations, use any air-purifying full facepiece respirator with a high-efficiency particulate filter. For 30-g/m³ concentrations, use any supplied air respirator with a full facepiece and operated in a pressure-demand or other positive-pressure mode. All concentrations may require eye protection. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below occupational exposure levels. Local exhaust ventilation is preferred since it prevents contaminant dispersion into work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Contact lenses may minimize or worsen eye injuries. In some cases, soft lenses can actually protect eyes, not worsen corneal damage, due to strong chemicals. In other cases, chemical entrapment is presumed a possible hazard. Since contact lens use in industry is controversial, establish your own policy. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in glass bottles, cans, or drums. Protect against physical damage. Separate from combustible, organic, or other easily oxidizable materials. Protect from excess moisture which could cause containers to rust. Do not store on wooden floors. Store away from foodstuffs and flammable liquids and solids.

Engineering Controls: Avoid dust inhalation and skin or eye contact. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good housekeeping procedures.

Other Precautions: Institute preplacement and periodic medical exams of exposed workers with attention to the skin and respiratory tract. Consider preplacement and periodic chest radiographs.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Chromic acid, solid	**IMO Shipping Name:** Chromium trioxide, anhydrous
DOT Hazard Class: Oxidizer	**IMO Hazard Class:** 5.1
ID No.: NA1463	**ID No.:** UN1463
DOT Label: Oxidizer	**IMO Label:** Oxidizer, Corrosive
DOT Packaging Exceptions: 173.153	**IMDG Packaging Group:** II
DOT Packaging Requirements: 173.164	

MSDS Collection **References:** 26, 38, 73, 85, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 143, 142, 145, 148, 159

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Copyright © 1991 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 162
Copper

Issued: 12/85 **Revision: A, 8/90**

Section 1. Material Identification

32

Copper (Cu) Description: Widely distributed in nature in elemental state, arsenites, sulfides, chlorides, and carbonates. Prepared by crushing, grinding, and concentrating copper ores by flotation and leaching or by smelting copper ore concentrates to yield a blister (96 to 98%) copper which is electrolytically refined to yield 99.9+% copper. Copper is the most widely used structural metal, next to iron and aluminum. Used in electric wiring; switches, heating, plumbing, roofing, and building construction; alloys (brass, bronze, Monel metal, beryllium-copper); coins; chemical and pharmaceutical machinery; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc., cooking utensils; insecticides; antifouling paints; and as a catalyst. Copper whiskers are used in thermal and electrical composites. Copper flakes are used as insulation for liquid fuels.

Other Designations: CAS No. 7440-50-8, bronze powder, copper slag-airborne, copper slag-milled.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

Cautions: *Copper may be toxic through contact, inhalation, and ingestion.* It may cause skin and eye irritation and metal fume fever. Copper is not considered a fire hazard, but fine particles may burn in air.

R 0
I 4
S 1
K 0

Genium

HMIS
H 2
F 0
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Copper, ca 100%

1989 OSHA PELs	1989-90 ACGIH TLVs	1988 NIOSH REL	1985-86 Toxicity Data‡
8-hr TWA: 1 mg/m³*	TLV-TWA: 1 mg/m³*	None established	Human, oral, TD_{Lo}: 120 µg/kg affects the gastrointestinal tract (nausea or vomiting)
8-hr TWA: 0.1 mg/m³†	TLV-TWA: 0.2 mg/m³†		Rat, oral, TD_{Lo}: 1210 µg/kg (35 weeks prior to mating) affects fertility (pre- and post-implantation mortality)

* Copper dusts and mists, as Cu.
† Copper fume.
‡ See NIOSH, *RTECS* (GL5325000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 4703 °F (2595 °C)
Melting Point: 1981 °F (1083 °C)
Vapor Pressure: 1 mm Hg at 2962 °F (1628 °C)
Molecular Weight: 63.546
Density/Specific Gravity: 8.94
Water Solubility: Insoluble

Appearance and Odor: Solid, various shapes, odorless, red/brown-colored metal or powder. Copper is ductile, tough, and easily worked. It is very resistant to corrosion, but readily attacked by alkalies.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire since copper does not burn. Finely divided copper burns in air, and in extreme cases ignites spontaneously.

Unusual Fire or Explosion Hazards: Liquid copper explodes on contact with water. High concentrations of fine copper particles in the air may present an explosion hazard.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit.

Section 5. Reactivity Data

Stability/Polymerization: Copper is stable at room temperature in closed containers under normal storage and handling conditions. However, on long standing, a white, highly explosive peroxide deposit may form. Copper's vapors are uninhibited and may form polymers in vents and flame arresters.

Chemical Incompatibilities: Copper reacts violently with ammonium nitrate, bromates, iodates, chlorates, ethylene oxide, hydrazoic acid, potassium oxide, dimethyl sulfoxide + trichloroacetic acid, hydrogen peroxide, sodium peroxide, sodium azide, sulfuric acid, hydrogen sulfide + air, and lead azide. A potentially explosive reaction occurs with actylenic compounds. Copper ignites on contact with chlorine, fluorine [above 250 °F (121 °C)], chlorine trifluoride, and hydrazinium nitrate [above 158 °F (70 °C)]. It is also incompatible with 1-bromo-2-propyne; an incandescent reaction occurs with potassium dioxide.

Conditions to Avoid: Avoid prolonged exposure to air and moisture. On exposure to moist air, copper slowly converts to the carbonate.

Hazardous Products of Decomposition: Thermal oxidative decomposition of copper can produce metallic oxides (copper fumes).

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list copper as a carcinogen. Experimental studies show tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Copper is a necessary human nutrient, excessive intake levels of which the kidneys normally eliminate. In individuals with kidney disease or, rarely, Wilson's disease (abnormal retention and storage of copper in the body that damages the liver, kidneys, brain, blood, bones, and endocrine glands), copper levels may accumulate. Significant industrial exposure to copper occurs mainly through inhalation of fumes during welding, smelting, or refining operations; or through exposure to copper dusts and mists during mining, extracting, refining, or manufacturing processes. Copper particles may irritate, discolor, and damage eyes. Exposure to copper salts in many applications is potentially toxic. Copper dusts, fumes, and salts may irritate the upper respiratory tract. Long-term exposure may irritate the skin and discolor the skin or hair.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with impaired pulmonary or renal function should avoid exposure.
Target Organs: Respiratory system, skin, eyes, liver, kidneys.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Inhalation of copper fumes may give rise to metal fume fever (after an incubation period of about 5 hr), an allergic reaction with flu-like symptoms—high temperature, metallic taste, nausea, coughing, general weakness, muscle aches, and exhaustion. These symptoms usually disappear within 24 hr. Direct contact with copper causes skin and (less often) eye irritation, and itching of the linings of the nose, mouth, and respiratory tract. Exposure to copper dust may cause a greenish-black skin discoloration. Copper ingestion causes nausea, vomiting, abdominal pain, and diarrhea. Ingestion of large doses may cause stomach and intestine ulceration, jaundice, and kidney and liver damage.
Chronic Effects: Continued exposure to copper may cause mild dermatitis and degeneration of the mucous membranes. Repeated or prolonged exposure to copper dusts and mists can discolor skin and hair and irritate the skin. Repeated inhalation can cause chronic respiratory disease. Individuals with Wilson's disease (1 in 200,000 individuals) are more susceptible to chronic copper poisoning. If undetected and untreated, this progressive condition is eventually fatal.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing with artificial respiration.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: A blood count shows leucocytosis if an individual has metal fume fever. Consider chellation with penicillamine or BAL (British Anti-Lewisite or dimercaprol) for chronic intoxication.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, remove all heat and ignition sources, and provide adequate ventilation. Avoid creating dusty conditions. Cleanup personnel should protect against vapor inhalation and skin and eye contact. Cleanup methods such as vacuuming (with the appropriate filter) or wet mopping minimizes dust dispersion. Absorb liquid containing copper with vermiculite, dry sand, or other inert materials. Place in appropriate containers for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per Clean Water Act, 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Some recommendations follow. For copper dust and mists greater than 50 mg/m^3, wear a high-efficiency particulate respirator, a supplied-air respirator, or an SCBA, all with a full facepiece. For copper dust and mists greater than 2000 mg/m^3, wear a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode. For copper fumes over 100 mg/m^3, wear either a powered air-purifying respirator with a high-efficiency filter, or a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode.
Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Eye and face protection is required when grinding, welding, cutting, or remelting. Protect skin from molten metal and radiant heat when melting scrap. Machine turnings may also present a laceration hazard. When handling oil-contaminated copper, wear rubber gloves to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below OSHA PELs and ACGIH TLVs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store copper in tightly closed containers in a cool, dry, well-ventilated area. Avoid exposure to air and moisture.
Engineering Controls: Avoid dust and fume inhalation and direct contact with skin and eyes. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Maintain exposures below the PEL/TLV. Monitor copper dust and mist levels in the air.
Other Precautions: Provide placement and periodic examinations that emphasize the skin, eyes, and respiratory system. Prevent exposing individuals with chronic respiratory disease or Wilson's disease.
Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection **References:** 26, 38, 73, 84, 88, 89, 100, 101, 103, 109, 124, 126, 127, 132, 133, 134, 136, 138, 139, 143, 144
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 45

ZINC OXIDE
(Revision A)
Issued: December 1978
Revised: February 1986

SECTION 1. MATERIAL IDENTIFICATION 19

MATERIAL NAME: ZINC OXIDE

DESCRIPTION: Fine metal oxide used as a pigment, filler, or reinforcing agent. An aerosol fume is formed when zinc metal is volatilized.

OTHER DESIGNATIONS: Flowers of Zinc, Zinc White, Chinese White, ZnO, CAS #1314-13-2

SUPPLIERS: Available from several suppliers, including:
Madison Industries, Inc., Old Waterworks Road, Old Bridge, NJ 08857;
Telephone (201) 727-2225

HMIS
H: 0
F: 0
R: 0
PPE: *
*See Sect. 8

Not Found

R 0
I 2
S 1
K -

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
ZINC OXIDE, ZnO Purity level may vary with grade. Typical impurities include lead and/or cadmium (normally <0.1%). Consult supplier's specification for impurity levels. NOTE: Current (1985-86) ACGIH TLV and OSHA PEL: TLV / PEL DUST: 10 mg/m^3 (Total Dust) / None Established FUME: 5 mg/m^3 / 5 mg/m^3 NIOSH recommends (1975 criteria document) a 10-hr TWA of 5 mg/m^3 with a 15 mg/m^3 ceiling limit for dust and fumes.	>99	See Note for TLV and PEL information Rat, Inhalation, LCLo: 400 mg/m^3

SECTION 3. PHYSICAL DATA

Melting Point ... ca 3587°F (1975°C) (Sublimes)
Specific Gravity ... 5.68
Solubility in Water @ 29°C ... 0.00016 gm/100cc
Vapor Pressure at 20°C ... Not Applicable
Molecular Weight ... 81.37

Appearance and odor: White or yellowish white powder. No odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
Not Applicable	Not Applicable	Not Applicable		

EXTINGUISHING MEDIA: Zinc oxide is noncombustible. Use extinguishing agents that are suitable for dousing the surrounding fire. If practical, wet down powder with water spray to reduce dusting and fume formation.

Fire fighters should wear self-contained breathing apparatus and fully protective gear for protection against dust and/or fumes that may be generated in a fire situation.

SECTION 5. REACTIVITY DATA

Zinc oxide is stable under normal conditions of handling and use. It does not polymerize. It is practically insoluble in water but is soluble in acids and alkalies and absorbs carbon dioxide from moist air.
When heated to elevated temperatures, zinc oxide sublimes to produce toxic fumes. (Also note that zinc metal burns at elevated temperatures in air to produce zinc oxide fume).
Zinc oxide and magnesium react explosively when heated. Mixtures of chlorinated rubber and zinc oxide can explode violently when heated to 419°F (215°C).

Copyright © 1986 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Zinc oxide dust is considered to be of low toxicity and is classified by the ACGIH as a nuisance particulate. However, inhalation of zinc oxide fume causes a condition known as "zinc fume fever" (ZFF). ZFF is characterized by flulike symptoms with "metallic taste," coughing, weakness, fatigue, muscular pain, and nausea, followed by fever and chills. Onset of symptoms occurs about 4 to 12 hours after exposure. A tolerance to zinc oxide fume may be acquired but is lost within a day or two after exposure ceases. Zinc oxide fume has also been reported to cause gastrointestinal disturbances. Although zinc oxide is not known to be a skin irritant, under poor personal hygienic conditions contact with zinc oxide has been reported to cause dermatitis ("oxide pox").
Zinc oxide has not been identified as a known or suspected carcinogen by the IARC, NTP, or OSHA.
FIRST AID: EYE CONTACT: Flush well with running water to remove particles. Get medical attention if irritation persists.* SKIN CONTACT: Wash contaminated area thoroughly with mild soap and water. Seek medical attention if irritation persists.* INHALATION: Remove victim from exposure. Provide bed rest and aspirin. Contact physician. (Recovery is generally complete in 24 to 48 hours.) INGESTION: Give victim a large quantity of water to drink. Contact physician or poison control center for instructions.

*GET MEDICAL ATTENTION = In plant, paramedic, community.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Collect spilled material in a way that will minimize excessive generation of dust such as vacuuming (with absolute filter) or wet sweeping. If dusting occurs, cleanup personnel should wear appropriate respiratory protective equipment.

DISPOSAL: Reclaim material when possible. Unsalvageable waste may be buried in an approved sanitary landfill. Follow Federal, state, and local regulations.

Zinc oxide is not listed as a hazardous waste in 40 CFR 261.33. It has not been assigned a reportable spill quantity in 40 CFR 117.3.

SECTION 8. SPECIAL PROTECTION INFORMATION

Use general and/or local exhaust ventilation to maintain dust and fume levels below the TLV and PEL. Where concentrations exceed these limits, workers should wear NIOSH-approved respirators with protection factors suitable for the exposure concentration. High-efficiency particulate (dust/fume) filter respirators are suitable for ZnO fume exposures up to 50 mg/m^3 (250 mg/m^3 with full facepiece). Respirator usage must be in accordance with OSHA requirements (29 CFR 1910.134).
Wear dustproof safety goggles where the possibility of eye contact exists. Gloves should be worn if prolonged or repeated contact is likely. Wear protective clothing (apron, coveralls, etc.) as required by the work situation to prevent gross contamination of skin and clothing.
Eyewash stations and washing facilities should be readily accessible to workers handling this material. Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a dry location. Protect containers from physical damage. Use with adequate ventilation. Maintain good housekeeping procedures to prevent accumulation of dust (avoid generating dust during cleaning).
Follow good personal hygiene practice. Wash thoroughly after handling. Launder contaminated clothing before reuse.
Individuals with preexisting pulmonary disease may be more susceptible to the effects of zinc oxide fume.
Avoid dust and fume inhalation.
Welding galvanized metal will generate zinc oxide fumes.

DOT Classification: Not listed in DOT Hazardous Material Tables (49 CFR 172.101 and 172.102).

Data Source(s) Code: 2, 4, 5, 12, 14, 19, 20, 25, 27, 49, 55, 61, 62, 82. CV

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corp. extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

Approvals/Author	J.D. Recchio
Indust. Hygiene/Safety	JW
Medical Review	

Copyright © 1986 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Copyright © February 1, 1986

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification

32

Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.
Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R	0
I	4
S	-
K	0

Genium

HMIS
H 3
F 1
R 0
PPG*
* Sec. 8

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 µg/m³
Action Level TWA*: 30 µg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 µg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 µg/m³

1988 NIOSH REL
10-hr TWA: <100 µg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 µg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specific Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[105]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Attachment C
Chemical/Material Data Sheets for Materials Stored, Used, or Processed at a SWMU or AOC

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 15
Asbestos and Asbestos-containing Materials

Issued: 11/90

Section 1. Material Identification

33

R 0
I 4
S 1
K 0
Genium

HMIS
H 3
F 0
R 0
PPG*
* Sec. 8

Asbestos and Asbestos-containing Materials Description: Asbestos is a generic term applied to many naturally occurring, hydrated silicates (minerals) found in rock which separate into flexible fibers when crushed or processed. Commercially important forms are amosite, anthrophyllite (mined and used only in Finland), chrysotile, and crocidolite. Other types include tremolite and actinolite. Most widely used in US industry is chrysotile, a fibrous form of serpentine. Since asbestos is insensitive to chemical attack and incombustible, there are over 2000 uses as processed fiber. It is added to such diverse materials as cement, vinyl, plaster, asphalt, and cotton, although due to its health hazards other materials are now replacing it wherever possible. Its use is now limited to products that bind fibers within the product. The largest use of asbestos is in asbestos cement for pipes in water supply, sewage disposal, and irrigation systems; ducts; and flat and corrugated sheets for a wide variety of construction applications. Other uses include fire-resistant textiles, floor tiles, underlayment and roofing papers, friction materials (brake linings), reinforcing filler in elastomers for packing and gaskets, reinforcing pigment in surface coatings and sealants, thermal and electrical insulation media, as a component of taping compound and industrial talcs, and as filler in industrial greases. About 98% of crocidolite is used in production of asbestos cement pipe. Between 1950 and 1972 asbestos was used as spray insulation in buildings, but OSHA now prohibits spray application of actinolite, anthophyllite, asbestos, or tremolite (29 CFR 1910.1001).
Other Designations: CAS No. 12172-73-5, amosite, brown asbestos; CAS No. 1332-21-4, asbestos; CAS No. 12001-29-5, chrysotile, white asbestos; CAS No. 12001-28-4, crocidolite, blue asbestos; Ascarite; earth flax; mountain cork; stone flax.
Molecular Formulas: Amosite, $(FeMg)SiO_3$; anthophyllite, $(MgFe)_7Si_8O_{22}(OH)_2$; chrysotile, $3MgO{\cdot}2SiO_2{\cdot}H_2O$; crocidolite, $NaFe(SiO_3)_2{\cdot}FeSiO_3{\cdot}H_2O$; tremolite, $Ca_2Mg_5Si_8O_{22}(OH)_2$.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(®) for a suppliers list.
Cautions: Asbestos causes three specific diseases: asbestosis (fibrous lung scarring), lung cancer, and mesothelioma (cancer of the chest lining and abdominal cavities). Prevent or maintain exposures at the lowest feasible level.

Section 2. Ingredients and Occupational Exposure Limits

	1989 OSHA PELs*			1990-91 ACGIH TLVs	1988 NIOSH REL
Asbestos	TWA: 0.2 f/cc†	Action Level TWA: 0.1 f/cc	Excursion Limit: 1.0 f/cc‡	TWA: 2.0 f/cc§	0.1 f/cc
Amosite	0.2 f/cc	0.1 f/cc	1.0 f/cc	0.5 f/cc	0.1 f/cc
Chrysotile	0.2 f/cc	0.1 f/cc	1.0 f/cc	2.0 f/cc	0.1 f/cc
Crocidolite	0.2 f/cc	0.1 f/cc	1.0 f/cc	0.2 f/cc	0.1 f/cc

1985-86 Toxicity Data for Asbestos (CAS No. 1332-21-4)**
Human, inhalation, TC_{Lo}: 1.2 fb/cc, continuous exposure over 19 years. Toxic to lungs.
* OSHA has proposed a lower asbestos exposure limit of 0.1 f/cc as an 8-hr TWA (*Industrial Safety and Hygiene News*, 8/90).
† Fiber/cm³
‡ Average over a 30-min sampling period.
§ As determined by membrane filter method at 400 to 450X magnification (4-mm objective) phase contrast illumination. Fibers longer than 5 µg and with an aspect ratio ≥ 3:1 (ACGIH).
** See NIOSH, *RTECS* (CI6475000), for additional toxicity data.

Section 3. Physical Data

Melting Point: Decomposes
Water Solubility: Insoluble (breaks down slowly in hot water)
Molecular Weight: Varies with asbestos form (Sec. 1)
Appearance and Odor: White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None rpeorted	UEL: None reported

Extinguishing Media: Asbestos is nonflammable. Use dry chemcial, CO_2, water spray, or regular foam. Do not scatter spilled material with high-pressure water streams. **Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since there may be airborne asbestos fibers, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode; structural firefighter's protective clothing provides limited protection. If feasible, remove containers from fire area. Avoid dust generation. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Develop decontamination procedures for protective clothing and equipment.

Section 5. Reactivity Data

Stability/Polymerization: Asbestos is inert under ordinary room temperature and heated use conditions. It is heat resistant, but decomposes and alters its microscopic fiber structure above 600 °C (1112 °F). Chrysotile dehydroxylates at 1112 to 1436 °F (600 to 780 °C); the "asbestos anhydride" in turn breaks down to a mixture of silica (SiO_2) and fosterite (Mg_2SiO_4) at 1472 to 1562 °F (800 to 850 °C). Above 1832 °F (1000 °C) magnesium pyroxenes form and melt at ~2642 °F (1450 °C). **Chemical Incompatibilities:** Strong acids can attack chrysotile and rapidly extract its MgO and H_2O content; glacial acetic acid can decompose it. Hot water slowly breaks down chrysotile. Like other asbestos forms, it resists strong alkali (5M NaOH at least up to 100 °C).

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, OSHA, and ACGIH list asbestos as a human carcinogen. **Summary of Risks:** Asbestos may cause 1) asbestosis, 2) lung cancer, 3) mesothelioma, 4) pleural plaques, and 5) several other forms of cancer. *Asbestosis* is fibrosis (scarring) of lung tissue after many years of high-level occupational exposure. Scarring may be progressive even after exposure ceases. Even though detectable in lungs of a high proportion of adults in industrialized areas, asbestosis does not result from lower level environmental exposure. Its symptoms range from mild shortness of breath and dry cough to severe disabling breathlessness, heart failure, and ultimately death. Lung scarring can be seen on X-ray and alterations in lung function can be detected with spirometry (a medical test). Examination typically detects rales (crackling sounds in lungs). Severe cases may have cyanosis (bluish skin discoloration) and clubbing of fingertips. *Lung cancer* can result from lower exposure levels than asbestosis, but also takes many years to develop. Smokers exposed to asbestos are at 5 to 10X higher risk than exposed nonsmokers. *Mesothelioma* is a very aggressive cancer of the pleura (lining around the lungs) or peritoneum (lining of the abdomen), and develops after decades of (sometimes low level) exposure. Symptoms may include chest and abdominal pain, weight loss, and/or shortness of breath, with death within 2 years of diagnosis. *Pleural plaques* are thickenings, sometimes with calcium deposits, of the lungs's lining and may be seen on X-ray. While not associated specifically with health effects, they indicate significant exposure. *Other sites of cancer* include larnyx (vocal cords), portions of digestive tract, and possibly the kidney. Asbestos's toxicity depends on fiber type (crocidolite > amosite > chrysotile), size (longer > shorter), shape (long, thin needle-like > curly), and solubility. Health effects depend on dose (exposure concentration and duration), smoking habits, and individual susceptibility. Prevent or maintain exposures at lowest feasible level.

Continue on next page

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Medical Conditions Aggravated by Long-Term Exposure: Long-term, high-level exposure may aggravate any chronic lung (asthma, emphysema, bronchitis) or heart condition. **Target Organs:** Respiratory system; possibly digestive system. **Primary Entry Routes:** Inhalation, ingestion, dermal contact. **Acute Effects:** Nose, throat, skin and eye irritation are possible with high exposure. **Chronic Effects:** Asbestosis, lung cancer, and mesothelioma typically develop decades (20 to 40 years) after exposure begins, but may occur sooner. **FIRST AID** *Emergency personnel should protect against asbestos exposure.* **Eyes:** Do not rub. Gently lift eyelids and flush with flooding amounts of water. **Skin:** Shower with water and soap. Wet contaminated clothing prior to removal and seal in a plastic bag for disposal as hazardous waste. If rash develops, consult physician. **Inhalation:** Remove to fresh air. Clean any fibers from nose and mouth. Encourage victim to cough, spit, and blow nose to remove fibers. **Ingestion:** Induce vomiting *only* if awake and alert. Consult a physician. **After first aid, consult medical care provider. Note to Physicians:** Asbestos diagnosis is based on chest X-ray with an abnormal ILO "B" reading (small irregular opacities), rales, restrictive pattern spirometry, adequate exposure history, and symptoms. Consider pneumovax, annual flu shot, and other supportive treatment as needed.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel. Cleanup personnel should protect against dust inhalation and skin or eye contact. Avoid dust generation, blowing, dry brushing, and dry mopping. Provide HEPA-filtered (high-efficiency particulate air) portable ventilation systems. Use wet cleaning methods or approved HEPA vacuum cleaning system to pick up spills. The techniques used must collect particulate without dispersing dust into air. Place waste in *properly labeled* dust-tight containers or sealed, heavy-gauge, impervious plastic bags for disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a); Clean Air Act, Sec. 112]
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremeley Hazardous Substance (40 CFR 355): Not listed
OSHA Designations
Listed as Air Contaminant (29 CFR 1910.1000, Table Z-1-A, Z-3)

Section 8. Special Protection Data

Note: *Do not substitute personal protective clothing or equipment for proper handling and engineering controls.* **Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals not in excess of 2 f/cc (10 X PEL), use a half-mask air-purifying respirator, other than a disposable respirator, equipped with high-efficiency filters; not in excess of 10 f/cc (50 X PEL), a full facepiece air-purifying respirator equipped with high-efficiency filters; not in excess of 20 f/cc (100 X PEL), any powered air-purifying respirator equipped with high-efficiency filters or any supplied-air respirator operated in continuous flow mode; not in excess of 200 f/cc (1000 X PEL), a full facepiece supplied-air respirator operated in pressure-demand mode; greater than 200 f/cc (>1,000 X PEL) or unknown concentration, a full facepiece supplied-air respirator operated in pressure-demand mode and equipped with an auxillary positive-pressure self-contained breathing apparatus (29 CFR 1910.1001). *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* **Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation and dust collection systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into work area by controlling it at its source.[103] **Safety Stations:** Make available in work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Never enter lunchroom facilities or leave workplace wearing clothing or equipment worn during workshift. Separate contaminated work clothes from street clothes. *If proper hygiene is not rigorously followed, family members can be exposed to asbestos fibers.* Place contaminated protective devices or work clothing in labeled, impermeable, and sealed containers or bags. Do not remove asbestos from clothing by blowing or shaking. Launder contaminated clothing before wearing. Inform laundering service of asbestos-contaminated clothing and of asbestos' potential harmful effects (29 CFR 1910.1001). **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using asbestos, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed (dust-tight) containers or heavy-gauge impervious plastic bags in a clean, secure area protected from physical damage. Do not open containers that can release asbestos dust without providing proper enclosure or control measure. **Engineering Controls:** Educate workers about asbestos's and asbestos-containing materials' hazards. Inform employees of asbestos standard (29 CFR 1910.1001). Exposure to asbestos, tremolite, anthophyllite, and actinolite in construction work is covered by 29 CFR 1926.58. ["OSHA is proposing an expanded requirement for a trained 'competent person' to ensure compliance with the standard on all construction operations involving asbestos, and requiring more stringent housekeeping to remove asbestos in general industry." (*Industrial Safety and Hygiene News*, 8/90).] Instruct employees in proper practices for handling asbestos-containing materials and correct use of protective equipment. Prevent or minimize asbestos exposure. Regulate areas where exposure in excess of the PEL is likely. Post warning signs in all regulated areas (see legend below). Work with asbestos only in a sufficient wet state to prevent emission of airborne fibers. Practice good personal hygiene and housekeeping procedures. Do not substitute personal protective equipment for proper handling and engineering controls. If exposures exceed the PEL, ensure employees wear appropriate protective clothing. Inhaling or ingesting asbestos fibers from contamined clothing or skin can be hazardous. Do not allow dusts and asbestos-containing wastes to accumulate. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Monitor work areas that expose employees to airborne concentrations at or above the action level (Sec. 2). Whenever production, process, control equipment, personnel, or work practices change, institute new monitoring. **Other Precautions:** Medical surveillance is required for all employees possibly exposed at or above the action level. Provide preplacement medical examination that includes complete medical and work history, complete physical examination that emphasizes respiratory and cardiovascular systems and digestive tract, the respiratory disease standardized questionnaire, a posterior-anterior 14" x 17" chest roentgenogram, and pulmonary function tests [FVC and FEV(1)]. Annual periodic medical examinations shall include all these elements and an abbreviated questionnaire. If it is 10+ years since first asbestos exposure, an individual should have a chest roentogram: every 5 years (ages 15 to 35), every 2 years (ages 35 to 45), every year (age 45+). Within 30 days of employment termination, an individual should receive a periodic medical examination with the elements listed above. Keep medical surveillance records for duration of employment, plus 30 years.

Transportation Data (49 CFR 172.101, .102)
DOT Shipping Name: Asbestos
DOT Hazard Class: ORM-C
ID No.: -
DOT Label: None
DOT Packaging Exceptions: 173.1090
DOT Packaging Requirements: 173.1090
Other Requirements: Stow and handle to avoid airborne particle
IMO Shipping Name: Asbestos, blue; asbestos, white
IMO Hazard Class: 9
ID No.: UN2212, UN2590
IMO Label: None
IMDG Packaging Group: II, III

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

MSDS Collection References: 2-4, 6, 12, 14, 20, 26, 32, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138-140, 142, 143, 146, 148, 152, 153, 156-158
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 469
Fuel Oil No. 2

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification

33

Fuel Oil No. 2 Description: A mixture of petroleum hydrocarbons; a distillate of low sulfur content. Fuel oil no. 2 resembles kerosine. Used as a general-purpose domestic or commercial fuel in atomizing-type burners; as a fuel for trucks, ships and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.
Other Designations: CAS No. 68476-30-2, diesel oil.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(77) for a suppliers list.

R	1
I	-
S	2
K	2

NFPA

HMIS
H 0
F 2
R 0
PPG*
* Sec. 8

Cautions: Fuel oil No. 2 is a skin irritant and central nervous system depressant with high mist concentrations. It is an environmental hazard and a dangerous fire hazard when exposed to heat, flame, or oxidizers.

Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 2*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data†
None established	None established	None established	Rat, oral, LD_{50}: 9 g/kg; produces gastrointestinal effects (hypermotility, diarrhea)

* A complex mixture (<95%) of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons; sulfur content (<0.5%); and benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)].
† Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 363 to 634 °F (184 to 334 °C)
Viscosity: 268 centistoke at 100 °F (37.8 °C)
Specific Gravity: 0.8654 at 59 °F (15 °C)
Appearance and Odor: Brown, slightly viscous liquid.
Water Solubility: Insoluble
Pour Point:* <21 °F (-6 °C)

*Pour point is the lowest temperature at which a liquid flows from an inverted test container.

Section 4. Fire and Explosion Data

Flash Point: 100 °F (38 °C) min.	Autoignition Temperature: 494 °F (257 °C)	LEL: 0.6% v/v	UEL: 7.5% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, foam, water fog or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire.
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. This fuel oil's volatility is similar to gasoline's.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to health and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Fuel oil no. 2 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of fuel oil no. 2 yields various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon dioxide, carbon monoxide, and sulfur dioxide.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: Although it has not assigned an overall evaluation to fuel oil No. 2, the IARC has evaluated distillate (light) fuel oils as not classifiable as human carcinogen (Group 3; animal evidence limited).

mmary of Risks: Excessive inhalation of aersol or mist can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, unconsciousness, depending on concentration and time of exposure. Since intestinal absorption of longer chain hydrocarbons is lower than absorption from lighter fuels, a lesser degree of systemic effects and more diarrhea may result. When removed from exposed area, affected persons usually experience complete recovery. Hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result if oil is aspirated into the lungs. These results are more likely when vomiting after ingestion rather than upon ingestion, as is often the case with lower viscosity fuels. A comparative ratio of oral-to-aspirated lethal doses may be 1 pt vs. 5 ml. Prolonged or repeated skin contact may cause irritation of the hair follicles and may block the sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Central nervous system (CNS), skin, and mucous membranes.

Primary Entry Routes: Inhalation, ingestion.

Acute Effects: Systemic effects from ingestion include gastrointestinal (GI) irritation, vomiting, diarrhea, and, in severe cases, CNS depression, progressing to coma and death. Inhalation of aerosol or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish coloration of the skin and mucous membranes caused by deficient blood oxygenation).

Chronic Effects: Repeated contact with the skin causes dermatitis.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body are exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Contact a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Fuel oil no. 2 is an environmental hazard. Report large spills.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

ARA Extremely Hazardous Substance (40 CFR 355): Not listed

RA Toxic Chemical (40 CFR 372.65): Not listed

SHA Designations

Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for an OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in areas of storage or use.

Engineering Controls: Avoid prolonged skin contact and vapor or mist inhalation. Use only in a well-ventilated area with personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Fuel oil

DOT Hazard Class: Combustible liquid

ID No.: NA1993

DOT Label: None

OT Packaging Exceptions: 173.118a

OT Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 103, 126, 127, 132, 133, 136, 143

Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 474
Fuel Oil No. 6

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification 33

Fuel Oil No. 6 Description: A high-viscosity residual oil. Used to power heavy units such as ships, trucks, and trains. A thick paste, fuel oil No. 6 is not usually used unless preheated to decrease its viscosity.
Other Designations: CAS No. 68553-00-4, bunker C.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	1
I	-
S	2
K	2

NFPA

HMIS
H 0
F 2
R 0
PPG*
* Sec. 8

Cautions: Fuel oil No. 6 is a respiratory irritant and central nervous system (CNS) depressant. It is a moderate fire hazard when exposed to heat or flame.

Fuel oil No. 6*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data†
None established	None established	None established	Rat, oral, LD_{50}: 9 g/kg

* A complex mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, including polycyclic aromatic hydrocarbons. Sulfur content is <2.8%. A fuel oil No. 6 with low sulfur (0.2 and 1.2%) is commercially available.
† Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Boiling Point: 500 °F (>260 °C)
Vapor Pressure: 0.2 mm Hg at 70 °F (21 °C)
Viscosity: 36,000 centistoke at 100 °F (37.8 °C)
Specific Gravity: ~0.966
Water Solubility: Insoluble
Appearance and Odor: Black liquid to heavy paste with a petroleum odor.

Flash Point: 150 to 270 °F (66 to 132 °C)	Autoignition Temperature: 765 °F (407 °C)	LEL: 3.9% v/v	UEL: 20.1% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, foam, water fog, or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire. Cool fire-exposed containers with water spray.
Unusual Fire or Explosion Hazards: Fuel oil No. 6 is an OSHA Class IIIA combustible liquid that exhibits "boil-over" characteristics.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire hazard area. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Stability/Polymerization: Fuel oil No. 6 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of fuel oil No. 6 can produce various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon dioxide, carbon monoxide, and sulfur dioxide.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The IARC lists fuel oils, residual (heavy) as possible human carcinogen (Group 2B); animal evidence-limited.
Summary of Risks: Residual oils are generally more viscous and less toxic than kerosene due to their low volatility and limited absorption through the intestinal tract. Inhalation of heated or misted fuel oil No. 6 can cause the same systemic and local pulmonary effects seen with lighter grade fuel oils, respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and time of exposure. When removed from exposure area, affected persons usually experience complete recovery. The residual (heavy) oils have a lower aspiration hazard since heavy oils are more viscous. Aspiration is limited to inhalation from vomiting after ingestion and dilution with gastric contents. Significant ingestion is unlikely. In addition, intestinal absorption of long-chain hydrocarbons is low. Its primary toxicities, then, are its laxative effect, mild gastrointestinal (GI) irritation, and skin irritation. After prolonged skin contact, changes in rabbit bladder linings are reported. Prolonged or repeated skin contact may cause irritation and block the sebaceous glands, with a rash of acne-like pimples and spots, usually on the arms and legs. Repeated prolonged dermal contact may also have systemic effects. Heavy repeated application of fuel oil No. 6 to rabbit skin gave severe skin changes and systemic toxicity including an increased incidence of hyperplasia of the urinary bladder epithelium.*
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Central nervous system (CNS), skin, and mucous membranes.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Systemic effects from ingestion include gastrointestinal (GI) irritation, vomiting, diarrhea, and in severe cases, CNS depression, progressing to coma and death. Inhalation of aerosol or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish coloration of the skin and mucous membranes caused by deficient oxygentation of the blood).
Chronic Effects: Repeated skin contact causes dermatitis and possible systemic toxicity.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting*. Consulting a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk.

* EPA (TOSCA) document 8EHQ-0181-0377, December, 1980.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclaim or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Report large oil spills.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for an OSHA Class IIIA combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in area of storage or use.
Engineering Controls: Avoid prolonged skin contact and vapor or mist inhalation. Use only in a well-ventilated area with personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil-contaminated clothing. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)
DOT Shipping Name: Fuel oil
DOT Hazard Class: Combustible liquid
ID No.: NA1993
DOT Label: None
DOT Packaging Exceptions: 173.118a
DOT Packaging Requirements: None

MSDS Collection **References:** 1, 6, 7, 12, 73, 84, 103, 126, 131, 132, 133, 136, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 298
Jet Fuels

Issued: 8/90

Section 1. Material Identification 32

Jet Fuel Description: A petroleum distillate similar to kerosine composed of C_5 to C_{16} aliphatics, monocyclo-paraffins, aromatics, and olefins (for turbine engines only). Aromatics are a lower percentage for jet fuels, but there are a number of jet fuel types with somewhat different compositions and properties.
Other Designations: Jet A, Jet A-1, Jet B, Jet fuel HEF-3, JP-1, JP-4, JP-5, JP-6.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.
Cautions: *Jet fuel is volatile, combustible, and thus, a dangerous fire hazard.* It is a skin, eye, and respiratory tract irritant. *Ingestion can be harmful, even fatal.*

(a) Jet A and Jet A-1 (combustible) and JP-5 (flammable to combustible).
(b) Jet B (dangerous fire hazard) and JP-4 (dangerous fire hazard and moderate explosion hazard in the form of vapor).

R 1
I -
S 2
K 2-4*
* Varying flash points

NFPA (a): 2 / 0 / 0 / -
NFPA (b): 3 / 1 / 0 / -

HMIS		HMIS	
H	1	H	1
F	2	F	3
R	0	R	0
PPG†		PPG†	

† Sec. 8

Jet fuel, ca 100%

1989 OSHA PEL	1989-90 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data*
None established	None established	None established	Rat, oral, LD_{50}: 40 mg/kg Rat, inhalation, LC_{50}: 23 ppm/4 hr Rat, skin, LD_{50}: 317 mg/kg

* These toxicity data pertain to jet fuel HEF-3. See NIOSH, *RTECS* (MH5425100), for additional toxicity data.

Boiling Point: 300 to 550 °F (149 to 288 °C)
Vapor Pressure: 0.1 mm Hg at 20 °C
Viscosity: 1.0 to 2.0 cSt at 72 °F (40 °C)
Relative Density (15 °C/4 °C): 0.79 to 0.84
Water Solubility: Negligible

Appearance and Odor: A clear liquid with a hydrocarbon odor.

* Physical data vary with fuel type. These data pertain to kerosine jet fuels in general.

Flash Point: 100 °F (37.8 °C), OC*	Autoignition Temperature: 446 °F (230.2 °C)*	LEL: 0.6% v/v	UEL: 3.7% v/v
Jet A and Jet A-1: 110 to 150 °F (43.4 to 65.6 °C) Jet B: -16 to -30 °F (-26.7 to -34.5 °C) JP-1: 95 to 145 °F (35.0 to 62.8 °C) JP-4†: -10 to 30 °F (-23.4 to -1.1 °C) JP-5: 95 to 145 °F (35.0 to 62.8 °C)	JP-1: 442 °F (228 °C) JP-4: 468 °F (242 °C) JP-5: 475 °F (246 °C)	JP-4: 1.3% v/v	JP-4: 8.0% v/v

Extinguishing Media: For large fire, use water spray, fog, or foam. For small fires, use dry chemical or CO_2. Water may be ineffective in fighting fires involving materials with low flash points. Apply in the form of a spray.
Unusual Fire or Explosion Hazards: Jet fuel is volatile and combustible.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

*A higher kerosene cut than JP-4 with fewer impurities.
† 65% gasoline and 35% light petroleum distillate.

Stability/Polymerization: Jet fuels are stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: A violent reaction occurs with fluorine (F_2). Jet fuels are also incompatible with halogens, strong acids, alkalines, and oxidizers.
Conditions to Avoid: Avoid heat, sparks, flame, and build up of static electricity.
Hazardous Products of Decomposition: Thermal oxidative decomposition of jet fuel can produce carbon monoxide from incomplete combustion.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list jet fuels as a carcinogen.
Summary of Risks: Jet fuel is a moderate skin, eye, and respiratory irritant. Ingestion may be harmful or fatal. The most serious toxic effect following ingestion is aspiration pneumonitis.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic pulmonary disease should not be exposed to jet fuel vapor.
Target Organs: Central nervous system, respiratory tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Systemic exposure through the respiratory or gastrointestinal (GI) tract may result in increasing levels of central nervous system depression, manifest by a staggering gait, slurred speech, or mental confusion. These symptoms could progress to unconsciousness, coma, and death from respiratory failure. Exposure of lung tissue through aspiration of liquid jet fuel causes an immediate irritant and destructive reaction. The inflammatory lung changes cause a chemical pneumonitis, pulmonary edema (fluid in the lungs), and/or bleeding in the lung tissue. Secondary infection as a result of the injury, and scarring may occur with resultant permanent lung damage. The immediate clinical effects are increasing shortness of breath, coughing, bloody sputum, and chest pain. These symptoms may worsen over the following hours to days. Ingestion causes irritation to the GI tract characterized by vomiting, abdominal pain, and diarrhea. Other organs possibly injured through systemic exposure include parenchyma of the liver, kidney, pancreas, and spleen. Exposure to high mist concentrations may irritate the mucous membrane.
Chronic Effects: Chronic lung dysfunction may result from aspiration into the lungs. Prolonged or repeated skin contact can cause dermatitis.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting*. If the victim is nauseated, position head lower than knees to prevent aspiration. Administer vegetable oil and call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a jet fuel spill control and countermeasure program (SCCP).* Notify safety personnel, isolate hazard area and deny entry, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and direct contact with skin or eyes. Immediately absorb spilled jet fuel with noncombustible, inert material such as fire-retardent treated sawdust or diatomaceous earth. Using nonsparking tools, immediately shovel spilled material in appropriate containers for disposal. After completing material pickup, ventilate area and wash spill site. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear nonsparking shoes (rubber, cord, or sewn leather soles).
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials (Sec. 5). Outside or detached storage is preferred.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Use with appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Jet fuel's greatest hazard is its fire potential. Train all employees to use fire-extinguishing equipment. Perform fire drill exercises periodically. Take all measures to prevent static electricity: electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. Maintain and test grounding and bonding connections. Do not use drag chains or cables on fueling vehicles. After filling jet fuel storage tanks, wait 30 min before opening hatches to permit the relaxation of any static charges generated during filling or hauling. Empty containers or drums retaining residue (liquid and/or vapor) can be dangerous. Do not expose to heat or ignition sources. All drums should be completely drained, properly bunged, and promptly disposed of per local regulations. Practice good personal hygiene and housekeeping procedures. Take care in handling hoses, cans, and funnels wet with jet fuel. Before touching with bare hands, carefully wipe jet fuel containers. Properly dispose of wet rags per EPA hazardous waste requirements. Avoid contamination of jet fuel with water, rust, scale, dirt, and other petroleum products. Use commercial kits (Hydrokit, Aqua-Glo, or "Clear and Bright") to detect water and dirt, respectively.

Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection **References:** 1, 73, 84, 103, 126, 132, 133, 136
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Otto Fuel II

CHAPTER 3

GENERAL PROPERTIES AND HAZARDS CRITERIA

3-1. SCOPE.

3-2. This chapter presents information on the chemical nature and physical properties of Otto Fuel II. The chapter also describes the health, fire, and explosion hazards associated with Otto Fuel II.

3-3. PROPERTIES.

3-4. CHEMICAL COMPOSITION. Otto Fuel II is a stable, liquid monopropellant composed of a nitrate ester in solution with a desensitizing agent and a stabilizer. The chemical composition and specification for Otto Fuel II are listed in table 3-1 and MIL-O-82672(OS).

Table 3-1. Otto Fuel II Chemical Composition

Ingredient	Percentage	Function
Propylene glycol dinitrate	76.0	Energetic component
Dibutyl sebacate	22.5	Desensitizer
2-Nitrodiphenylamine	1.5	Stabilizer

3-5. GENERAL APPEARANCE. Otto Fuel II is a bright-red, free-flowing, oily liquid which is heavier than water; however, when in a thin layer (i.e., spill, stain, or leak), Otto Fuel II is a yellow-orange color.

3-6. CHEMICAL NATURE. Otto Fuel II is a noncorrosive liquid monopropellant with an extremely low vapor pressure which minimizes the explosive and toxic hazard. Otto Fuel II can be made to detonate, but the conditions and stimulus required are so extreme that it is considered a nonexplosive. The propellant has a high flash point and other safety characteristics which permit it to be classified as a low fire hazard material.

3-7. Solubility. Table 3-2 lists the solubilities of Otto Fuel II in various liquids. Since all components are insoluble in water, a spill washed down with water does not leave a residue more explosive than the original mixture.

Table 3-2. Solubilities of Otto Fuel II in Various Liquids

Insoluble	Slightly soluble	Very soluble
Ethylene glycol	Fuel oil	Acetone
Propylene glycol	Heptane	Alcohols
Water	Kerosene	Dibutyl phthlate
	Petroleum ether	

3-8. Stability. The decomposition of a nitrate ester, such as Otto Fuel II, is continuous and dependent upon time and temperature. The function of the stabilizing material in Otto Fuel II is to control this decomposition rate so that the fuel can remain a usable material for as long as possible. In controlling the rate of decomposition, the stabilizer reacts with the products of the nitrate ester decomposition. The products of this reaction are only slightly soluble in Otto Fuel II. Discovery of a crystalline precipitate in Otto Fuel II is good evidence that the propellant has been exposed to unusually high temperatures for an extended period of time.

NOTE

If a precipitate appears in Otto Fuel II, the condition should be brought to the attention of the Naval Ordnance Station, Indian Head, MD, Code 5252, as soon as it is detected, even though it does not present an immediate hazard.

3-9. Decomposition Conditions. In normal circumstances, the unusual decomposition conditions noted in the preceding section will never be observed. Tests have shown that the fuel is thermally stable at temperatures up to 150° F for several years, up to 180° F for a few months, and up to 250° F for about 30 minutes. Above 250° F there is serious danger of self-heating and decomposition. At temperatures exceeding 290° F, rapid self-heating and decomposition of the fuel will occur with container rupture and fire as a very likely consequence.

3-10. Safe-Life. The predicted safe life of Otto Fuel II at various temperatures, based on high-temperature stability tests, is shown in table 3-3. No significant changes have been found in samples of fuel which have been held for over 9 years at 122° F or in fuel which has been in the fleet for 6 years. To ensure an adequate useful life for this fuel, the recommended storage limits have been set at −18° F to 140° F. The low temperature storage limit of −18° F is recommended to prevent freezing of Otto Fuel II. For individual weapons which are required to have a lower storage limit, the Otto Fuel II could be stored frozen.

3-11. PHYSICAL PROPERTIES. The physical properties of Otto Fuel II are listed in table 3-4. Otto Fuel II is heavier, less volatile, and slightly more viscous than water or ethyl alcohol. Otto Fuel II, compared with water, has a lower freezing point and about half the surface tension.

WARNING

Personnel shall not be exposed to Otto Fuel II vapor concentrations in excess of 0.2 ppm (1.3 mg/m^3).

3-12. HAZARDS.

3-13. HEALTH. The ingredient of medical concern in Otto Fuel II is the nitrated ester, propylene glycol dinitrate (PGDN). Nitrated esters are known for their acute effects on the human body. These include nasal congestion, headache, dizziness, nausea, dilation of blood vessels, decrease in blood pressure, and labored breathing.

Table 3-3. Safe Life of Otto Fuel II at Various Temperatures

Storage temperature (°F)	Minimum safe life (days)
195	24
180	112
165	500
150	2,256 (6 yr)
135	10,000 (27 yr predicted)
122	37,500 (102 yr predicted)

3-14. Toxic Effects. Toxic effects may occur from the inhalation of Otto Fuel II vapors, inhalation of combustion by-products (see paragraph 3-18), absorption from direct skin contact, or ingestion.

3-15. Chronic Effects. Chronic effects of long-term exposure to Otto Fuel II or to PGDN are unknown. The severity of the toxic effects varies with the concentration, length of exposure, and temperature of the propellant.

3-16. Tolerances. Tolerance to the effects of exposure to Otto Fuel II does occur. Headache, dizziness, and a fall in blood pressure often appear during the first few days of excessive exposure. Tolerance may then develop and the rest of the working week is usually symptom-free. On returning to work on Monday after a weekend without exposure, the first contact with the organic nitrates often produces the symptoms again.

Table 3-4. Physical Properties of Otto Fuel II Compared with Common Liquids

Property	Otto Fuel II	Water	Ethyl alcohol
Density	1.232 g/ml at 77° F	1.000 g/ml at 40° F	0.7950 g/ml at 77° F
Flash point (Cleveland open cup)	265° F	—	70° F[1]
Freezing point	−18.4° F	32° F	−174° F
Surface tension	34.45 dynes/cm at 77° F	71.97 dynes/cm at 77° F	22.75 dynes/cm at 68° F
Vapor pressure	0.0877 mm Hg at 77° F	23.75 mm Hg at 77° F	46.75 mm Hg at 68° F
Viscosity	4.04 cp at 77° F	1.0 cp at 68° F	1.2 cp at 68° F
Water saturation point	0.31% at 77° F	—	Completely miscible

[1]Flash point (open cup).

3-17. Air Concentrations. Individuals vary in their sensitivity to air concentration of Otto Fuel II. Normally, nasal congestion is the first sign of exposure to Otto Fuel II vapors. Otto Fuel II concentrations of less than 1.0 parts per million (ppm), but greater than 0.4 ppm, produce a complete nasal blockage in some individuals. A headache, lasting for several hours after exposure, is the chief symptom of vapor inhalation, although nausea may develop after prolonged exposure. The threshold limit value (TLV) for Otto Fuel II established by the Bureau of Medicine and Surgery of the Navy is 0.2 ppm [1.3 milligram/cubic meter (mg/m^3)] ceiling, "C". This threshold limit is established as a ceiling value, meaning it is never to be exceeded.

3-18. Combustion By-Products. The by-products from the combustion of Otto Fuel II include carbon monoxide (CO), carbon dioxide (CO_2), hydrogen (H_2), methane (CH_4), and hydrogen cyanide (HCN). The CO, CO_2, and HCN gases present toxic hazards to personnel. See chapter 4 for more detail.

3-19. EXPLOSION. Safety tests including drop tests, projectile impact tests, bullet impact tests, and card gap tests have resulted in the classification of Otto Fuel II as a nonexplosive. However, Otto Fuel II can be detonated when a sufficiently strong booster is used. OP 5 describes Otto Fuel II as liquid propellant hazard group I, compatibility group G.

3-20. FIRE. Otto Fuel II is classified as liquid propellant hazard group I, a relatively low fire hazard, by military service regulations. Group I materials are considered to be the least hazardous of the liquid propellants.

4-33. USE REQUIREMENTS. Requirements for the use of protective equipment and clothing are dependent on the degree of hazard involved. See table 4-2 for the body protective items required for each Otto Fuel II operation. An adequate supply and inventory of protective clothing and safety equipment shall be maintained at all times. A list of the required items for Otto Fuel II handling is presented in appendix C and includes the following:

a. Clothing. Clothing items consist of disposable shirts, trousers, and aprons.

WARNING

Do not use polyvinyl chloride or latex gloves, such as surgical gloves, in Otto Fuel II handling operations. These gloves provide almost no protection against Otto Fuel II.

b. Gloves. Gloves shall be worn to protect the hands from direct contact with Otto Fuel II during all handling operations. Gloves shall be replaced immediately if torn, damaged, or seriously contaminated.

c. Booties. Footwear covers shall be worn over shoes during routine working conditions whenever there is a possibility of footwear contamination by accidental spillage, splashing, or dripping of Otto Fuel II.

d. Boots. Whenever there is a gross spillage of Otto Fuel II, neoprene or natural rubber boots shall be worn for cleanup operations. The boots shall be thoroughly cleaned and decontaminated following each use with detergent and lukewarm water. Boots shall discarded when they show signs of deterioration.

e. Eye Protection. Industrial goggles or a faceshield shall be worn whenever there is a possibility of splashing or spraying of Otto Fuel II or cleaning solvent.

4-34. DISPOSITION OF CONTAMINATED CLOTHING AND EQUIPMENT. Protective equipment need not be discarded following each use if free of contamination. Those items which are stained, contaminated, or torn shall be discarded as unsuitable for further use. Caution shall be exercised in removing and handling contaminated clothing and protective equipment to prevent exposure to the fuel. Contaminated protective clothing items and other expendables shall be tightly sealed in plastic disposal bags and disposed of as Otto Fuel II solid waste (See paragraph 6-63).

4-35. FIRE AND EXPLOSION SAFETY.

4-36. FIRE. Otto Fuel II has been classified as a low fire hazard. Attempts to burn Otto Fuel II in bulk at atmospheric pressure and temperatures under 250° F have been unsuccessful; however, a finely dispersed spray Otto Fuel II may be readily ignited in an atmosphere containing oxygen. Furthermore, the propellant may be ignited in bulk when heated above 265° F. When porous or absorbent material, such as paper, rags, or fiberglass, is present to act as a wick, Otto Fuel II can be easily ignited at room temperature.

Table 4-2. Use Requirements for Protective Clothing

Operations	Protective apparel			
	Shirts, pants, and aprons	Gloves	Goggles/ faceshield	Booties
Mk 46 Torpedo				
Baffle removal	X	X	X	X
Mk 48 Torpedo				
Fuel pump priming	X	X	X	X
Mk 46 and Mk 48 Torpedo:				
Fueling/defueling	X	X	X	X
Fuel pump breakdown	X	X	X	
Afterbody breakdown	X	X	X	X
Washing or handling contaminated parts	X	X	X	X
Degreasing operation	X	X	X	X
Clean up minor fuel spills		X		
Clean up large fuel spills	X	X	X	X[1]
Retrieval operations	X	X		

[1]Boots are required for cleanup of large fuel spills.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 9
Sulfuric Acid, Concentrated

Issued: 10/77 Revision: D, 9/92

Section 1. Material Identification

Sulfuric Acid Concentrated (H_2SO_4) Description: Prepared by the "Cat-Ox" process; by the contact process (vanadium pentoxide catalyst) with sulfur, pyrite (FeS_2), hydrogen sulfide, or sulfur-containing smelter gases; and from gypsum (calcium sulfate). Sulfuric acid is by far the most widely used industrial chemical. Its uses include: in the manufacture of fertilizers, chemicals, nitrate explosives, parchment paper, glue, dyes and pigments; as an etchant, a lab reagent, an electrolyte in lead/acid batteries, a dehydrating agent in the manufacture of ethers and esters, and an alkylation catalyst; in the purification of petroleum, the refining of mineral and vegetable oils, the leather industry, the carbonization of wool fabrics, the recuperation of fatty acids from soapworks waste water, the production of rayon and film, the extraction of uranium from pitchblende, and pickling of metal; in electroplating baths, gas drying and nonferrous metallurgy; and to obtain glucose by the hydrolysis of cellulose.

Other Designations: CAS No. 7664-93-9, battery acid, BOV, Caswell No 815, dipping acid, electrolyte acid, hydrogen sulfate, matting acid, oil of vitriol, sulphuric acid, vitriol brown oil.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Handle concentrated sulfuric acid with extreme caution because it is corrosive to all body tissues. Vapor inhalation can cause severe lung damage. Skin or eye contact can produce severe burns; blindness may result.

R	1
I	3
S	4
K	0

NFPA

HMIS
H 3*
F 0
R 2
PPE†
* Chronic effects
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Sulfuric acid concentrated, 93-98% sulfuric acid; remainder is water. Impurities include nonvolatiles, 0.02-0.03 ppm; SO_2, 40-80 ppm; iron, 50-100 ppm; nitrate, 5-20 ppm.

1991 OSHA PEL
8-hr TWA: 1 mg/m^3

1990 IDLH Level
80 mg/m^3

1990 NIOSH REL
TWA: 1 mg/m^3

1992-93 ACGIH TLVs
TWA: 1 mg/m^3
STEL: 3 mg/m^3

1990 DFG (Germany) MAK
TWA: 1 mg/m^3
Category: Local irritants
Peak: 2 mg/m^3, 5 min, momentary value †, 8 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 3 mg/m^3 for 24 weeks; toxic effects not yet reviewed.
Man, unreported route, LD_{Lo}: 135 mg/kg; toxic effects not yet reviewed.
Rat, oral, LD_{50}: 2140 mg/kg; toxic effects not yet reviewed.
Rabbit, eye: 100 mg rinse produced severe irritation.

* See NIOSH, *RTECS* (WS5600000), for additional toxicity data.
† The momentary value is a level which the concentration should never exceed.

Section 3. Physical Data

Boiling Point: 554 °F (290 °C); decomposes at 644 °F (340 °C) into sulfur trioxide and water.
Melting Point (100%): 50.65 °F (10.36 °C)
Vapor Pressure: <0.001 mm Hg at 20 °C
Saturated Vapor Density (air = 1.2 kg/m^3): 1.2 kg/m^3, 0.075 lbs/ft^3
pH: 1 N sol = 0.3, 0.1 N sol = 1.2, 0.01 N sol = 2.1

Molecular Weight: 98.08
Density/Specific Gravity (96-98%): 1.841
Water Solubility: Soluble; reacts!*
Other Solubilities: Ethyl alcohol
Odor Threshold: 0.150 ppm

Appearance and Odor: Colorless (pure) to dark brown (impure), odorless, dense, oily liquid. Pure compound is a solid below 51 °F (11 °C).

* Sulfuric acid reacts violently with water with the evolution of heat. *Always add the acid to water or other diluent, not the water to acid!*

Section 4. Fire and Explosion Data

Flash Point:	Autoignition Temperature:	LEL:	UEL:
Not combustible	None reported	None reported	None reported

Extinguishing Media: Use extinguishing media appropriate to surrounding fire. Only use water if absolutely necessary and use with great caution. Water applied directly to sulfuric acid results in violent heat liberation and splattering of the material. Use water spray only to keep fire-exposed containers cool. **Unusual Fire or Explosion Hazards:** Sulfuric acid, a strong dehydrating agent, reacts with organic materials and produces enough heat ignition, chars wood, and may cause ignition of finely divided materials on contact. Reaction with metals may produce highly flammable, hydrogen gas. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is *not* effective. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Sulfuric acid is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include acetic acid; acetone cyanohydrin; (acetone + nitric acid); (acetone + potassium dichromate); acetonitrile; acrolein; acrylonitrile; acrylonitrile + water; (alcohol + hydrogen peroxide); allyl alcohol; allyl chloride; ammonium hydroxide; 2-amino ethanol; ammonium; triperchromate; aniline; (bromates + metals); bromine pentafluoride; *n*-butyraldehyde; carbides; cesium acetylene carbide; chlorates; (chlorates + metals); chlorine trifluoride; chlorosulfonic acid; cuprous nitride; diisobutylene; (dimethylbenzylcarbinol + hydrogen peroxide); epichlorohydrin; ethylene cyanohydrin; ethylene diamine; ethylene glycol; ethylene imine; fulminates; hydrochloric acid; hydrogen; iodine heptafluoride; (indene + nitric acid); iron; isoprene; lithium silicide; mercuric nitride; mesityl oxide; powdered metals; (nitric acid + glycerides); *p*-nitrotoluene; pentasilver trihydroxydiaminophosphate; perchlorates; perchloric acid; (permanganates + benzene); (1-phenyl-2-methylpropryl alcohol + hydrogen peroxide); phosphorus; phosphorus isocyanate; picrates; potassium *tert*-butoxide; potassium chlorate; (potassium permanganate + potassium chloride); (potassium permanganate + water); beta-propiolactone; propylene oxide; pyridine; rubidium acetylene carbide; silver permanganate; sodium; sodium carbonate; sodium chlorate; sodium hydroxide; steel; styrene monomer; (toluene + nitric acid); vinyl acetate; and water. **Conditions to Avoid:** Water, combustibles, heat, ignition sources, and other incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of sulfuric acid can produce sulfur oxides.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list sulfuric acid as a carcinogen. However, a number of studies have associated exposures to sulfuric acid or to acid mists in general with laryngeal cancer. In 50 confirmed cases there was an approximately four-fold increased risk among highly exposed individuals relative to matched controls. It is not known if sulfuric acid can act as a direct carcinogen, as a promoter, or in combination with other substances.[167] **Summary of Risks:** Concentrated sulfuric acid is a severe respiratory tract, skin, and eye irritant.

Continue on next page

Copyright © 1992 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Exposure can result in severe burns, tissue damage, scarring, functional inhibition, and blindness if splashed in the eye. Although ingestion is unlikely, it may cause severe injury and death. **Medical Conditions Aggravated by Long-Term Exposure:** Chronic respiratory, gastrointestinal, nervous, skin or eye diseases. **Target Organs:** Respiratory system, eyes, skin, and teeth. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor or mist inhalation causes coughing, sneezing, nose irritation and nose bleeds, reflex bronchospasm, shortness of breath, pulmonary edema (fluid in lungs), emphysema, and permanent changes in pulmonary function. Ingestion causes corrosion of the mucous membranes of mouth, throat, and esophagus; and epigastric pain with nausea and vomiting of mucoid and "coffee ground" material. Skin contact produces severe burns; initially the zone of contact is bleached and turns brown prior to the formation of a clearly defined ulcer. These wounds are slow in healing and may cause extensive scarring that results in functional inhibition. If burns are extensive, the outcome may prove fatal. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death. Eye contact produces deep corneal ulceration, kerato-conjunctivitis, palpebral lesions, and possible blindness. **Chronic Effects:** Chronic effects may include dental erosion, conjunctivitis, tracheobronchitis, emphysema, stomatitis (inflammation of the mouth mucous membranes), gastritis (inflammation of stomach mucous membranes), and dermatitis. **FIRST AID Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Use a 2% sodium bicarbonate solution to further neutralize any H_2SO_4 on the skin. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water or milk to dilute. *Do not* induce vomiting! Do not attempt to neutralize the acid with sodium bicarbonate. **Note to Physicians:** Monitor arterial blood gases, chest x-ray, and pulmonary function tests if respiratory tract irritation or respiratory depression is evident. Treat dermal irritation or burns with standard topical therapy.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all ignition sources, and provide adequate ventilation. Cleanup personnel should wear fully-encapsulating, vapor-protective clothing to protect against inhalation and skin or eye contact. Keep water and combustibles away from release. Stop or control leak if this can be done without undue risk. Neutralize small spills with sodium bicarbonate or a mixture of soda ash/slaked lime (50/50) and place into sealed containers for disposal. If a neutralizing agent is not available, absorb spilled sulfuric acid with vermiculite, dry sand, or earth. *Never* use organic material (e.g., sawdust) to absorb spill. For large spills, dike far ahead to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). Report any release in excess of 1000 lbs. **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Neutralize waste water pH between 5.5 and 8.5. Follow applicable Federal, state, and local regulations.

Aquatic Toxicity: LC_{50} (saltwater, prawns): 42.5 ppm for 48 hrs; lethal (freshwater, bluegill): 24.5 ppm/24 hr.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311(b)(4)]

Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 1000 lbs.

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations < 25 mg/m^3 use any powered, air-purifying respirator with acid gas cartridge(s) in combination with a high-efficiency particulate filter. For concentrations < 50 mg/m^3, use any chemical cartridge respirator with a full facepiece and acid gas cartridge(s) in combination with a high-efficiency particulate filter. For concentrations < 80 mg/m^3, use any supplied air-respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. H_2SO_4 has a minor to moderate effect on neoprene or rubber.[131] **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in clearly labelled, steel containers in a cool [below 50 °F (10 °C)], dry, well-ventilated location on an acid-resistant cement floor and away from direct sunlight, combustibles, and other reactive materials. Separate from carbides, chlorates, fulminates, nitrates, picrates, and powdered metals. Protect storage containers against damage and water. Use non-sparking tools near sulfuric acid carboys, drums, tank cars, or metal storage tanks because of the possible production of hydrogen during storage. Use hand pumps for the decanting and emptying of carboys. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Total enclosures of processes and the mechanization of handling procedures are the most effective measures to prevent contact with sulfuric acid. Protect electrical installations against the corrosive action of acid vapors. **Administrative Controls:** Consider preplacement and periodic physical examinations with emphasis on the respiratory tract (including pulmonary function tests), skin, eyes, and teeth.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Sulfuric acid
DOT Hazard Class: 8
ID No.: UN1830
DOT Packaging Group: II
DOT Label: Corrosive
Special Provisions (172.102): A3, A7, B2, B83, B84, N34, T9, T27

Packaging Authorizations
a) Exceptions: 173.154
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 1L
b) Cargo Aircraft Only: 30L

Vessel Stowage Requirements
a) Vessel Stowage: C
b) Other: 14

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 131, 132, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 180
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MPH

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Attachment D
Emergency Procedures for Exposure to Hazardous Materials/Waste

ATTACHMENT D

EMERGENCY PROCEDURES FOR EXPOSURE TO HAZARDOUS MATERIALS/WASTE

1. Call ambulance or transport individual to hospital/clinic immediately. Don't forget to take the HASP with you; it contains information on the contaminants expected to be found on site and will assist the physician in his/her assessment of the exposure.

2. Fill in Potential Exposure Report, answering each of the questions to the best of your ability.

3. Contact our physician(s) at EMR as soon as possible. The procedure is as follows:

   a. **Call EMR at 1-800-229-3674!**

   b. Ask to speak with:

      Dr. David L. Barnes;
      Dr. Elaine Theriault; or
      Ms. T.J. Wolff, R.N.

Note: During nonbusiness hours (after 6 p.m.) call 1-800-229-3674 and follow directions for paging the aforementioned individuals.

4. Once in contact with any of these individuals, explain what has happened (they will review the information on the form with you and may ask you to fax the form to them, if possible), and allow either of them to speak with the attending physician.

5. When asked about payment (and they will ask), inform the Hospital/Clinic/Physician that this is a "work related injury" and have them contact Ms. Teresa Nelson at (412) 269-4655. Have invoices sent to:

   Michael Baker Jr. Inc.
   Attn: Benefits Coordinator
   Airport Office Park, Bldg. 3
   Coraopolis, PA 15108

6. Contact the Project Manager and the Project Health and Safety Officer as soon as it is feasible, but wait no longer than 24 hours.

POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

I. Exposing Agent

Name of Product or Chemicals (if known) _____

_____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? _____

How long did individual work in area before signs/symptoms developed?

_____

Was protective gear being used? If yes, what was the PPE?

_____

Was there skin contact? _____

Was the exposing agent inhaled? _____

Were other persons exposed? If yes, did they experience symptoms?

_____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately with Exposure:

- ☐ Burning of eyes, nose, or throat
- ☐ Tearing
- ☐ Headache
- ☐ Cough
- ☐ Shortness of breath
- ☐ Delirium
- ☐ Chest tightness/pressure
- ☐ Nausea/vomiting
- ☐ Dizziness
- ☐ Weakness
- ☐ Heat flashes
- ☐ Other

Delayed Symptoms:

- ☐ Weakness
- ☐ Nausea/vomiting
- ☐ Shortness of breath
- ☐ Cough
- ☐ Loss of appetite
- ☐ Abdominal pain
- ☐ Headache
- ☐ Numbness/tingling
- ☐ Other

IV. Present Status of Symptoms (check off appropriate symptoms)

- ☐ Burning of eyes, nose, or throat
- ☐ Tearing
- ☐ Headache
- ☐ Cough
- ☐ Shortness of breath
- ☐ Chest tightness/pressure
- ☐ Cyanosis (bluish skin color)
- ☐ Nausea/vomiting
- ☐ Dizziness
- ☐ Weakness
- ☐ Loss of appetite
- ☐ Abdominal pain
- ☐ Numbness/tingling
- ☐ Other _____

Have symptoms (please check off appropriate response and give duration of symptoms):

Improved _____ Worsened _____ Remain Unchanged _____

V. Treatment of Symptoms (check off appropriate response)

None _____ Self-medicated _____ Physician treated _____

VI. Name _____
(Attending physician)

VII. Hospital/Clinic _____

Source:
EMR, Inc.

FINAL

COMMUNITY RELATIONS PLAN ADDENDUM

RCRA FACILITY INVESTIGATION

NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

CONTRACT TASK ORDER 0223

SEPTEMBER 14, 1995

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

TABLE OF CONTENTS

		Page
7.0	**ADDENDUM INTRODUCTION**	**7-1**
8.0	**CONVERSION TO RCRA**	**8-1**
8.1	RCRA Facility Investigation (RFI)	8-1
9.0	**SITE DESCRIPTIONS AND STUDY RESULTS TO DATE**	**9-1**
9.1	SWMU 1 - Former Cremator Disposal Site (IR Site No. 5)	9-1
9.2	SWMU 2 - Langley Drive Disposal Site (IR Site No. 6)	9-2
9.3	SWMU 3 - Base Landfill (IR Site No. 7)	9-3
9.4	SWMU 6 - Building 145 (IR Site No. 11)	9-4
9.5	SWMU 9 - Tank 212-217 Sludge Burial Pits (IR Site No. 13)	9-5
9.6	SWMU 10 - Substation 2/Building 90 (IR Site No. 15)	9-6
9.7	SWMU 11/45 - Old Power Plant/Building 38 (IR Site No. 16)	9-7
9.8	SWMU 12 - Fire Training Pit Oil/Water Separator	9-8
9.9	SWMU 13 - Old Pest Control Shop/Building 258 (IR Site 18)	9-9
9.10	SWMU 14 - Fire Training Pit Area (IR Site 17)	9-10
9.11	SWMU 23 - Oil Spill Separator Tanks	9-11
9.12	SWMU 24 - Oil Spill Oil/Water Separator and Adjoining Pad	9-12
9.13	SWMU 25 - DRMO Storage Yard	9-12
9.14	SWMU 26 - Building 544 Area	9-13
9.15	SWMU 31 - Waste Oil Collection Area/Buildings 31 and 202 (IR Site 10)	9-14
9.16	SWMU 32 - PWD Storage Yard/Battery Collection Area/Building 31 (IR Site 10)	9-15
9.17	SWMU 37 - Waste Oil Storage Area/Building 200	9-16
9.18	SWMU 39 - Building 3158/Former Battery Drain Area	9-16
9.19	SWMU 45 - Part of IR Site 16	9-17
9.20	SWMU 46 - Pole Storage Yard Covered Pad	9-17
9.21	SWMU 51 - New AIMD Storage Pad/Building 379	9-18
9.22	Area of Concern (AOC) B - Building 25 (IR Site 10)	9-18
9.23	Area of Concern C - Transformer Storage Pad	9-19
10.0	**ROLES, RESPONSIBILITIES AND ACTIVITIES**	**10-1**
11.0	**SUMMARY**	**11-1**

LIST OF TABLES

Number

8-1 IR and SWMU List
8-2 SWMUs/AOCs Media Subject to Corrective Action Requirements

10-1 Community Relations Activities

LIST OF FIGURES

Number

8-1 SWMU/AOC Locations

7.0 ADDENDUM INTRODUCTION

This Community Relations Plan (CRP) addendum has been prepared to provide an update of the U. S. Navy's environmental studies at Naval Station Roosevelt Roads (NSRR) to the communities of Roosevelt Roads, Ceiba, and Vieques. To avoid confusion, this addendum will continue the Table of Contents numbering, starting with Section 7.0, Addendum Introduction, to follow Section 6.0, References. As described earlier in the CRP in Section 2.5 The IR Program at Naval Station Roosevelt Roads, the Station's environmental studies have been transferred from compliance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulations to compliance with the Resource Conservation and Recovery Act (RCRA) regulations. This conversion will be explained in Section 8.0, Conversion to RCRA, while updated descriptions of the former IR Program sites and additional sites will be provided in Section 9.0, Site Descriptions. Section 10.0 provides information about the roles, responsibilities and community relations activities under RCRA and Section 11.0 provides a summary of this addendum.

7.1 Community Relations Activities for Naval Station Roosevelt Roads, Ceiba, Puerto Rico

The following subsections provide a brief summary of Community Relations activities to date.

7.1.1 Community Relations Plan (CRP)

The Station held a series of community relations interviews during June 1992. A total of 17 persons were interviewed regarding the IR Program at the station. The interview participants included station personnel, local residents and local officials. The interview responses formed the basis of the station's CRP which was finalized August 1993 and printed in both Spanish and English. The CRP provides a review of the IR Program, site and community information, and also contact persons. The CRP serves as a guide for the Public Affairs Office and Environmental Office to communicate effectively with the public. A schedule of required and recommended communication activities for each stage of the IR Program was provided to the station.

7.1.2 Information Repositories

The station established several information repositories at community libraries. Draft and draft final documents as well as correspondence, meeting minute notes and other IR Program information are housed in the repositories.

7.1.3 Technical Review Committee (TRC)

The TRC consists of Commonwealth of Puerto Rico and federal regulators, representatives from Ceiba and Vieques, Station personnel and community representatives. The function of the TRC is to provide technical review of work plans and documents and to serve as another vehicle of public involvement in the Department of Defense's (DOD's) Installation Restoration Program. The TRC group is currently in the process of converting to a Restoration Advisory Board (RAB) in accordance with a Chief of Naval Operations directive. The purpose of the conversion is to expand the group and provide an open forum for Navy and public participation. The membership of the RAB will be expanded to include additional community representatives to appropriately reflect the diverse interests of the community. Membership may include but is not limited to local officials, school district representatives, civic club members and other interested community members. The expressed purpose of the RAB is to allow increased public participation. As such, the meetings are open to the public, and notice of the meetings will be published in the local newspaper.

8.0 CONVERSION TO RCRA

As explained in Section 2.5, The IR Program at Naval Station Roosevelt Roads, the goal of the CERCLA program is to study and cleanup, if necessary, former waste sites. While former practices may have been appropriate in the past, new technologies have been developed and the former ways of waste disposal are now not seen as protective of human health and the environment. Many of the IR Program sites at the Station are former waste disposal sites. Some sites are some still in use, for example the Station landfill.

In addition to the IR Program sites, there are areas at the Station called Solid Waste Management Units, or "SWMUs." These areas are also regulated by RCRA. The U.S. Environmental Protection Agency (USEPA) calls a SWMU any unit at which solid wastes have been placed at any time, whether that unit was intended or not for solid or hazardous waste management. This definition includes areas at which wastes have been released in a routine, deliberate, and systematic manner. According to this definition, a SWMU may include landfills, waste storage areas, or even a concrete pad where drums were stored. Sometimes, SWMUs are grouped together, for ease of study, to form Areas of Concern, or "AOCs." These groupings may be based upon geographical location or similarities of wastes or chemicals of concern.

8.1 RCRA Facility Investigation (RFI)

All of the IR Program sites were combined with the SWMUs or AOCs under the RCRA program. Some IR sites were grouped with SWMUs according to either common location or by the type of waste handled. Table 8-1, IR and SWMU List, identifies the IR sites with their new SWMU designation.

A Draft RCRA Part B permit has been issued by USEPA Region II to NSRR. This permit contains requirements for Remedial Facility Investigation (RFI) activities at 22 SWMUs and 2 AOC. Table 8-2 provides a list of these SWMUs and AOCs. The table also provides a list of which media (i.e., groundwater, soil, etc.) require study. SWMU/AOC locations are presented on Figure 8-1 as seen on Table 8-2, requirements vary for each SWMU/AOC. For example, some SWMUs require a first phase RFI while others require a full phase RFI. A first phase RFI is required at these sites where available information indicates the potential is present for a release of hazardous waste or hazardous constituents. It is the intent of these preliminary investigations to establish whether a release has occurred. A full phase RFI is required where waste releases were established during previous investigations.

This Community Relations Plan Addendum is one of five project plans associated with the RFI. Other RFI project plans include:

- Project Management Plan
- Data Collection Quality Assurance Plan
- Data Management Plan
- Health and Safety Plan

Background information on the SWMUs/AOC, including the results of previous environmental investigations, is presented in the Project Management Plan. The specific RFI scope of work for each SWMU/AOC is presented in the Data Collection Quality Assurance Plan. These documents are available in the information repositories.

9.0 SITE DESCRIPTIONS AND STUDY RESULTS TO DATE

The following site descriptions are supplements for Section 2.5, The IR Program at Naval Station Roosevelt Roads. Some information is repeated for ease of reading. For the IR sites, the format is to present information about the location, years of operation, waste disposed or history, studies/results and future action while for the "new" Sites, the available information is not as complete.

9.1 SWMU 1 - Former Cremator Disposal Site (IR Site No. 5)

Location: The Army Cremator site is located south of the intersection of the access road to the Coast Guard Pier and Langley Drive, west and southwest of the Navy Exchange and Bowling Alley, and near the Ensenada Honda Mangrove Swamp (NEESA, 1984).

Years of Operation: The site operated as the Station Landfill from the early 1940s until the early 1960s.

Waste Disposed: An estimated 100,000 tons of waste including scrap metal, inert ordnance, batteries, tires, appliances, cars, cables, dry cleaning solvent cans, paint cans, gas cylinders, construction debris, dead animals, and residential waste was disposed of at this site (NEESA, 1984). No reliable information exists regarding the amounts of material present in the disposal area that could be hazardous; however, in 1984, the Initial Assessment Study (IAS) team estimated that as much as 1,000 tons of hazardous material could be present in the area (NEESA, 1984).

Studies/Results:

- In 1988, Environmental Science and Engineering (ESE) sampled surface water, sediment and groundwater. The sediment, surface water and groundwater samples contained elevated levels of metals. Low levels of organic compounds were also detected in some of the groundwater samples (Technical Review Committee Meeting Minutes, 1989).

- In 1993, Baker Environmental, Inc. (Baker) sampled groundwater and soil. Trace organic contaminants were detected in each media. The results of a risk assessment indicated no threat to human health or the environment associated with the soil or groundwater.

Future: A full RFI is planned for the site. Results of previous investigations will be used to satisfy RFI requirements. Previous environmental investigations at this SWMU have adequately characterized the soil, surface water and sediment. As a result of this, the planned RFI activities will focus on groundwater.

9.2 SWMU 2 - Langley Drive Disposal Site (IR Site No. 6)

Location: The Langley Disposal Site is located along Langley Drive approximately 2,000 feet north of the Navy Exchange Complex and 300 feet east of the drive towards Ensenada Honda.

Years of Operation: The site operated as a landfill from approximately 1939 to 1959 (NEESA, 1984).

Waste Disposed: According to Navy documents, this unit was used for both hazardous and nonhazardous waste disposal (A.T. Kearney, Inc., 1988). During the 1984 IAS site inspection, the team observed partially buried metal and concrete objects, old fuel lines, flexible metal hoses, small containers containing pellets, steel cables, hardened tar, rubble, and ten to fifteen 55-gallon drums that were corroded. The drum contents, usually consisting of a whitish solid with a green outer crust, were not sealed (NEESA, 1984). The IAS team estimated the volume of disposed waste to be approximately 1,700 cubic yards, of which approximately 20,000 pounds could be hazardous material.

Studies/Results:

- In 1988, a RCRA Facility Assessment (RFA) was performed at this site. The Visual Site Inspection (VSI) team observed a dump site with lengths of thick cable, broken concrete blocks, ringed metal hoses, and six severely corroded drums. At least one of the drums was filled with a white, damp chalky substance (A.T. Kearney, Inc., 1988).

- In 1988, ESE sampled soil, sediment, surface water and groundwater at two different times (rounds). Elevated levels of lead were found in some soil samples (Technical Review Committee Meeting Minutes, 1989). The soil samples did not exhibit sufficient levels of lead to be classified as hazardous waste. Elevated levels of metals were detected in surface water samples (Technical Review Committee Meeting Minutes, 1989). Organic contaminants were detected in the soil, sediment, surface water and groundwater.

- In 1993, Baker collected several soil samples and one groundwater sample. The results of a risk assessment indicated no threat to human health or the environment associated with the soil, sediment, surface water and groundwater.

Future: A full RFI is planned for the site. Results of previous investigations will be used to satisfy RFI requirements. Previous environmental investigations at this SWMU have adequately characterized the soil, surface water and sediment. As a result of this, the planned RFI activities will focus on groundwater.

9.3 SWMU 3 - Base Landfill (IR Site No. 7)

Location: The Base Landfill is located south of the Industrial Area Wastewater Plant (Building 1758).

Years of Operation: The landfill operated from the early 1960s and is still operational. The landfill covers 85 acres.

Wastes Disposed: It is estimated that from 40 to 60 tons of waste per day were disposed (A.T. Kearney, Inc., 1988). Wastes that were disposed include the following: residential wastes, scrap metal, cables, paint waste, solvents, PCBs, OTTO Fuel II, Agentine, Askarel, pesticides, lubricating oil, unlabeled 55-gallon drums, dead animals, inert ordnance, digested sludge, construction debris, asbestos, and possibly Super Tropical Bleach (STB), a decontaminating agent (NEESA, 1984).

Studies/Results:

- In 1988, an RFA was performed. The VSI team observed one fiberglass drum with a polyethylene liner, and a decaying Volkswagen Beetle (A.T. Kearney, Inc., 1988). Groundwater monitoring wells were installed and samples of groundwater and soil were taken. Low levels of oil and grease were detected in the soil samples while low levels of organic compounds and metals were detected in the groundwater samples collected during both rounds of sampling (ESE 1988).

- In 1993, Baker sampled groundwater. Trace concentrations of organic contaminants were detected in the 1993 groundwater samples.

Future: The landfill is still operating and accepting wastes in accordance with Environmental Quality Board regulations. A part of the permitted operation includes regular groundwater monitoring with attendant reporting of results. A full RFI is planned for the site. Based on results of previous and ongoing investigation activities of this SWMU, planned FRI activities will focus on the sediment around the perimeter of the landfill.

9.4 SWMU 6 - Building 145 (IR Site No. 11)

Location: The site is a bunker, approximately 60 yards long, 7 feet high, and 8 feet wide with three openings to the surface through the roof. The floor is concrete.

Years of Operation: Unknown; bunker appears to have been used as a storage facility possibly since 1957.

Waste Disposed: Items stored over the years included the following: 55-gallon drums, one hundred 5-gallon pails, and a number of other small containers (NEESA, 1984). The condition of the containers ranged from being intact and neatly stacked to randomly placed and leaking (A.T. Kearney, Inc., 1988). The 1984 IAS Report stated that the drums and other containers had been in the building for sometime, probably since 1957. Some of the materials identified by the IAS team included spray paint, olive drab paint, black boot polish and some adhesives (NEESA, 1984). The IAS team concluded that the majority of the material (approximately 2,000 gallons) could be classified as hazardous (NEESA, 1984).

Studies/Results:

- The 1988 RFA VSI reported that the building was empty except for some protective clothing and some water on the floor. There were several old paint covered gloves and pieces of clothing, broken pallets and several empty paint cans outside [the] unit (A.T. Kearney, Inc., 1988). The RFA VSI team indicated that there was no evidence of a release to the environment.

- The 1993 RFA team found conditions to be similar to those of 1988 (TRC, 1993).

Future: A first phase RFI is planned for the site. Surface and subsurface soils will be studied.

9.5 SWMU 9 - Tank 212-217 Sludge Burial Pits (IR Site No. 13)

Location: This SWMU consists of reported sludge burial pits associated with eight fuel storage tanks. Tanks 212 through 215 are located north of Forrestal Drive along Manila Bay Road. Tanks 216 and 217 are located on a hilltop about 4,000 feet southeast of tanks 212 through 215, north of Forrestal Drive (NEESA, 1984). This SWMU comprises IR Site 13. This SWMU is divided into the following areas:

Area A - Tanks 212 and 213
Area B - Tanks 214 and 215
Area C - Tanks 216 and 217

Years of Operation: The 1984 IAS report indicated that the tanks were constructed in 1948 for the storage of AVGAS (aviation gasoline), and that the tanks were cleaned about every five years until 1978. This does not include tanks 210 and 211, which were abandoned in 1950 and probably cleaned only once (NEESA, 1984).

Wastes Disposed: The IAS report indicated that cleaning resulted in the removal of 20 to 30 drums (800 to 1,250 gallons) of leaded sludge per tank (NEESA, 1984). The report estimated that between 30,000 and 50,000 gallons of leaded sludge were disposed of at these areas over a 40-year period (NEESA, 1984).

This sludge was disposed of in a series of pits 8 feet x 8 feet x 8 feet (A.T. Kearney, Inc., 1988) located within 300 feet of the tank that was being cleaned. After the sludge settled in the pits, it was covered with three to four feet of soil (A.T. Kearney, Inc., 1988).

Studies/Results:

- In 1988, the RFA report indicated a start date of 1940 instead of 1948 as noted in the 1984 IAS report. The VSI team was unable to locate the buried pits during their inspection. ESE conducted two rounds of sampling of sediment, surface water and groundwater.

  According to ESE, oil and grease were detected in each sampling round, but levels were not significant when shipping activities in the area were considered. Lead was also detected in both rounds, but not at significant levels (Technical Review Committee Meeting Minutes, 1989). Low levels of volatile organic compounds were detected in the second round, but not in the first round.

Several of the first round surface water samples indicated low levels of oil and grease. Oil and grease were not detected in any of the second round surface water samples. Low levels of lead were detected in the second round of surface water samples. Some groundwater samples contained significant levels of fuel-derived organic constituents. During the second round, only two of the four wells continued to show significant fuel-derived organic constituents.

- The pits were not found during the 1993 Baker site visit.

Future: A full RFI is planned for the site. Soil and groundwater will be studied. A surface water and sediment investigation is contingent pending results of the soil and groundwater studies.

9.6 SWMU 10 - Substation 2/Building 90 (IR Site No. 15)

Location: This SWMU comprises IR Site 15.

Years of Operation: According to the IAS report, the transformer maintenance area (Building 90, Substation 2) has been used as a transformer repair shop by the Public Works Department - Power Distribution Shop since 1964.

Wastes Disposed: Electrical transformers were formerly repaired at this building, resulting in PCB containing transformer oils on the ground. In order to repair pole-mounted distribution transformers, the transformer oil would first be drained from the unit. Personal interviews revealed that from 1964 through 1979, used transformer oil (by the trade names Askarel, Inerteen, and Pyranol) were released directly onto the ground in the vicinity of Building 90. The 1984 NACIP report estimates that approximately 3,000 gallons of transformer oil was drained to the soil. The Navy is currently conducting a cleanup of these soils. They will be excavated and taken off base for disposal.

Future: A first phase RFI for soils is planned for the site if the results of the ongoing soil cleanup project show that significant levels of PCBs remain in the soil. Surface water/sediment and groundwater studies are contingent pending results of the soil investigation and cleanup.

9.7 SWMU 11/45 - Old Power Plant/Building 38 (IR Site No. 16)

Location: These SWMUs are located at Building 38 north of the Station Landfill.

Years of Operation: According to the 1984 RFA report, Building 38 was a 60-megawatt steam turbine facility that generated power from the early 1940s through 1949.

Wastes Disposed: The facility used Bunker C fuel, which was stored in two 50,000-gallon reinforced concrete tanks located directly northwest of the building. (NEESA, 1984). In the 1970s, Bunker C fuel was observed in manholes near Building 38 during heavy rainfalls. Bunker C fuel was also discharged to the Enlisted Beach through the old power plant cooling water tunnel (NEESA, 1984).

Studies/Results:

- The 1988 RFA report stated that these SWMUs are regulated by the Toxic Substances Control Act (TSCA). Located inside Building 38 was a cyclone fence which surrounded a curbed 8-inch concrete pad. PCB-contaminated items (e.g., old transformers and full 55-gallon drums) were temporarily stored on the concrete pad inside the cyclone fence (A.T. Kearney, Inc., 1988). The VSI team observed drums that they believed to contain PCB contaminated soil outside the cyclone fence. The VSI team also observed oil contaminated sorbent inside the fence on the concrete pad (NEESA, 1984). A facility representative told the VSI team that the oil spill inside the fence was from a non-PCB transformer and that laboratory results were pending regarding the contents of the drums located outside of the fence (NEESA, 1984).

- In 1988, ESE produced a Remedial Action Alternative Analysis Report. Soil samples were taken and analytical results indicated the presence of PCB and lead contamination at the site (Technical Review Committee Meeting Minutes, 1989).

- In 1992, Versar prepared a Remedial Investigation/Feasibility Study for this site. During their investigation, Versar collected numerous surface water, sediment, soil, wipe and chip samples (of the concrete). Based on their data and the data collected by ESE in 1988, Versar investigated the feasibility of the three following remedial (cleanup) alternatives:

1. Soil excavation, transportation and off-site incineration
2. Soil excavation, transportation and off-site land disposal
3. Soil excavation and on-site incineration (Versar 1992)

Of the three, Versar recommended Alternative 2 (soil excavation, transportation, and off-site land disposal).

- The 1993 RFA reinspection indicated conditions within the building were similar to those seen in 1988 (TRC, 1993). Surface water and sediment samples were collected from these SWMUs during the Supplemental Investigation (Baker, 1993). Organic contaminants were detected in both media.

Future: Remedial (cleanup) action for this site under the IR Program is underway. In addition, a full RFI is planned for the site. Planned FRI activities will focus on soil in the vicinity of the underground storage tanks and sediment from the old cooling water tunnel.

9.8 SWMU 12 - Fire Training Pit Oil/Water Separator

Location: According to the RFA, the fire training pit oil/water separator is an inground concrete tank that measures approximately 7 feet x 30 feet x 10 feet deep.

Years of Operation: This SWMU (which is active) began operations in 1983; however, the 1984 IAS report does not address this SWMU. The first mention of this SWMU is in the 1988 RFA report.

Wastes Disposed: Waste oils are burned at the Fire Training Pit during training exercises and the excess oil and firefighting water collected in the oil/water separator. Water from this unit is pumped to the Sewer Drainage System to be processed by one of the Naval Station wastewater treatment plants. Oils from this unit are pumped back into the Fire Training Pit.

Studies/Result:

- The VSI team noted an area of dead grass, adjacent to the oil/water separator, and oil stains on the curbing and guardrail uprights (A.T. Kearney, Inc., 1988).

- No evidence of releases were seen during the 1993 RFA reinspection (TRC, 1993).

Future: A first phase RFI addressing surface soils is planned.

9.9 SWMU 13 - Old Pest Control Shop/Building 258 (IR Site 18)

Location: This SWMU comprises IR Site 18.

Years of Operation: The pest control shop was located in Building 258 from the late 1950s through 1983. Pesticides were stored in Building 258 and also on the parking apron (IAS, 1984).

Wastes Disposed: Past practices and known spills indicated that pesticides have been spilled onto the soil, eventually washing into the drainage ditch behind the building. This same ditch received rinse waters from the cleaning of pesticide equipment over a storm drain which discharged to the ditch. Excess pesticides were also poured into this ditch, which leads to Ensenada Honda.

Studies/Results:

- In 1988, a RFA was performed at this SWMU. The VSI team noted that a faint but discernible pesticide odor was present behind the building and inside what was then the Diving Club pump room. However, signs of stressed vegetation were not observed. (A.T. Kearney, Inc., 1988). Two rounds of soil, sediment, and surface water and one round of groundwater samples were collected. In the first round, several pesticides were detected in the surface soils in the area adjacent to Building 258. Pesticides were detected in the sediment and surface water samples collected from the drainage ditch which conveys storm water runoff from the site. A low pesticide concentration was detected in one of the three monitoring wells at the site (Technical Review Committee Meeting Minutes, 1989).

- Since the 1988 RFA, the building has been demolished. A reinspection of the site found no visible signs of releases (TRC, 1993). Groundwater, soil, a surface water and a sediment sample were collected from this SWMU during the Supplemental Investigation (Baker, 1993). Organic contaminants were detected in groundwater, soil, surface water and sediment. A risk assessment conducted as part of the Supplemental Investigation indicated that there is no threat to human health or the environment associated with these media.

Future: Previous investigations at this SWMU have adequately characterized the soil, groundwater and surface water/sediment media. The results of these environmental investigations will be used to satisfy RFI requirements. As a result, there are no planned RFI activities for this SWMU.

9.10 SWMU 14 - Fire Training Pit Area (IR Site 17)

Location: This SWMU comprises IR Site 17.

Years of Disposal: According to the IAS report, the crash crew training area was operated by the Air Operations Department from early 1960s through 1983.

Wastes Disposed: Two unlined pits were used in the past for fire fighting training. The first pit, which was approximately 40 feet in diameter, was used from the early 1960s through the beginning of 1983. Assuming 20 years of operation, about 120,000 gallons of waste solvents, fuels, and oils were placed in the pits and set on fire for fire fighting training. Also burned were wood, trash, plastic, fuel filter elements, oily rags, and other debris. The fires were extinguished using aqueous film-forming foam (AFFF) and potassium bicarbonate (Purple K). Past aerial photographs showed drainage from this pit to the ditch along the runway shoulder. The new fire training pit was built at the same location as the old pit. When the new pit was built, all of the oil-stained, contaminated soil was excavated and most likely disposed of in the base landfill.

The second pit was used temporarily during the construction of the new fire training pit in 1983. This unlined gravel pit has a diameter of 200 feet and was used approximately six times. Approximately 3,000 gallons of waste fuel, oil, and solvents were burned in this area. Only small amounts of fuel were allowed to soak into the ground (NEESA, 1984).

Studies/Results:

- In 1988, a RFA inspection was performed at this SWMU. During the inspection, the VSI team observed that within the concrete curbing of the pit was a metal structure (what appeared to be the tank from a railroad tank car and large pieces of scrap metal) underlain by a layer of bricks which rested on the concrete lining. The metal structure, rocks and concrete curbing were completely stained black. Immediately adjacent to the pit was an area of darkly stained soil measuring approximately 40 feet by 100 feet. Vegetation was observed to be growing in the stained area adjacent to the pit (A.T. Kearney, Inc., 1988).

- The 1993 RFA reinspection found conditions similar to those seen in 1988 (TRC, 1993).

Future: A first phase RFI addressing soils is planned. Depending on these results, groundwater also may be investigated.

9.11 SWMU 23 - Oil Spill Separator Tanks

Location: Three oil spill separator tanks which process waste pumped in from the Ships Waste Off-load Barges are located approximately 100 feet inshore from the fuel pier. The oil spill separator tanks are large steel boxes of approximately 2,000 gallon capacity that are underlain by a concrete pad. (A.T. Kearney, Inc., 1988). The oil separated from the tanks is transferred to the Oil Spill Oil/Water Separator (SWMU 24).

Years of Operation: The exact dates involving the operation of the oil/water separator are unknown at this time. However, available background information indicates operation occurring during the mid to late 1980's.

Waste Disposed: Over time, waste oil was disposed and may have affected site soils.

Studies/Results: The VSI team noted black staining on the concrete pad underneath the tanks, curbing and areas of asphalt around the SWMUs both in 1988 and during the 1993 RFA reinspection (TRC, 1993).

Future: A first phase RFI addressing surface soils is planned for this site. Depending on these results, groundwater also may be investigated.

9.12 SWMU 24 - Oil Spill Oil/Water Separator and Adjoining Pad

Location: According to the 1988 RFA report, the oil spill oil/water separator is a below ground structure built of concrete with steel grating covering the top at ground level (A.T. Kearney, Inc., 1988). This unit receives discharge from the Oil Spill Separator Tanks (SWMU 23). After separation, the waste oil is removed by DRMO. (A.T. Kearney, Inc., 1988). Facility representatives reported to the VSI team that the oil/water separator has a capacity of 1,500 gallons.

Years of Operation: The exact dates involving the operation of the oil/water separator and adjoining pad are unknown at this time. The oil/water separator is currently operational. Available background information indicates operation began in the mid to late 1980's.

Waste Disposed: Waste oil.

Studies/Results:

- In 1988, a RFA was conducted. The VSI team did not observe any sign of a release at the time of the VSI.

- The site was reinspected in 1993. Minor staining around the edge of the separator was observed (TRC, 1993).

Future: A first phase RFI addressing soils is planned for this site. Depending on these results, groundwater also may be investigated.

9.13 SWMU 25 - Defense Restoration Marketing Office (DRMO) Storage Yard

Location: This unit is an area measuring approximately 40 feet x 100 feet and is located immediately adjacent to the Ignitable Storage Facility (SWMU 18) (A.T. Kearney, Inc., 1988).

Years of Operation: The exact dates involving the operation of the oil/water separator and adjoining pad are unknown at this time. However, available background information indicates operation in the mid to late 1980's.

History: In 1988, a facility representative stated to the VSI team that this unit was used for hazardous waste storage prior to the use of the Ignitable Storage Facility and DRMO Hazardous Waste Storage Facility (A.T. Kearney, Inc., 1988). A facility representative told the VSI team that this SWMU was being used to store hazardous materials at the time of the inspection. Evidence of past release was observed during the VSI including several oil stains, the largest measuring approximately 20 feet in diameter (A.T. Kearney, Inc., 1988).

During the 1993 RFA reinspection, the area could not be accurately located but was thought to coincide with an area that is now used for storage of raw material (TRC, 1993).

Future: A first phase RFI addressing soils is planned for this site. Depending on these results, groundwater also may be investigated.

9.14 SWMU 26 - Building 544 Area

Location: Building 544 is located in the Bundy area of NSRR.

History: This SWMU is comprised of approximately twenty-five 30-gallon drums, some of which had polyethylene liners (A.T. Kearney, Inc., 1988). The 1988 RFA report indicated that these drums were located behind Building 544 and were surrounded by thick brush (A.T. Kearney, Inc., 1988). The VSI team noted that some of the drums contained engine lubricating oil, and that one of the labels had the number 9150-231-6654 stamped on it (A.T. Kearney, Inc., 1988). The VSI team could not identify the contents in all of the drums because not all of the drums were labeled. The VSI team also observed a tar-like substance leaking onto the ground (A.T. Kearney, Inc., 1988).

In 1992, the Navy conducted a site inspection of this SWMU. The site has changed since the 1988 RFA was issued. Building 544 had been demolished (in approximately 1990) and the drums had been removed. No evidence of stained soil was observed during the 1993 RFA reinspection (TRC, 1993); however, it is possible that the incorrect area was examined.

Future: A first phase RFI addressing soils is planned for this site. Depending on these results, groundwater also may be investigated.

9.15 SWMU 31 - Waste Oil Collection Area/Buildings 31 and 2022 (IR Site 10)

Location: This site is located in the Public Works Department storage yard, near the Transportation Shop (Building 21) and Building 2022.

History: This SWMU is part of IR Site 10. According to the 1988 RFA, the Transportation Shop services Public Works Department vehicles inside Building 31 and in the yard just north of the building. This SWMU is a concrete pad, used for the temporary storage of 55-gallon waste oil drums, near the Transportation Shop warehouse. No leakage was evident at the time of the VSI; however, with the drain pipe valve broken in the open position any spills on the concrete pad would have flowed directly onto the Public Works Department yard (A.T. Kearney, Inc., 1988).

The 1984 IAS report does not specifically discuss SWMU 31 but discusses Building 31. According to the IAS report, the area around Building 31 was used for open storage of drummed material and approximately 50

drums were found within the vegetation bordering the north side of Building 31 transportation lot. Most of the drums were full to partially full with unknown contents. The Public Works Department attempted to remove some of these drums; however, the condition of the drums resulted in leakage and the resulting spill flowed onto a flatbed truck before running onto the ground, staining an approximately 10-foot-diameter circle of soil. The spilled material was identified by the Navy as asphalt, and was to be sent to Defense Property Disposal Office (DPDO) for sale or reuse (NEESA, 1984).

Studies/Results:

- In 1988, ESE conducted two rounds of groundwater sampling for IR Site 10 (SWMUs 31 and 32, and AOC B). The analyses results indicated the presence of low levels of organic compounds and some metals.

- In 1993 during the RFA reinspection, the pad was in full use and heavy staining both on the pad and around the perimeter was present (TRC, 1993).

- In 1993, during the Supplemental Investigation, soil samples were collected from IR Site 10 (Baker, 1993). Organic contaminants were present in trace concentrations. A risk assessment conducted as part of the Supplemental Investigation indicated that there is no threat to human health or the environment associated with soils from this site.

Future: A first phase RFI addressing soils surrounding the asphalt pavement is planned. Depending on these results, groundwater also may be investigated.

9.16 SWMU 32 - PWD Storage Yard/Battery Collection Area/Building 31 (IR Site 10)

Location: This site is located in the Public Works Department storage yard, approximately 100 yards northeast of the Transportation Shop (Building 31).

History: This SWMU is part of IR Site 10. It consists of an outdoor area where a number of batteries were stored. The 1988 VSI team noted that several dozen batteries were in various stages of decay, but that none of the batteries were corroded to the point of leakage. The VSI did not observe any evidence of release.

Studies/Results:

- In 1988, ESE performed two rounds of groundwater sampling for IR Site 10 (SWMUs 31 and 32, and AOC B). Analytical results indicated the presence of organic compounds and elevated concentrations of some metals. In 1993, the battery storage facility was found to have been moved. The new unit consists of a fiberglass box in which batteries are placed to contain any possible leakage.

- The 1993 RFA reinspection found no evidence of release in the former SWMU location. It now contains a fiberglass box for battery accumulation and a number of drums containing fuel-contaminated soil (TRC, 1993).

- During the 1993 Supplemental Investigation soil samples were collected from IR Site 10 (Baker, 1993). Organic contaminants were present in trace concentrations. A risk assessment conducted as part of the Supplemental Investigation indicated no threat to human health or the environment associated with this media.

Future: A first phase RFI addressing soils is planned. Depending on these results, groundwater also may be investigated.

9.17 SWMU 37 - Waste Oil Storage Area/Building 200

Location: According to the 1988 RFA, this unit consisted of nineteen 55-gallon drums resting on wooden pallets, which were on a raised, covered concrete pad behind Hangar 200.

History: The drums were observed by the VSI team to contain waste gasoline and lubricating oil from Aircraft Intermediate Management Department (AIMD) operations. During the 1988 VSI, minor oil stains were observed on the concrete pad, and a minor area on the nearby grass was observed to be stressed (A.T. Kearney, Inc., 1988).

Studies/Results:

- In 1988, ESE conducted two rounds of soil, sediment and surface water sampling. One soil sample was collected as a background sample in the first round. The sample had elevated

levels of oil and grease. The sediment samples had elevated oil and grease levels. Significant levels of oil and grease were found in the first round of surface water samples while none was detected in the second round (Technical Review Committee Meeting Minutes, 1989).

- During the 1993 RFA reinspection, the area was found to be well managed. A minor area of stressed vegetation was seen at the rear of the unit. Fresh soil from the area yielded measurable organic vapors (TRC, 1993).

Future: A first phase RFI addressing soils is planned. Depending on these results, groundwater also may be investigated.

9.18 SWMU 39 - Building 3158/Former Battery Drain Area

Location: This SWMU is located on the southwest side of Building 3158 within the Naval Mobile Construction Battalion (NMCB or "SEABEES") complex.

History: According to the 1988 RFA, this unit consisted of a storage building and covered battery drainage area. The building stored waste batteries and battery acid that were generated by SEABEE operations. The metal battery drain tank (shaped like a funnel) was underlain by a curbed concrete pad. Battery contents were poured into the drain tank and the battery acid was caught below in a container. The curbing around the pad was seen to be cracked and stained, indicating that there have potentially been releases to the soil (A.T. Kearney, Inc., 1988).

Studies/Results:

- Navy personnel visited the site in March 1992 and observed no visible signs of release to the soils. The area is no longer used for battery storage according to the 1993 RFA reinspection. It is now employed to store flammable raw materials. The original pad was not found (TRC, 1993).

Future: A first phase RFI addressing soils on the southwest side of Building 3158. Depending on these results, groundwater also may be investigated.

9.19 SWMU 45 - Part of IR Site 16

Location: See SWMU 11 for descriptions of the SWMU.

Future: See SWMU 11 for a description of planned RFI activities.

9.20 SWMU 46 - Pole Storage Yard Covered Pad

Location: SWMU 46 is located north of Building 42, along Valley Forge Road.

History: According to the 1988 RFA report, this unit was cited in the Navy Assessment and Control of Installation Pollutants (NACIP) report as a Public Works Department hazardous waste storage area that had been used to store transformers and 55 gallon drums of PCB-contaminated material. The NACIP report further stated that the area showed evidence of oil spillage. A facility representative confirmed that this unit formerly had been used to store transformers.

Studies/Results:

- In 1988, the VSI team observed that this unit was a covered concrete pad, and that it was used for the storage of products including insulators, telephone poles, small cardboard boxes of electrical equipment, and several full 5 gallon pails, one marked as electrical lubricant. No evidence of release was observed by the VSI team (A.T. Kearney, Inc., 1988).

- During the 1993 RFA reinspection, the pad was observed to be clean with only some wire present (TRC, 1993).

Future: A first phase RFI for soils around the perimeter of the pad is planned. Depending on these results, groundwater also may be investigated.

9.21 SWMU 51 - New Aircraft Intermediate Maintenance Department (AIMD) Storage Pad/Building 379

Location: SWMU 51 consists of a curbed concrete storage pad located outside Building 379. This storage pad is roofed and enclosed with a cyclone fence.

History: The site was first identified during the 1993 RFA reinspection, and is presently utilized by the AIMD facilities in place of SWMU 33. Also present at this SWMU was a 200-gallon tank which touches the storage pad, but was outside the curbed area. The entire pad area was surrounded by asphalt pavement. Oil stains were observed emanating from two drain valves in the curb surrounding this pad, and from the 200-gallon tank located outside the pad curb (TRC, 1993).

Future: A first phase RFI is planned for soils at the downslope edge of the asphalt pavement surround this SWMU. Depending on these results, groundwater also may be investigated.

9.22 Area of Concern (AOC) B - Building 25 (IR Site 10)

Location: AOC B is located near Building 25 in the general vicinity of the Public Works Department.

History: This AOC is part of IR Site 10. The 1984 IAS report noted the following:

- Building 25 was used by the Public Works Supply Department from 1951 until the structure collapsed in 1979. The building was used for temporary storage of materials to be turned over to DRMO. The entire area around the building was used for open storage of drummed material from at least 1957, according to aerial photographs.

- Materials found in and around Building 25 included 20 to 25 apparently empty to partially filled 55-gallon drums; 10 to 15 5-gallon pails; office furniture; mechanical devices; construction rubble; industrial gas cylinders; asbestos sheeting; fiberglass buoys; and transformers.

- Of particular interest were the 5-gallon pails, the drums, and a large transformer found at the collapsed building. The compound had a greenish crust about 1/2-inch thick, encasing a white material with the consistency of semi-dry plaster. A large transformer was seen lying on its side at the east corner of the building. No evidence of oil leakage was apparent (NEESA, 1984).

Studies/Results:

- The 1988 RFA VSI team observed that Building 25 had collapsed. Also noted: the majority of material stored at this AOC consisted of old clothing, empty wooden boxes and small empty shells; no sign of release; possibility that some amount of material was completely covered by vines and could not be observed (A.T. Kearney, Inc., 1988).

- During the Supplemental Investigation soil samples were collected from IR Site 10 during(Baker, 1993). Organic contaminants were present in trace concentrations. A risk assessment conducted as part of the Supplemental Investigation indicated that there is no threat to human health or the environment associated with this media.

Future: An RFI encompassing soil and groundwater is planned for this AOC.

9.23 Area of Concern C - Transformer Storage Pad

Location: This AOC is located east of Buildings 41 and 42, along Valley Forge Road.

History: Specifics regarding past practices at this site are limited at this time. Available information is described below.

Studies/Results:

The 1988 RFA report describes this AOC as follows:

- This AOC is comprised of two raised concrete pads that, at the time of the VSI, were used for storage of transformers. During the VSI, 40 transformers were observed to be stored on the storage pad to the south, which measured approximately 20 feet x 50 feet. This pad was covered by ripped canvas stretched over a wooden frame. The north pad was uncovered and contained at least 25 transformers and 20 to 40 batteries. The products stored at this unit were in good condition. Standing oil inside the north pad and release to the soil through a crack in the concrete were observed. Transformers of various sizes were scattered around both the south pad and the north concrete pad.

- The 1993 RFA reinspection indicated that the site remains as found in 1988 except more transformers were present (TRC, 1993).

Future: A first phase RFI is planned for this AOC to address soils. Depending on these results, groundwater also may be investigated.

10.0 ROLES, RESPONSIBILITIES AND ACTIVITIES

The roles and responsibilities of community relations activities at the Station essentially remain the same. Through the RCRA program, the Station works more closely with the U. S.Environmental Protection Agency, Region II and the Commonwealth of Puerto Rico Environmental Quality Board. The activities found in Section 4.3, Communication Activities and Techniques, have also remained the same except that at this time, due to the complexity and number of sites, the Station is not planning to develop the four page brochure.

11.0 SUMMARY

This addendum to the Final Community Relations Plan for Naval Station Roosevelt Roads provides the community with a brief overview of the changes in the Station's environmental program. The main issue the addendum reviews is the fundamental change from regulating former disposal sites under CERCLA to regulating current and past disposal sites under RCRA. The sites will continue to be studied and, if necessary, cleaned up. The welfare of the community and the environment is of the utmost importance to the U.S. Navy. Through ongoing environmental restoration, the safety of the community will continue to be protected.

TABLES

TABLE 8-1

IR AND SWMU LIST
NAVAL STATION ROOSEVELT ROADS,
PUERTO RICO

IR Site	Description	SWMU/AOC
5	Army Cremator Disposal Area	1
6	Langley Drive Disposal Site	2
7	Station Landfill	3
10	Public Works Dept. Building 25	AOC B
11	Building 145	6
13	Tanks 210 - 217 Area	9
15	Building 90/Substation 2	10
16	Old Power Plant (Bldg. 38)	11 & 45
17	Crash Crew Fire Training Pit	14
18	Former Pest Control Shop Area	13

IR = Installation Restoration
SWMU = Solid Waste Management Unit
AOC = Area of Concern

TABLE 8-2

SWMUs/AOC MEDIA SUBJECT TO CORRECTIVE ACTION REQUIREMENTS
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

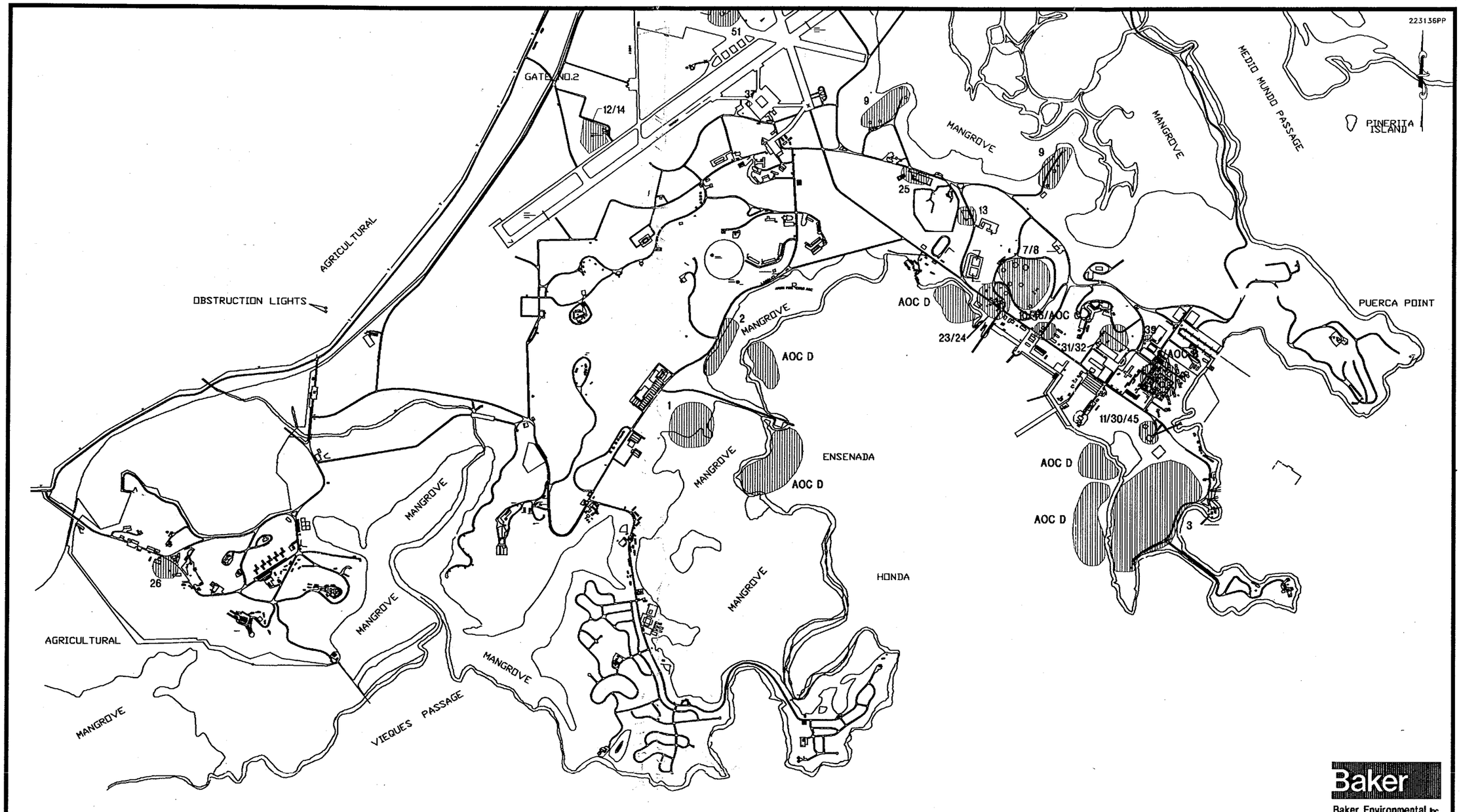
SWMU/AOCs	Ground-water	Soil	Surface Water/ Sediment	RFI Type
#1 Former Cremator Disposal Site	Yes	Yes	Yes	Full(1)
#2 Langley Drive Disposal Site	Yes	Yes	Yes	Full
#3 Base Landfill	Yes	Yes	Yes	Full
#6 Building 145	No	Yes	No	First Phase(2)
#7 Tow Way Fuel Farm	Yes	Yes	No	Full
#8 Tow Way Fuel Farm - Disposal Pits	Yes	Yes	No	Full
#9 Tank 212-217 Sludge Burial Pits	Yes	Yes	Contingent(3)	Full
#10 Substation 2/Bldg. 90	No	Yes	No	First Phase
#11 Old Power Plant/Bldg. 38	Yes	Yes	Yes	Full
#12 Fire Training Pit Oil/Water Separator	No	Yes	No	First Phase
#13 Old Pest Control Shop/Bldg. 258	Contingent	Yes	Yes	First Phase
#14 Fire Training Pit Area	Contingent	Yes	No	First Phase
#19 Bldg. 121 - Discarded Pesticide Storage Area	Contingent	Contingent	No	Contingent
#23 Oil Spill Separator Tanks	Contingent	Yes	No	First Phase
#24 Oil Spill Oil/Water Separator & Adjoining Pad	No	Yes	No	First Phase
#25 DRMO Storage Yard	No	Yes	No	First Phase
#26 Building 544 Area	No	Yes	No	First Phase
#30 Former Incinerator	Yes	No	No	First Phase
#31 Waste Oil Collection Area/Bldg. 31 & 2022	No	Yes	No	First Phase
#32 PWD Storage Yard/Battery Collection	No	Yes	No	First Phase
#37 Waste Oil Storage Area/Bldg. 200	No	Yes	No	First Phase
#39 Bldg. 3158/ Former Battery Drain Area	No	Yes	No	First Phase
#45 PCB Spill Area/ Old Power Plant	Yes	Yes	Yes	Full
#46 Pole Storage Yard Covered Pad	No	Yes	No	First Phase
#51 New AIMD Storage Pad/ Bldg. 379	No	Yes	No	First Phase
AOC #B/ Bldg. 25	Yes	Yes	No	Full
AOC #C/ Transformer Storage Pad	No	Yes	No	First Phase
AOC #D/Ensenada Honda Sediments	No	No	Yes	First Phase

Notes: (1) Full RFIs are conducted where releases were established during previous investigations. The purpose of the full RFI is to determine the nature, rate, direction, and extent of hazardous waste or hazardous constituents.

(2) The purpose of the first phase RFI is to confirm any releases from these SWMUs and/or AOCs.

(3) Contingent requirements are pending results of ongoing investigation or closure activities.

FIGURES



LEGEND

1 SWMU AND/OR AOC

SOURCE: LANTDIV, FEB. 1992

2500 0 1250 2500 5000

1 inch = 2500ft.

FIGURE 8-1
SWMU/AOC LOCATION MAP
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

00171B032