PART 5
IOC's/SOC's/POC's
(continued)

VOCs - Volatile Organic Chemicals or POCs - Principal Organic Chemicals

Volatile Halocarbons	Volatile Aromatics	Practical Quantitation Limit (ppb)
		0.5
bromochloromethane	benzene	
bromomethane	bromobenzene	
carbon tetrachloride	n-butylbenzene	
chloroethane	sec-butylbenzene	
chloromethane	tert-butylbenzene	
dibromomethane	chlorobenzene	
dichlorodifluoromethane	2-chlorotoluene	
1,1-dichloroethane	4-chlorotoluene	
1,2-dichloroethane	1,2-dichlorobenzene	
1,1-dichloroethene	1,3-dichlorobenzene	
cis-1,2-dichloroethene	1,4-dichlorobenzene	
trans-1,1-dichloroethene	ethylbenzene	
1,2-dichloropropane	hexachlorobutadiene	
1,3-dichloropropane	isopropyltoluene	
2,2-dichloropropane	p-isopropyltoluene	
1,1-dichloropropene	n-propylbenzene	
cis-1,3-dichloropropene	styrene	
trans,1,3-dichloropropene	toluene	
methylene chloride	1,2,3-trichlorobenzene	
1,1,1,2-tetrachloroethane	1,2,4-trichlorobenzene	
1,1,2,2-tetrachloroethane	1,2,4-trimethylbenzene	
tetrachloroethene	1,3,5-trimethylbenzene	
1,1,1-trichloroethane	m-xylene	
1,1,2-trichloroethane	o-xylene	
trichloroethene	p-xylene	
trichlorofluoromethane		
1,2,3-trichloropropane		
vinyl chloride		

VOCs - Total Trihalomethanes

Compound	MCL - Total in mg/L	Practical Quantitation Limit (ppm)
		0.001
Bromoform		
Chloroform	0.10	
Bromodichloromethane		
Dibromochloromethane		

PART 5
IOC's/SOC's/POC's
(continued)

SOCs - Synthetic Organic Chemicals

Due to the fact that more than one test method may be performed to complete the analysis in a grouping, please refer to th price/method list below.

SOCs

Method	P.Q.L.'s
EPA 504	0.01
EPA 508	0.05 - 1
EPA 515.1	0.05
EPA 525.2	0.2 - 2
EPA 531	
EPA 547	
EPA 548	
EPA 549	
EPA 1613	

SOCs - ORGANOHALIDE PESTICIDES

Compound	MCL in mg/L	Method
Alachlor	0.002	EPA 525.2
Aldrin	0.005	EPA 525.2
Atrizine	0.003	EPA 525.2
Chlordane, total	0.002	EPA 525.2
Dieldrin	0.005	EPA 508
Endrin	0.0002	EPA 508
Heptachlor	0.0004	EPA 508
Heptachlor epoxide	0.0002	EPA 508
Lindane	0.0002	EPA 508
Metolachlor	0.05	EPA 525.2
Methoxychlor	0.04	EPA 525.2
Metribuzin	0.05	EPA 525.2
Simazine	0.004	EPA 525.2
Toxaphene	0.003	EPA 508

SOCs - METHYLCARBAMATE PESTICIDES

Compound	MCL in mg/L	Method
Aldicarb	0.003	EPA 531.1
Aldicarb Sulfone	0.002	EPA 531.1
Aldicarb Sulfoxide	0.004	EPA 531.1
Carbaryl	0.05	EPA 531.1
Carbofuran	0.04	EPA 531.1
3-Hydroxy Carbofuran	0.05	EPA 531.1
Methomyl	0.05	EPA 531.1
Oxamyl	0.05	EPA 531.1

PART 5
IOC's/SOC's/POC's
(continued)

SOCs - CHLORINATED ACIDS

Compound	MCL in mg/L	Method
2,4-D	0.05	EPA 515.1
Dalapon	0.05	EPA 515.1
Dicamba	0.05	EPA 515.1
Dinoseb	0.007	EPA 515.1
Pentachlorophenol	0.001	EPA 515.1
Pichloram	0.001	EPA 515.1
2,4,5-TP (Silvex)	0.01	EPA 515.1

SOCs - MISCELLANEOUS

Compound	MCL in mg/L	Method
Benzo(a)pyrene	0.0002	EPA 525.2
Butachlor	0.05	EPA 525.2
Di(2-ethylhexyl)adipate	0.05	EPA 525.2
Bis(2-ethylhexyl)Phthalate	0.006	EPA 525.2
Glyphosate	0.05	EPA 547
Hexachlorobenzene	0.001	EPA 525.2
Hexachlorocyclopentadiene	0.005	EPA 525.2
PCB, total	0.0005	EPA 508
Propachlor	0.05	EPA 525.2
Diquat		EPA 549
Endothall		EPA 548
Dioxin		EPA 1613

MICRO EXTRACTABLES

1,2-Dibromomethane	EPA 504
1,2-Dibromo-3-chloropropane	EPA 504

RCRA CHARACTERIZATION

Parameter	Matrix	Method	Practical Quantitation Limit
Corrosivity (pH-if miscible with water)	Solid	9045	
Corrosion of Steel	Oil	1110	
Reactivity			
Cyanide	Solid	SW846 Chapter 7	100 ppm
Sulfide	Solid	SW846 Chapter 7	100 ppm
Ignitability (Closed Cup)	Solid	1010	70 F
Paint Filter Test (FREE Liquid)	Solid	9095	

TCLP
(Toxicity Characteristic Leaching Procedure)

Parameter	Matrix	Method	Practical Quantitation Limit
TCLP Extractions:			
ZHE (zero headspace extraction)	Solid	1311	
Extraction - Metals/Semivolatiles	Solid	1311	
Pesticides/Herbicides			
TCLP Analysis:			
TCLP Metals	Solid	6010/7000 Series	0.0002 - 0.01 ppm
TCLP Semivolatiles (BNA)	Solid	8270	10 - 50 ppb
TCLP Pesticides/Herbicides	Solid	8080/8150	1 ppb
TCLP Volatiles	Solid	8240	5 - 10 ppb

TOTAL RCRA METALS

Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver	Soil Water	6010/7000	0.02 - 1.0 ppm

RCRA CHARACTERIZATION
(continued)

EPTOX
(Extraction Procedure Toxicity Test)

Parameter	Matrix	Method	Practical Quantitation Limit
Extraction* (for all parameters)	Solid	1310	
EPTOX Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver (All metals are analyzed by standard additions)		6010/7000 Series	0.0002 - 0.01 ppm
EPTOX Pesticides: Lindane, Endrin, Toxaphene, Methoxychlor	Solid	8080	1 ppb
EPTOX Herbicides: 2,4-D/2,4,5-TP	Solid	8150	1 ppb

TARGET COMPOUND LIST (TCL)

Parameter	Matrix	Method	Practical Quantitation Limit
Appendix IX/33			
Volatiles	All	8240	See Organics
Semi-volatiles (BNA)	All	8270	See Organics
Pesticides/PCB's	All	8080	See Organics
Nitrogen-Phosphorus Pesticides	All	8140	See Organics
Herbicides	All	8150	See Organics
Dioxin	All	8280	See Organics
Metals	All	6010/7000 Series	See Metals
Cyanide	All	9010	See Wet Chem
Sulfide	All	9030	See Wet Chem
TCL			
Volatiles	All	8240	See Organics
Semivolatiles: Acid	All	8270	See Organics
B/N	All	8270	See Organics
Pesticides/PCBs	All	8080	See Organics
Metals: TAL	All	6010/7000 Series	See Metals
Cyanide	All	9010	See Wet Chem

Please see page 28 for necessary quality control packages (i.e., ASP, CLP, etc.)

NOTE: QC samples (field blanks, MS/MSD, transport blank) are considered as separate samples.

PRIORITY POLLUTANTS

Parameter	Matrix	Method	Practical Quantitation Limit
Priority Pollutant Volatiles	Water Soil	624 8240	See Organics
Priority Pollutant Semi-Volatiles (Acid) (BN) (BNA)	Water/Soil Water/Soil Water/Soil	625/8270 625/8270 625/8270	See Organics
Priority Pollutant Pesticides/PCB's	Water Soil	608 8080	See Organics
Priority Pollutant Metals	All	200/7000 Series	See Metals
Cyanide	All	335.2/9010	See Wet Chem
Phenol (4AAP)	All	420.1/420.2/9065	See Wet Chem
Asbestos*	Water Solid	100.1	See Wet Chem

* Sometimes waived by NYSDEC/DOH

NEW YORK STATE PART 360.2.11
Updated March 1, 1993

LANDFILLS - WATER QUALITY

	Practical Quantitation Limit
Baseline Parameters	See Methods
Routine Parameters	See Methods
Expanded Parameters	See Methods
Appendix 33 Only	See Methods

* Does not include dioxins and dibenzofurans

Please check with regulatory agency. A validation package may be required under updated Part 360.2.11 regulations.
If a QA/QC package is required, please see page 28 for associated surcharges.

AIRBORNE POLLUTANTS

Parameter	Practical Quantitation Limit
Carbon Dioxide Screen (Draeger tube)	
Carbon Monoxide Screen (Draeger tube)	
Formaldehyde (NIOSH 3500)	
Hydrocarbons:	
Aromatic (NIOSH 1500/1501)	
Chlordane (NYS APC-34)	
Volatile Organics (GC/MS) (Modified T02)-Includes Library Search	
Halogenated volatiles (NIOSH 1003)	
Hydrocarbon Screen, H Nu Meter Rental	
Mercury (NYS DOH APC 16)	
Nitrogen Dioxide (NIOSH P&CAM 108)	
Ozone (NIOSH 58)	
PCB (NYSDOH 311.1)	
PARTICULATES:	
Asbestos	
Bacteria	
Dust: Total (NIOSH 0500)	
Respirable (NIOSH 0600)	
Metals (NIOSH 7300)	

OIL TESTING

Parameter	Practical Quantitation Limit
% Ash	0.04 %
% Chlorine	0.02 %
Corrosivity	
Flash Point	70 F
Gravity	
Heating Value, BTU/lb	100 BTU/lb
Heating Value, BTU/Gal	600 BTU/lb
Metals: See pages 16-17	
PCBs	
% Sulfur, bomb wash without heating value	
% Sulfur, bomb wash with heating value	

GENERAL INFORMATION

Sample Receipt

SCILAB readily accepts samples Monday through Friday between the hours of 7:30 AM to 5:00 PM.
Samples received after 3:00 PM will be considered next business day.
If samples need to be delivered during non-business hours, please contact the lab in advance.

Normal turnaround time for most analyses is TEN BUSINESS DAYS, a written report will be mailed within 2 business days of completion of the analysis.

The number of samples received at one time, and the type of testing requested may alter normal turnaround times. PLEASE CALL IN ADVANCE TO ASSURE THE TURNAROUND TIME YOU NEED.

For those tests requiring expedited turnaround times, priority rates are applied accordingly:

TURNAROUND TIME	% SURCHARGE
Same Business Day	100%
1 Business Day	90%
2 Business Days	80%
3 Business Days	70%
4 Business Days	60%
5 Business Days	50%
6 Business Days	40%
7 Business Days	30%
8 Business Days	20%
9 Business Days	10%

Some bacterial and chemical tests must be analyzed within a specific time period after sampling. PRIOR ARRANGEMENTS or scheduling of sample submission is needed to comply with these timing requirements. A surcharge will be added to the listed fees if sampling schedules result in analyses being performed during other than scheduled hours.

SCILAB ALBANY, Inc. is open and readily accepts samples:

Monday - Friday 7:30 A.M. - 5:00 P.M.

QUALITY ASSURANCE/QUALITY CONTROL DATA PACKAGES

		Package Cost
Level 1 QC Package		10% surcharge of project cost
Includes:	Case Narrative QC Summary Sheets for: Blanks Surrogates MS/MSD Controls	
Level 2 QC Package		25% surcharge of project cost
Includes:	Level 1 QC Deliverables plus Chromatograms	
Level 3 QC Package		
CLP (EPA)		50% surcharge of
NYS Category A		25% project cost
NYS Category B		50%
NYS Category CLP		50%

BOTTLE/SAMPLE PREPARATION INFORMATION

PARAMETER	CONTAINER	TOP	PRESERVATIVE	COMMENTS
Acidity	500 ml, P	Foil	Cool, 4°C	Fill Completely
Alkalinity	250 ml, P	Foil	Cool, 4°C	Fill completely
BOD, BODC	500 ml, P	Foil	Cool, 4°C	48 Hour holding time
BTU	2 oz, G	Foil	None	
Chloride (water)	250 ml, P	Foil	None	
Chloride (cement)	2 oz, G	Poly	None	
Chlorine, demand	250 ml, P	Foil	None	
Chlorine, residual	250 ml, P	Foil	None	Analyze immediately
Color	125 ml, P	Foil	None	48 Hour Holding Time
Conductivity	250 ml, P	Poly	Cool, 4°C	
COD	125 ml, P	Poly	Cool, 4°C H_2SO_4 to pH<2	
Corrosivity (water)	125 ml, P	Poly	None	Analyze immediately
Corrosivity (oil)	4 oz, G	Poly	None	
Chromium, Hexavalent	500 ml, P	Poly	None	24 Hour holding time
Cyanide, Total	500, P	Poly	NaOH to pH>12 Ascorbic, 0.6 g	
Cyanide, Free	500, P	Poly	Na OH to pH>12 Ascorbic, 0.6 g	
Dissolved Oxygen	Winkler	Glass	None	Fill completely No air, store in dark
Total Glycol	40 ml VOAS	Teflon	None	7 Day Holding Time
Fluoride (drinking water)	250 ml, P	Foil	None	
Fluoride	L, P	Foil	None	
Formaldehyde (water)	40 ml	Teflon	Sodium Bisulfate 1/2 g	
Flash point (oil)	4 oz, G	Poly	None	
Flash point (soil)	4 oz, G	Poly	None	
Hardness	250 ml, P	Poly	HNO_3 to pH<2	
Ammonia (N)	250 ml, P	Poly	H_2SO_4 to pH<2	
TKN (N)	L, P	Poly	H_2SO_4 to pH<2	
Nitrate	250 ml, P	Poly	Cool, 4°C - chlorinated supplies H_2SO_4 to pH<2 - non-chlorinated	
Nitrite	250 ml, P	Foil	Cool, 4°C	48 Hour holding time
Odor	L, G	Foil	None	Separate bottle-48 hrs
Oil and Grease (solids/sludge)	4 oz, G	Teflon	none	
Oil and Grease (water)	L, G	Teflon	H_2SO_4 to pH<2	
pH (liquid)	125 ml, P	Foil	None	15 Minute Hold Time
pH (solid)	2 oz, G	Foil	None	
Phenols	L, G	Poly	Cool, 4°C H_2SO_4 to pH<2	

BOTTLE/SAMPLE PREPARATION INFORMATION
(continued)

PARAMETER	CONTAINER	TOP	PRESERVATIVE	COMMENTS
Phosphorus, Total	250 ml, P	Poly	Cool, 4°C H_2SO_4 to pH<2	
Phosphorus (ortho)	250 ml, P	Poly	Cool, 4°C	Filter immediately
Radioactivity	1/2 gal, P	Poly	HNO_3 to pH<2	
Specific Gravity	125 ml/8 oz	Foil	None	
Silica	250 ml, P	Foil	Cool, 4°C	
Solids				
Suspended	500 ml, P	Foil	Cool, 4°C	7 Day Holding Time
Dissolved	500 ml, P	Foil	Cool, 4°C	7 Day Holding Time
Total	500 ml, P	Foil	Cool, 4°C	7 Day Holding Time
Settleable	L, P	Foil	Cool, 4°C	48 Hour Holding Time
%Sulfur	2 oz, G	Foil	None	
Sulfate	250 ml, P	Foil	Cool, 4°C	
Sulfide	250 ml, P	Poly	Zinc acetate, NaOH to pH>9	
Sulfite	250 ml, P	Foil	None	
Surfactant (MBAS)	L, P	Foil	Cool, 4°C	48 Hour Holding Time
Temperature	250 ml, P	Foil	None	
Turbidity	250 ml, P	Foil	Cool, 4°C	48 Hour Holding Time
TOC (sparged)	40 ml, G	Teflon	H_2SO_4 to pH<2	
TOX (water)	L, amber, G	Teflon	None	
TOX (sludge)	4 oz, G	Teflon	None	
%Cl (oil)	40 ml, amber	Teflon	None	
%Water	250 ml, P	Poly	None	
Metals				
Mercury	L, P	Poly	HNO_2 to pH<2	
All other metals	500 ml, P	Poly	HNO_2 to pH<2	
EPTOX (solid)	8 oz, G	Poly	None	
EPTOX (liquid)	L, P	Poly	None	
Metals (soils)	8 oz, G	Poly	None	

When Copper and Lead samples are to be collected by client -

1 liter, plastic with plastic cap and unpreserved. (Should be preserved upon receipt in the laboratory).

BOTTLE/SAMPLE PREPARATION INFORMATION
(continued)

PARAMETER	CONTAINER	TOP	PRESERVATIVE	COMMENTS
Organics - Drinking Water				
THMs	2 + smeller 40 ml vial	Septum	0.008% $Na_2S_2O_3$	
EPA 502.2	4-40 ml vial	Septum	25 mg ascorbic add 1:1 HCL to pH<2 in field Cool, 4°C	
EPA 503.1	3 + smeller 40 ml vial	Septum	25 mg ascorbic add 1:1 HCL to pH<2 in field Cool, 4°C	
EPA 504	4-40 ml vial	Septum	Cool, 4°C	
EPA 524.2	4-40 ml vial	Septum	1:1 HCL to pH<2 Cool, 4°C	
EPA 507 (NP Pest)	2 L borosilicate	Teflon	80 mg $Na_2S_2O_3$ Cool, 4°C	Protect from light
EPA 508 (Pesticides)	2 L borosilicate	Teflon	80 mg $Na_2S_2O_3$ Cool, 4°C	Protect from light
EPA 515.1 (Herbicides)	2 L borosilicate	Teflon	80 mg $Na_2S_2O_3$ Cool, 4°C	Protect from light
EPA 525 (GC/MS Pest)	2 L amber G	Teflon	50 mg Na_2SO_3 then 1:1 HCL to pH<2 Cool, 4°C	
Organics - Environmental Analysis				
EPA 601/8010	2 + smeller 40 ml vial	Septum	Cool, 4°C 25 MG ascorbic	
EPA 602/8020	2 + smeller 40 ml vial	Septum	0.008% $Na_2S_2O_3$ HCL to pH<2, Cool 4°C	
PCB (water)	2 L G	Teflon	Cool, 4°C	
PCB (oil)	40 ml vial	Teflon	--	
PCB (soil)	4 oz. glass	Teflon	--	
EPA 608 (Pest/PCB)	2 L amber G	Teflon	Cool, 4°C	
EPA 610 (PAH)	2L, G	Teflon	Cool, 4°C 0.008% $Na_2S_2O_3$	
Pesticides	2 L amber G	Teflon	0.008% $Na_2S_2O_3$ Cool, 4°C, pH 5-9	
EPA 624/8240	2 + smeller	Septum	HCL to pH<2 40 ml vial Cool, 4°C	
EPA 625/8270	2 L amber G	Teflon	Cool, 4°C 0.008% $Na_2S_2O_3$	Store in dark
Pet ID (water)	2 L, G	Teflon	Cool, 4°C	
Pet ID (soil)	glass	Teflon	--	
Methane	3 40 ml vial	Septum	--	vials kept upside down 3/4 full

APPENDIX B

SITE SPECIFIC HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

ORANGE & ROCKLAND UTILITIES, INC. WEST NYACK, NEW YORK INACTIVE HAZARDOUS WASTE SITE (ID#: 3-44-014)

Prepared for:

Orange & Rockland Utilities, Inc.
One Blue Hill Plaza
Pearl River, New York 10965

Prepared by:

Rust Environment &
Infrastructure
12 Metro Park Road
Albany, New York 12205

August, 1997

Rust Environment & Infrastructure

SIGNATURE PAGE
RUST ENVIRONMENT & INFRASTRUCTURE

Anthony M. Noce — 24 OCT 97

Prepared by Anthony M. Noce
Chemist/Industrial Hygienist — Date

10/27/97

Reviewed by Edward G. Fahrenkopf
Project Manager — Date

Reviewed by Robert L. Rafferty
East Region Environmental Health & Safety Manager — Date

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LIST OF TABLES

APPENDICES

1.0 INTRODUCTION

This site-specific Health and Safety Plan (HASP) has been prepared by Rust Environment & Infrastructure (Rust) for Orange & Rockland Utilities, Inc. (ORU) in accordance with the regulatory requirements of 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response."

The purpose of this HASP is to summarize the project organization and responsibilities; establish Standard Operating Procedures (SOPs) for preventing accidents, injuries, and illnesses; identify hazards, discuss the personal protective equipment that may be used at the site; identify personnel health and safety training requirements; summarize the monitoring techniques to be used; establish emergency procedures; describe the medical surveillance program; identify that appropriate first aid equipment is available; provide for accident reporting; and establish a schedule for safety inspections.

The HASP will be implemented by the Site Safety Officer (SSO) during site work. Compliance with this HASP is required of all personnel who enter this site. Assistance in implementing this plan can be obtained from the Rust Region Environmental, Health & Safety Manager (REHSM), and the Corporate Environmental, Health & Safety Director (CEHSD).

Using the HASP Modification Form presented in Appendix C, the content of this HASP may change or undergo revision based upon additional information made available to health and safety personnel, monitoring results, or changes in the technical scope of work. Any changes proposed must be approved by the REHSM or CEHSD.

1.1 SCOPE OF WORK

The scope of work to be performed for this remedial activity is detailed in the Remedial Work Plan prepared by Rust and dated August 1997 which is available under separate cover. The project tasks covered by this HASP include:

- Site Preparation Activities;
- Soil Excavation and Stockpiling Activities;
- Soil Sampling (Post Excavation Sampling);
- Vehicle and Equipment Decontamination; and
- Project Monitoring and Air Sampling Activities

A Remedial Contractor will perform the work detailed in the Remedial Work Plan. This contractor will be responsible for its safety in connection with the work. The contractor will be responsible for initiating, maintaining and supervising the safety precautions and programs governing its employees.

1.2 PROJECT PERSONNEL

NAME / FIRM	TITLE	PHONE
Edward G. Fahrenkopf Rust	Project Manager	518-437-8310
Alan Tavenner, P.E. Rust	Project Engineer	518-437-8367
Pam Markelz, CSS, CET Rust	Corporate Environmental Health & Safety Director	414-451-2775
Robert Rafferty Rust	Region, Environmental Health & Safety Manager	518-437-8374
Anthony M. Noce Rust	Site Safety Officer	518-435-7219

2.0 ASSIGNMENT OF HASP RESPONSIBILITY

The following describes the health and safety designations and general responsibilities which will be implemented for the ORU West Nyack remedial activities.

2.1 CORPORATE ENVIRONMENTAL, HEALTH & SAFETY DIRECTOR (CEHSD)

The CEHSD is responsible for the development of company safety protocols and procedures necessary for field operations and is also responsible for the resolution of any outstanding safety issues which arise during the site work.

2.2 REGION ENVIRONMENTAL, HEALTH & SAFETY MANAGER (REHSM)

The REHSM has overall responsibility for review and approval of this HASP. The REHSM shall approve any changes to this plan due to modification of procedures or newly proposed site activities. Health and safety-related duties and responsibilities will be assigned only to qualified individuals by the Project Manager. Before personnel may work on site, a current medical examination and acceptable health and safety training must be approved by the division Safety Representative or the REHSM.

2.3 PROJECT MANAGER

The Project Manager (PM) is responsible for having a project-specific HASP prepared, reviewed and approved prior to the start of on-site activities. In addition, the PM is responsible for assigning a qualified Site Safety Officer (SSO) and project team members. (Refer to Rust General Health & Safety Standard T.00.020, Hazardous Waste Site Training, Appendix A - Site Safety Officer Qualifications).

2.4 SITE SAFETY OFFICER

The REHSM shall direct the site health and safety efforts through a Site Safety Officer (SSO) as needed. The SSO will be responsible for implementing the HASP. The SSO may direct or participate in on-site activities as appropriate when this does not interfere with primary SSO responsibilities. The SSO has stop-work authorization which he/she will execute upon determination of an imminent safety hazard, emergency situation, or other potentially dangerous situations, such as detrimental weather conditions. Authorization to proceed with work will be issued by REHSM in conjunction with the Project Manager after such action.

2.5 SUBCONTRACTORS

Subcontracts will be issued for this project. Subcontractors shall comply with the requirements outlined in this HASP and in accordance with OSHA 29 CFR 1910 and 29 CFR 1926; but, in all cases, subcontractors shall be responsible for site safety related to or affected by their own field operations (*e.g.*, heavy equipment operations).

3.0 SITE LOCATION AND DESCRIPTION

3.1 LOCATION

The ORU facility (the Site) is located at 180 West Nyack Road in the hamlet of West Nyack, Town of Clarkstown, a developed commercial and residential area of West Nyack, Rockland County, New York. A site location map is presented as Figure 1 in the Remedial Work Plan.

3.2 SITE DESCRIPTION

The Site is approximately three acres in size and is situated north of Route 59 and immediately north of the Old Nyack Turnpike, and seven-tenths of a mile west of the intersection of Routes 59 and 303. The Site is bordered on the west by Consolidated Rail Corporation (Conrail) rail tracks and a small property occupied by Yaboo Fence Company, Inc. for storage purposes. The Hackensack River borders the Site to the north and east.

The Site is mostly flat, sloping gently from southwest to northeast, with the southwest corner rising slightly to approximately 69 feet, which is about 6 to 7 feet higher than most of the Site. The range of elevations encountered at the Site is from 50 to 70 feet.

4.0 HAZARD ASSESSMENT

4.1 WASTE DESCRIPTION/CHARACTERIZATION

The following chemical information is presented in order to identify the types of materials that may be encountered at the Site. Detailed information on these materials was obtained from:

- ACGIH, Threshold Limit Values and Biological Exposure Indices for 1996;
- Material Safety Data Sheets; and
- NIOSH Pocket Guide to Chemical Hazards - 1994.

The following is a list of chemicals and compounds that are potentially found on-site. Material Safety Data Sheets for each compound listed below, providing information such as the chemical's characteristics, health hazards, protection, exposure limits, and first aid procedures are presented in Appendix A. These chemicals include:

Benzene
Toluene
Ethylbenzene
Xylene

Polychlorinated Biphenyls (PCBs)

- ***Metals*** *(Note: the metals concentrations known to be present are unlikely to be cause a significant health and safety concern.)*

Waste Types:	Liquid	X	Solid	X	Gas		
	Sludge		Semi-Solid	X	Other	X	
Characteristics:	Corrosive	X			Flammable	X	
	Explosive	X			Volatile	X	
	Radioactive				Inert	X	
	Other	TOXIC					

Exposure limits for the chemicals of potential concern are presented in Table 4-1 and the tasks, hazards, and control measures are shown in Table 4-2.

Table 4-1
Exposure Limits

COMPOUND	PEL-TWA ppm	TLV-TWA ppm	TLV-STEL ppm	IONIZATION POTENTIAL	ODOR THRESHOLD ppm
Benzene	1	10	5	9.25	4.68 - 12
Ethylbenzene	100	100	125	8.76	0.25 - 2.0
Toluene	200	50	500.*	8.82	0.17 - 40
Xylene	100	100	150	8.44 - 8.56	1.1
Polychlorinated Biphenyls (PCBs)	0.5 mg/m^3	0.5 mg/m^3	NE	NA	

References: American Conference of Governmental Hygienists (ACGIH) Threshold Limit Values (TLV) for 1996.

TLV - Threshold Limit Value
STEL - Short-Term Exposure Limit
PEL - Permissible Exposure Limit
NE - Not Established
* - 10 Min. Peak/8 Hours
NA - Not Applicable
IP - Ionization Potential
IDLH - Immediately Dangerous to Life & Health
TWA - Time Weighted Average

Table 4-2
Task Specific Hazard Assessment Table

TASK	HAZARD	CONTROL MEASURES
Soil Excavation	Dermal Contact Inhalation Thermal Stress Toxic Atmosphere Heavy Equipment	General Awareness, Access Controls, PPE, Respiratory Protection, Work/Rest Cycles, Fluids, Continuous Air Monitoring
Equipment Decontamination	Dermal Contact Inhalation Toxic Atmosphere Thermal Stress Equipment	General Awareness, Access Controls, PPE, Respiratory Protection, Work/Rest Cycles, Fluids
Construction oversight/ Project Monitoring	Slip, Trip, Fall Inhalation Toxic Atmosphere	General Awareness, Access Controls, PPE, Respiratory Protection
Sample Collection	Slip, Trip, Fall Dermal Contact Inhalation Thermal Stress Toxic Atmosphere	General Awareness, Access Control, Continuous Monitoring, PPE, Work/Rest Cycles, Fluids

4.2 DEGREE OF HAZARD

On-site hazards include physical and chemical hazards. No radiological, biological, or laboratory wastes are suspected on-site.

4.2.1 Chemical Hazards

The contaminants of concern at the Site can affect the body if they are inhaled, come in contact with the eyes or skin, or are ingested. These compounds may be released during soil excavation and sampling activities. The primary concern is for skin exposure to contaminated soils and potential inhalation of dust released during soil intrusive activities. Exposure to these substances by inhalation (in the Breathing Zone (BZ)) at elevated levels approaching the OSHA PEL are not anticipated due to the relatively low levels found in the soil and water from previous studies.

Atmospheric monitoring, however, will be conducted during all phases of on-site field activities to determine the need for upgrading to appropriate levels of respiratory protection, as found in Section 9.2. Exposure by skin absorption is a low to moderate possibility, but can be prevented by use of proper protective equipment and good hygiene practices. Table 4-1 presents exposure levels for contaminants of concern.

4.2.2 Physical Hazards

Primary physical hazards at the site are those associated with heavy equipment operations. Hazards that could be encountered during subsurface activities include falls and trips, injury from lifting heavy objects, falling objects, eye injuries, head injuries, and pinched or crushed hands and feet. Fire hazards may also be present due to the use of gasoline/diesel powered heavy equipment. Rust employees shall not operate subcontractor equipment or handle subcontractor materials and tools, with the exception of subcontractor sampling tools. Also see Section 11.3 - Safe Work Practices.

Depending on seasonal weather conditions, there is potential for workers on-site to be affected by heat stress or cold exposure. The SSO will monitor for heat stress or cold exposure in accordance with Section 12.6 of this HASP.

Soil excavation activities provides the potential for encountering buried hazards such as utilities. It shall be the subcontractor's responsibility to obtain "clearance" from the local utilities prior to initiating intrusive activities. Overhead electrical lines shall also be identified. If encountered, soil intrusive activities will be halted and the REHSM will be notified.

If dusty conditions exist during soil excavation activities, the work zone area will be kept wet by spraying the work zone (WZ) with water to provide dust control. Noise related to soil excavation and stockpiling operations is expected to be minimal; however, as a precaution, hearing protection will be available and worn as necessary.

Soil sampling activities present the potential for slips and falls associated with wet surfaces and soft unstable sediment surfaces.

4.2.3 Additional Precautions

No unusual conditions or activities requiring additional safety or health precautions are anticipated at this time. The SSO will monitor site activities and a HASP modification form will be prepared, if necessary.

4.2.4 Natural Hazards

Natural hazards such as weather, poisonous plants, bites from poisonous or disease-carrying animals and insects (*e.g.*, snakes, ticks), cannot always be avoided. Refer to Section 12.0 for precautions and emergency procedures.

4.2.5 Confined Space Entry

Confined space entry is not anticipated and is, therefore, not addressed in this HASP. If confined space entry is necessary, work will be halted and the REHSM will be notified.

4.2.6 Spill Containment

Field activities associated with this site are unlikely to require spill containment and are, therefore, not addressed in this HASP.

5.0 TRAINING REQUIREMENTS

5.1 BASIC TRAINING REQUIRED

Personnel who are required to work in areas where the potential for toxic exposure exists shall complete training and have site experience conforming to the requirements of 29 CFR 1910.120(e). In keeping with 29 CFR 1910.20, medical records and exposure records will be available to workers or his/her designated representative upon request.

Training includes a 40-hour course which describes procedures for working at hazardous waste sites. The procedures include a safety and health program, medical surveillance, decontamination, site characterization and analysis, protective clothing and monitoring equipment, site control work documentation, emergency response, engineering and administrative control to reduce exposure, and site safety evacuation procedures.

Contractors/subcontractors shall provide written documentation that these training/experience requirements have been met. Personnel shall also be trained in the contents of Appendix B, "Respiratory Protection Program."

5.2 SITE-SPECIFIC TRAINING

Site-specific training will be conducted by the SSO for on-site personnel and visitors to minimize exposure to potential of on-site hazards. Site-specific training will address the activities, procedures, monitoring, and equipment for the field operations.

This training at a minimum will include the following:

1. Site description and history.
2. Project activities, including coordination with other contractors.
3. Hazard evaluation.
4. On-site safety responsibilities.
5. Site control and work zones.
6. Personnel training.
7. Medical monitoring.
8. Atmospheric monitoring.
9. Personal protection, clothing, and equipment.
10. Decontamination procedures.
11. Emergency procedures.
12. Review of site-specific material safety data sheets (MSDSs).
13. Safe work practices.
14. Other elements covered in this site-specific HASP.

This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safe operations. Training must include emergency preparedness, location of assembly areas, proper entry and exit procedures for exclusion zone (EZ), warning systems, location of emergency equipment, and route to the hospital.

The contractor shall also hold safety training for those operations under its control. An initial safety training session and daily training sessions as appropriate will be conducted.

5.3 SAFETY BRIEFINGS

Project personnel will be given briefings by the SSO on a daily or as-needed basis to further assist site personnel in conducting their activities safely. Briefings will be provided when new activities are to be conducted, changes in work practices must be implemented due to new information made available, or if site or environmental conditions change. Briefings will also be given to facilitate conformance with prescribed safety practices when performance deficiencies are identified during routine daily activities or as a result of safety audits.

5.4 SAFETY AUDITS

The REHSM or CEHSD or designee, as necessary, may conduct safety audits of field operations and subcontractor performance to review for compliance with health and safety policies and procedures. Health and safety audit findings will be documented and corrective action taken.

5.5 FIRST AID AND CPR

At least one individual on-site shall be trained and qualified to administer first aid and cardiopulmonary resuscitation (CPR).

The SSO will identify the individuals possessing this training in order to ensure that emergency treatment is available during every work shift from a person qualified in first aid and CPR. These courses will be consistent with requirements of the American Red Cross and/or American Heart Association.

6.0 MEDICAL SURVEILLANCE PROGRAM

All Rust personnel and subcontractors performing field work at the Site will be required to have passed a pre-assignment and/or periodic medical examination that is consistent with 29 CFR 1910.120(f). Medical examinations shall be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine. A release for work will be confirmed by the REHSM before an employee can begin hazardous site activities.

Additional medical testing may be required by the REHSM in consultation with the company physician and CEHSD if an overt exposure or accident occurs, or if other site conditions warrant further medical surveillance.

Contractors/subcontractors will maintain the medical records for their own employees, but shall also provide the SSO with written documentation certifying that each employee at the site has met the requirements of the Medical Surveillance Program. This documentation will be provided before the first day of work for each employee assigned to the site. The pre-assignment and annual examinations are essentially the same in content and are the examining physician's discretion but generally include:

- An updated medical and occupational history
- A screening physical examination
- Blood and urine laboratory tests
- Chest X-ray
- Electrocardiogram
- Pulmonary function tests
- Audiometry
- Visual acuity test

At the end of employment or if deemed necessary after an employee's involvement in project-specific site work, he/she may have to complete a medical examination. This examination may be limited to obtaining an internal medical history of the period since the last full examination (consisting of medical history, physician examination, and laboratory tests).

6.1 JOB EXPOSURE REPORT

A Job Exposure Report must be completed at the end of the project for each Rust employee who participated in on-site field activities. The Job Exposure Report must be submitted to the REHSM who will route it to the employee's medical record.

7.0 SITE CONTROL MEASURES

The purpose of the site control measures discussed in this section are to maintain order at the Site and to minimize chemical and physical hazards to on-site personnel, visitors, and the public. Site control zones will include an exclusion zone (EZ), a contamination reduction zone (CRZ), and a support zone (SZ). In addition, temporary activity-specific WZ s will be established at specific locations. These defined areas of operation are intended to reduce the risk of personnel exposure to site contaminants. The dimensions of the defined zones and the safe working distances between each area shall be established by the SSO.

7.1 SITE ACCESS

Site access will be controlled by the contractor Superintendent under the guidance of the SSO. Specific plans shall be prepared by the contractor indicating the approved routes of access to the site as well as the site control zones in use at the site.

7.2 EXCLUSION ZONE

The EZ is the area containing or suspected of containing contaminated materials. The soil excavation areas shall be delineated as the EZ. All personnel within this area must employ the prescribed levels of protection and other health and safety measures as deemed appropriate by the SSO. The EZ is a regulated area where the potential exists for a hazardous material to become airborne triggering the use of appropriate PPE and respiratory protection.

7.3 CONTAMINATION REDUCTION ZONE

The CRZ shall serve as a buffer between the EZ and the SZ. The CRZ is intended to prevent the spread of contaminants from the EZ. Personnel and equipment decontamination shall take place in the CRZ.

7.4 SUPPORT ZONE

The SZ is considered the uncontaminated area and will be identified by the SSO before field activities begin. It will contain the Command Post (*i.e.*, engineer's office) which will provide for team communications and emergency response. Appropriate sanitary facilities, safety, medical, and support equipment will be identified. No potentially contaminated personnel or materials are allowed in the SZ except for appropriately packaged/decontaminated and labeled samples.

7.5 WORK ZONES

Temporary activity-specific WZs shall be established at each sampling activity. The WZ shall be a radius large enough to allow sufficient space for safe work practices. A CRZ shall be placed at the WZ perimeter at an upwind location. A portable eye wash unit, fire extinguisher, towels, plastic garbage bags, decontamination supplies, and a first aid kit (sufficient to accommodate the field team) shall be available on-site.

7.6 PERSONNEL DECONTAMINATION

Personnel decontamination areas will be established on-site. Personnel will decontaminate and/or dispose of soiled protective clothing (*e.g.*, disposable boots and gloves, *etc.*) in the CRZ established next to the temporary WZ or EZ. A fixed personnel decontamination area will be established adjacent to the fixed equipment decontamination pad where, after equipment decontamination, personnel can decontaminate and dispose of protective clothing and equipment before exiting the EZ. Refer to Section 10 for further decontamination procedures.

7.4 EQUIPMENT DECONTAMINATION PAD

To prevent off-site transport of contamination, excavators, transporters and associated equipment and vehicles will be decontaminated on-site at pre-designated decontamination area prior to exiting the CRZ. This location will be selected by the SSO prior to start-up of field activities at the project site. Refer to Section 3.6 of the Remedial Work Plan for further decontamination procedures.

Sampling equipment such as stainless steel hand augers, bowls, and spoons may be decontaminated at each sampling location in accordance with procedures set forth in the Remedial Work Plan and QAPjP. Refer to Section 10 of this document for further decontamination procedures.

7.6 SITE VISITORS

Visitors are required to report to the SSO prior to accessing the Site, although none are anticipated. The SSO will document decisions regarding their access to the Site. If granted limited access, visitors must provide the SSO with documented compliance with Section 5.0 of this HASP, comply with other applicable sections, and satisfy additional conditions placed on them as deemed appropriate by the SSO to ensure visitor safety. Visitors must sign in and out daily under the SSO's direction for the duration of their approved visit. Under no circumstances will visitors be allowed to interfere with, or participate in operations within the scope of the field investigation. All visitors shall be escorted throughout the Site by appropriately trained personnel.

As needed, the SSO will establish a designated Level D area as an observation point during intrusive activities. This designated area will be located to offer proximate viewing of site operations, and positioned such that visitors in no way may inhibit site access, logistics, or general operations. Further, the SSO will locate the viewing areas such that visitors present are at minimal risk of exposure to site hazards.

8.0 PERSONAL PROTECTIVE EQUIPMENT

8.1 GENERAL

The level of protection to be worn by field personnel will be defined and controlled by the SSO. Personal protective equipment for general operations will be consistent with the requirements of 29 CFR 1910 Subpart I, "Personal Protective Equipment." Basic levels of protection for hazardous waste operations will be selected in accordance with the provisions of 29 CFR 1910.120(g)(3), "Personal Protective Equipment Selection," and Appendix A, "General Description and Discussion of the Levels of Protection and Protective Gear." Modification to basic protective equipment ensembles may be necessary for specific operations. In these cases, further definition will be provided by review of specific hazards, conditions, and proposed operational requirements, and by conducting air monitoring at the particular operation. Protection may be upgraded or downgraded, as deemed appropriate by the SSO and verified by the REHSM.

8.2 ANTICIPATED LEVELS OF PROTECTION FOR SITE OPERATIONS

Action levels used to determine the need to upgrade or downgrade the levels of protection are described in Section 9.2 of this HASP.

Level D personal protective clothing and equipment includes:

- Disposable Tyvek coveralls. (Polyethylene Coated Tyvek required in sampling areas when splashing by contaminated soils or water is a possibility).
- Hardhat (when overhead hazards exist).
- Safety glasses or goggles.
- Steel toe boots.
- Disposable latex gloves - required when handling and collecting soil, water, sediment, and tissue samples.
- Noise protection - as warranted.

Level C protective clothing and equipment includes:

- Full-face air-purifying respirator National Institute for Occupational Safety & Health (NIOSH), Mining Safety and Health Administration (MSHA) approved fitted with organic vapor/HEPA (High Efficiency Particulate Air Filter) cartridges.
- Disposable Tyvek coveralls. (Polyethylene Coated Tyvek required in sampling areas when splashing by contaminated soils or water is a possibility).
- Disposable latex inner gloves.
- Neoprene outer gloves.
- Hard hat (when overhead hazard exists).
- Steel toe boots.
- Disposable outer boots.

Level B protective clothing and equipment includes the above Level C clothing with the addition of a self-contained breathing apparatus (SCBA) or supplied air-line respirator in place of an air-purifying respirator. If action levels are exceeded and based on evaluation of the conditions, and Level C protection is not sufficient and Level B respiratory protection is deemed necessary, work activities will be halted and arrangements for Level B equipment will be implemented.

The use and care of respiratory protection will be in accordance with the protocols described in Appendix B.

9.0 AIR MONITORING AND ACTION LEVELS

9.1 GENERAL

It will be necessary to monitor the atmospheric conditions during field activities to determine the possible need to upgrade the personal protection of on-site workers. Air monitoring will be performed in the worker's BZ and ambient air monitoring will be performed in accordance with Section 4.0 of the Remedial Work Plan and the QAPjP.

9.2 Soil Excavation, Stockpiling and Soil Sample Collection

The activities shall be initiated in Level D personal protective equipment (see Section 9.1). The excavation subcontractor shall be responsible for implementing safety procedures associated with OSHA 29 CFR 1926 Subpart P, Excavations.

During the excavation and stockpiling activities, continuous air monitoring shall be conducted in the immediate work zone. Air monitoring around the work zone perimeter shall also be periodically conducted. In the event action levels are exceeded at the work zone perimeter, the excavation work will be stopped and appropriate work practices and procedures will be employed to prevent continued elevated measurements at the work zone perimeter. If action levels are not exceeded upon reaching the bottom of the excavation, personnel may downgrade to the appropriate level of protection determined by the SSO.

Field crews in the immediate proximity of the backhoe/excavator face risk of injury caused by operator error and equipment malfunction. Personnel within the range of the backhoe/excavator bucket's reach must maintain ongoing communication with the operator to avoid accidental impact. Routine or emergency movement of tire- or track-mounted equipment presents added risk to nearby personnel. Failure of backhoe/excavator hydraulic systems can also present unanticipated risks. During backhoe/excavator operation, personnel shall not enter the excavation under any circumstances.

Open excavation present hazards compounded by potentially collapsing sidewalls coupled with proximate location of heavy equipment. Personnel standing near excavations must avoid sidewalls unless properly secured with life lines. (Life lines shall be secured to a stationary anchor point.) Due to close proximity of heavy equipment, personnel shall also exhibit caution when viewing excavations. When practical, the field crew should avoid logging and other observatory actions while excavations are in progress. No tasks are expected to involve confined space entry.

9.3 ACTION LEVELS

Instrumentation may include: a photoionization detector (PID) equipped with a 10.2 eV or 11.7 eV lamp and/or a flame ionization detector (FID); a combustible gas indicator (CGI). A Miniram PDM-3 particulate monitoring instrument will be used to monitor for airborne particulate emissions. The SSO will determine the need for air monitoring instruments not specified in the Remedial Work

Plan. Action levels in this HASP will apply to site work during the duration of activities at the project site.

Instrument	Action Levels	Level of Respiratory Protection/Action
PID/FID	Continuous sustained readings to 5 ppm above background in BZ.	Level D(based on identification of volatile contaminant(s) present)
PID/FID	Continuous sustained readings between 5 and 50 ppm above background in BZ.	Level C (based on identification of contaminant(s) present)
PID/FID	Continuous readings above 50 ppm above background in BZ	Level B (if applicable)
CGI	<10% LEL	Proceed with caution
CGI	Greater than 10%	Cease work, vent, begin work only after levels return to 0%
Miniram	<100 ug/m^3 above background	Level D
	>150 ug/m^3 and > 100 ug/m^3 above background	Level C (Suspend Work, implement fugitive dust control measures)

If visible dust is detected while working in Level D, upgrade to Level C respiratory protection is required. However, engineering controls, such as wetting the WZ area with water to control dust, will be implemented when feasible.

In the event any action levels are exceeded, work activities shall be halted, and an attempt will be made to identify the contaminants present using colorimeter indicator tubes so that correct respiratory protection can be selected and action levels may be adjusted higher or more conservatively. The SSO shall notify the REHSM immediately prior to upgrading the level of respiratory protection.

9.4 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Personal air monitoring will not be conducted unless Level D action levels are exceeded in the EZ.

9.5 INSTRUMENT CALIBRATION AND MAINTENANCE

Instrument calibration and maintenance shall be performed according to manufacturer's specifications and documented on Field Instrument Calibration Logs or Field Log Books. PID calibration shall be completed along with a FID calibration check on a daily basis. Combustible gas/oxygen meters shall be calibrated according to manufacturer's recommended frequency (*e.g.*, daily or weekly).

10.0 DECONTAMINATION PROCEDURES

The SSO shall determine the level of decontamination necessary based on the evaluation of specific work activities and the potential degree of contamination. Temporary CRZs shall be established at each sampling location.

10.1 EQUIPMENT

Prior to leaving the Site, the excavator, transporters, associated equipment, and vehicles will be decontaminated on-site at a pre-determines decontamination area selected by the SSO. Decontamination of this equipment will be performed in accordance with Section 3.6 of the Remedial Work Plan.

Non-disposable sampling equipment will be decontaminated before use, between samples, and before leaving the sampling location.

Equipment that cannot be immersed in soap solution and water will be wiped clean and rinsed with distilled water.

10.2 PERSONNEL

Personnel will perform decontamination in the personal decontamination area. Decontamination of personnel in Level D will consist of removal and disposal of coveralls (when worn) disposable boots, and gloves. Decontamination of personnel using Level C protective equipment will consist of:

- Washing boots, waders, or other non-disposable protective equipment (i.e., hard hat, safety glasses/goggles, etc.) suspected of being contaminated using soap solution followed by potable or distilled water rinse.
- Removal and disposal of boot covers and waders if worn.
- Removal and disposal of coveralls.
- Removal and disposal of outer gloves.
- Removal, cleaning, and storage of respiratory equipment.
- Removal and disposal of inner gloves.

10.3 CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination avoidance include:

PERSONNEL

- Know the limitations of all personal protective equipment being used.
- Do not walk through areas of obvious or known contamination.
- Do not handle or touch contaminated materials directly. Do not sit or lean on potentially contaminated surfaces.
- Make sure all personal protective equipment has no cuts or tears prior to donning.
- Fasten all closures on suits, covering with tape, if necessary.
- Particular care should be taken to protect any skin injuries.
- Stay upwind of airborne contaminants.
- Do not carry cigarettes, gum, food, or candy into contaminated areas.
- On-site personnel are encouraged to shower at the end of their work day.

SAMPLING/MONITORING

- Cover instruments with clear plastic, leaving openings for sampling ports, and sensor points.
- Bag sample containers prior to placement of sample material into containers.

HEAVY EQUIPMENT

- Care should be taken to limit the surface area of equipment that comes into contact with contamination.

GENERAL

- If contaminated tools are to be placed on noncontaminated equipment for transport to the decontamination pad, plastic should be used to keep the equipment clean.
- Spoils from sampling work should be placed so as not to be in the expected paths of individuals.

10.4 DISPOSAL PROCEDURES

Waste materials and other field equipment/supplies shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left on-site.

11.0 GENERAL SAFE WORK PRACTICES AND COMMUNICATIONS

11.1 SAFETY EQUIPMENT

Basic emergency and first aid equipment will be available at the SZ and/or the CRZ, as appropriate. This shall include communications equipment, first aid kit (sufficient to accommodate field team), emergency eye wash, and other safety-related equipment. Fire extinguishers will be provided, inspected, and available on-site.

11.2 COMMUNICATIONS

WALKIE TALKIES - Hand-held units shall be used as much as possible by field teams for communication between downrange operations and the Command Post base-station.

TELEPHONES - A mobile telephone may be located in the Command Post area in the SZ for communication with emergency support services/facilities.

HAND SIGNALS - Hand signals will be used by downrange field teams in conjunction with the buddy system. These signals are very important when working with heavy equipment. They shall be known by the entire field team before operations commence and reviewed during site-specific training.

	SIGNAL	MEANING
•	Hand gripping throat	Out of air; can't breathe
•	Grip partner's wrist	Leave area immediately; no debate
•	Hands on top of head	Need assistance
•	Thumbs up	OK; I'm all right; I understand
•	Thumbs down	No; negative

11.3 SAFE WORK PRACTICES

The following safe work practices will be implemented during site operations:

- Only properly trained and equipped personnel will be allowed to work in potentially contaminated areas.
- The number of personnel and equipment in the sampling areas will be kept to a minimum, consistent with safe site operations.
- Workers shall adhere to the "buddy system" while working downrange and in designated EZ s. Radio contact shall be maintained between pairs on-site in order to assist each other in case of emergencies.
- Workers shall not exit EZs until soiled equipment and clothing have been removed and decontaminated or properly disposed of.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer, ingestion, and inhalation of potentially contaminated materials is prohibited.

- As necessary, personnel will thoroughly wash their hands and faces upon leaving the investigation areas.
- Contact with potentially contaminated materials and surfaces shall be avoided. Personnel shall comply with contamination control measures.
- Personnel with facial hair or other facepiece seal obstructions will not be permitted to work where respirators are required.
- Work shall only be conducted if adequate illumination is provided, *i.e.*, visual observation is not impaired due to loss of daylight conditions.

12.0 EMERGENCY PREPAREDNESS

12.1 EMERGENCY COORDINATOR

The Site Emergency Coordinator shall be the SSO. The SSO shall verify appropriate emergency contacts before beginning work on-site.

EMERGENCY PHONE NUMBERS:

911 SHOULD BE CALLED IN ROCKLAND COUNTY

Police Department (Orangetown)	911 (914-359-3700)
Fire Department (Fire Chief)	911 (914-358-5454)
Hospital: West Nyack Hospital ER	914-348-2345
Hospital Address:	160 No. Midland Ave. Nyack, New York, 10960
Ambulance	911

NATIONAL OR REGIONAL SOURCES OF ASSISTANCE:

Corporate Environmental, Health & Safety Director 414-451-2775
Region Environmental, Health & Safety Manager 518-437-8374
EPA (RCRA-Superfund Hotline) 800-424-9346
Chemtrec (24 Hours) 800-424-9300
Bureau of Explosives (24 Hours) 202-293-4048
Centers for Disease Control (Biological Agents) 404-633-5313
National Response Center (NRC) 800-424-8802
DOT (Office of Hazardous Operations) 202-426-0656
DOT (Regulatory Matters) 202-426-2075
U.S. Coast Guard (Major Incidents) 800-424-8802
Pesticide Health Hotline 800-858-7378
EMR Inc. (Rust Medical Provider) - Dr. Elayne Theriault 800-229-3674

HOSPITAL ROUTE:

A hospital route map and written description depicting the route to the hospital from the investigation area is presented in Appendix D.

Once the SZ is established, and before field activity start-up, the Site Emergency Coordinator (*i.e.*, the SSO) shall drive the route to the hospital, post directions and/or a map to the hospital, and set up the first aid station including a 10-pound Type A/B/C fire extinguisher.

12.2 IMPLEMENTATION

The Site Emergency Coordinator (SSO) shall implement the emergency action procedures whenever conditions at the site warrant such action. The Site Emergency Coordinator (SSO) will be responsible for coordinating the evacuation, emergency treatment, and emergency transport of site personnel as necessary, and for notification of emergency response units and the appropriate management staff. In the event an evacuation is necessary, the SSO will take a role count at the designated gathering location with the use of the daily sign in and out sheet. The following conditions may require implementation of emergency action procedures:

- Fire or explosion on-site.
- Serious personal injury.
- Release of hazardous materials, including gases or vapors at levels greater than the maximum use concentrations of respirators.
- Unsafe working conditions, such as inclement weather.

12.3 FIRE OR EXPLOSION

If an actual fire or explosion has taken place, emergency steps will include 1) evacuation of work area and venting, and 2) notification of the fire department and other appropriate emergency response groups if necessary.

12.4 PERSONAL INJURY

Emergency first aid will be administered on-site as appropriate. Then the individual will be decontaminated if possible, depending on the severity of the injury, and transported to the nearest medical facility if needed.

12.5 OVERT CHEMICAL EXPOSURE

Typical response procedures include:

SKIN CONTACT:	Use copious amounts of cleaner and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention. Eye wash will be provided on-site at the CRZ and/or SZ. Eyes should be rinsed for 15 minutes upon chemical contamination.
INHALATION:	Move to fresh air and/or, if necessary, decontaminate/transport to hospital.
INGESTION:	Decontaminate and transport to emergency medical facility.
PUNCTURE WOUND OR LACERATION:	Decontaminate and transport to emergency medical facility. The SSO will provide medical data sheets to medical personnel as requested.

12.6 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SSO will determine if work can continue without endangering the health and safety of field workers. Some items to be considered before determining if work should continue are:

- Potential for heat stress and heat-related injuries.
- Potential for cold stress and cold-related injuries.
- Treacherous weather-related working conditions (*e.g.*, mud, ice, rain).
- Limited visibility.
- Potential for electrical storms.

12.6.1 Heat Stress

The SSO shall visually monitor personnel to note for signs of heat stress. Field personnel will also be instructed to observe for symptoms of heat stress and methods on how to control it. One or more of the following control measures can be used to help control heat stress:

- Provide adequate liquids to replace lost body fluids. Personnel must replace water and salt lost from sweating. Personnel must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.
- Replacement fluids can be commercial mixes such as Gatorade.
- Establish a work regime that will provide adequate rest periods for cooling down. This may require additional shifts of workers.
- Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments.
- Breaks are to be taken in a cool rest area (77°F is best).
- Personnel shall remove impermeable protective garments during rest periods.
- Personnel shall not be assigned other tasks during rest periods.
- Personnel shall be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

One of the following biological monitoring procedures may be used when the workplace temperature is 70°F or above.

- Heart rate (HR) shall be measured by the pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of rest period stays the same. If the pulse rate is 100 beats/minute at the beginning of the next rest period, the following work cycle should be shortened by 33 percent. The length of the initial work period will be determined by using the table below.

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES			
Work Load / Work-Rest Regimen	**Light**	**Moderate**	**Heavy**
Continuous Work	80.0°F	80.0°F	77.0°F
75% Work - 25% Rest, Each Hour	87.0°F	82.4°F	78.6°F
50% Work - 50% Rest, Each Hour	88.5°F	85.0°F	82.2°F
25% Work - 75% Rest, Each Hour	90.0°F	88.0°F	86.0°F

- Body temperature shall be measured orally with a clinical thermometer as early as possible in the resting period. Oral Temperature (OT) at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the oral temperature exceeds 99.7°F at the beginning of the next rest period, the following work cycle shall be further shortened by 33 percent. OT should be measured at the end of the rest period to make sure that it has dropped below 99°F. At no time shall work begin with the oral temperature above 99°F.

12.6.2 Cold Exposure

If field activities occur during a period when temperatures average below freezing, the following guidelines will be followed.

Persons working outdoors in temperatures at or below freezing may be subject to frostbite. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling of the body core, resulting in coma and death. Areas of the body which have high surface area-to-volume ratio such as fingers, toes, and ears are the most susceptible.

Two factors influence the development of a cold injury; ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a 15-mile per hour (mph) wind is equivalent to chilling still air to -18°F. Refer to Table 12-1 Windchill Index.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration-soaked.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

- Frost nip or incipient frostbite: Characterized by sudden blanching or whitening of skin.
- Superficial frostbite: Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- Deep frostbite: Tissue is cold, pale, and solid; extremely serious injury.

Prevention of frostbite is vital. Keep the extremities warm. Wear insulated clothing as part of one's protective gear during extremely cold conditions. Check for symptoms of frostbite at every break. The onset is painless and gradual--you may never know you have been injured until it is too late.

Table 12-1
Windchill Index

	ACTUAL THERMOMETER READING (F):									
Wind Speed in mph	50	40	30	20	10	0	-10	-20	-30	-40
	EQUIVALENT TEMPERATURE (F):									
Calm	50	40	30	20	10	0	-10	-20	*-30*	*-40*
5	48	37	27	16	6	-5	-15	*-26*	*-36*	*-47*
10	40	28	16	4	-9	-21	*-33*	*-46*	*-58*	*-70*
15	36	22	9	-5	-18	*-36*	*-45*	*-58*	*-72*	**-85**
20	32	18	4	-10	*-25*	*-39*	*-53*	*-67*	**-82**	**-96**
25	30	16	0	-15	*-29*	*-44*	*-59*	**-74**	**-88**	**-104**
30	28	13	-2	-18	*-33*	*-48*	*-63*	**-79**	**-94**	**-109**
35	27	11	-4	-20	*-35*	*-49*	*-67*	**-82**	**-98**	**-113**
40	26	10	-6	-21	*-37*	*-53*	*-69*	**-85**	**-100**	**-116**
>40 mph (little added effect)	Little Danger (For properly clothed person)				***Increased Danger*** (Danger from freezing of exposed flesh)			**Great Danger**		

Source: Fundamentals of Industrial Hygiene, Third Edition, Plog, B.A., Benjamin, G.S., Kerwin, M.A., National Safety Council, 1988.

To administer first aid for frostbite, bring the victim indoors and rewarm the areas quickly in water between 39°C and 41°C (102°F to 105°F). Give a warm drink--not coffee, tea, or alcohol. The victim should not smoke. Keep the frozen parts in warm water or covered with warm clothes for 30 minutes, even though the tissue will be very painful as it thaws. Then elevate the injured area and protect it from injury. Do not allow blisters to be broken. Use sterile, soft, dry material to cover the injured areas. Keep victim warm and get immediate medical care.

After thawing, the victim should try to move the injured areas a little, but no more than can be done alone (without help).

- Do **not** rub the frostbitten part (this may cause gangrene).
- Do **not** use ice, snow, gasoline, or anything cold on frostbite.
- Do **not** use heat lamps or hot water bottles to rewarm the frostbitten area.
- Do **not** place the body part near a hot stove.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F; 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing of the extremities; and, finally, 5) death.

Effects arising from cold exposure will be minimized by providing workers with insulated clothing when the equivalent chill temperature is less than 30°F as defined and presented in the ACGIH booklet in Table 5. Furthermore, field activities will generally be curtailed or halted if the equivalent chill temperature is below -20°F. The ultimate responsibility for delaying work at a site due to inclement weather rests with the SSO.

12.7 POISON IVY

If personnel come in contact with poison ivy, the individual should immediately wash the affected area with Ivy Cleaner provided in the first aid kit. If a rash develops, it should be treated at a medical facility as soon as possible.

12.8 SNAKES AND TICKS

12.8.1 Snake Bite Prevention and First Aid

On project sites, precautions against the possible presence of snakes should be taken when walking through overgrown vegetation and when moving debris (i.e. lumber, scrap metal, etc.). If someone is bitten by a snake, and the snake bite occurs in a location that is within a 1-hour drive of a medical facility, a conservative approach is safest. Keeping the victim quiet, lying or sitting, and reassuring him/her is all that is required. He/she should be transported safely (no speeding) to the nearest medical facility. For the reassurance of both the victim and the first aider, a snake bite is not nearly as dangerous as popular mythology would suggest. In North America, death from snake bite to healthy adults is very rare. Many bites, even from known poisonous snakes, do not result in a significant amount of venom being injected. Even when significant envenom occurs, symptoms develop slowly over many hours and can be controlled with appropriate treatment. Field treatments advised against include ice, cutting and suction around the wound, and tourniquets. Studies indicate that ice leads to increased tissue destruction. Cutting and sucking out the wound can be shown to offer some help if it is done with the correct technique and equipment and if the victim has received a large dose of venom. In light of the damage that can be done, the risk of such a procedure is too high. It is best to transport the person immediately to a medical facility.

12.8.2 Tick Bite Prevention and First Aid

Routinely check for ticks after being outdoors. Remove ticks as soon as possible before they embed. To minimize exposure, wear light-colored clothing so ticks can be detected. Tuck pants into boots or socks and wear long sleeved shirts. Apply tick/insect repellent to clothing.

When a tick is found embedded, remove it by grasping it with a tweezers as close to the skin as possible and gently pull it straight out. Do not twist or jerk the tick because the head may remain embedded. Once the tick is removed, wash the bite area and your hands with soap and water and apply an antiseptic to the bite. Save the tick in a jar labeled with the date and the place where the tick was acquired. A physician may find this information and the tick specimen helpful in diagnosis if an infection results.

12.9 ACCIDENT/INJURY REPORTING AND RECORD KEEPING

The SSO shall maintain logs and reports covering health and safety aspects of the project throughout the duration of work activities. In the event of an on-site accident resulting in an exposure or injury, the SSO shall immediately complete a Supervisor's Incident Report (SIR) and send a copy to the REHSM. The SSO shall be responsible for maintaining on-site, the routinely completed records and forms presented in Appendix C of this HASP.

13.0 HASP ACCEPTANCE

Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read and understand this Health and Safety Plan. I will comply with the provisions contained therein.

Site/Project: _____

PRINTED NAME	SIGNATURE	DATE

APPENDIX A

Material Safety Data Sheets

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

Material Safety Data Sheets Collection:

Sheet No. 311
Methyl Chloroform

Issued: 11/75 Revision: F, 3/92 Errata: 6/92

Section 1. Material Identification

Methyl Chloroform ($C_2H_3Cl_3$) Description: Derived by catalytic addition of hydrogen chloride to 1,1-dichloroethylene or by re-fluxing chlorine monoxide with carbon tetrachloride and chloroethane. Available in technical and solvent grades which differ only in the amount of stabilizer added to prevent metal parts corrosion. Used as a solvent for oils, waxes, tars, cleaning precision instruments, and pesticides; as a component of inks and drain cleaners; in degreasing metals, and textile processing. In recent years, methyl chloroform has found widespread use as a substitute for carbon tetrachloride.

R 1
I 2
S 2*
K 1

Genium

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

Other Designations: CAS No. 71-55-6, α-trichloroethane; Inhibisol; 1,1,1-trichloroethane; Strobane.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.
Cautions: Methyl chloroform is a skin, eye, and respiratory tract irritant and can become narcotic with an anesthetic effect at high concentrations.
* Data on skin absorption via methyl chloroform is conflicting.[133] Some studies show definite absorption where others don't.

Section 2. Ingredients and Occupational Exposure Limits

Methyl chloroform, ca 92 to 97%*

1990 OSHA PELs
8-hr TWA: 350 ppm (1900 mg/m^3)
15-min STEL: 450 ppm (2450 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
15-min Ceiling: 350 ppm (1900 mg/m^3)

1991-92 ACGIH TLVs
TWA: 350 ppm (1910 mg/m^3)
STEL: 450 ppm (2460 mg/m^3)

1990 DFG (Germany) MAKs
TWA: 200 ppm (1080 mg/m^3)
Half-life: 2 hr to shift length
Peak Exposure Limit: 1000 ppm/30 min (average value)/2 per shift

1985-86 Toxicity Data†
Human, oral, TD_{Lo}: 670 mg/kg produced diarrhea, nausea, and vomiting
Human, inhalation, LC_{Lo}: 27 g/m^3/10 min; toxic effects not yet reviewed
Man, eye: 450 ppm/8 hr produced irritation
Rat, inhalation, TC_{Lo}: 2100 ppm/24 hr for 14 days prior to mating and from 1 to 20 days of pregnancy produced specific developmental abnormalities of the musculoskelatal system

* Methyl chloroform usually contains inhibitors (3 to 8%) to prevent corrosion of aluminum and some other metals. Typical inhibitors are nitromethane, butylene oxide, secondary butyl alcohols, ketones, and glycol diesters.
† See NIOSH, *RTECS* (KJ2975000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 165 °F (75 °C)
Freezing Point: -22 °F (-30 °C)
Vapor Pressure: 100 mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 4.55
Corrosivity: Readily corrodes aluminum and its alloys
Refraction Index: 1.43765 at 69.8 °F (21 °C)
Viscosity: 0.858 cP at 68 °F (20 °C)
Molecular Weight: 133.42
Density: 1.3376 at 68/39.8 °F (20/4 °C)
Water Solubility: Insoluble
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, carbon tetrachloride, and carbon disulfide
% in Saturated Air: 16.7% at 77 °F (25 °C)
Relative Evaporation Rate (butyl acetate = 1): 12.8
Appearance and Odor: Colorless liquid with a sweetish, chloroform-like odor. The odor threshold is 44 ppm.

Section 4. Fire and Explosion Data

Flash Point: None (in conventional CC tests) | **Autoignition Temperature:** 932 °F (500 °C) | **LEL:** 7% v/v | **UEL:** 16% v/v

Extinguishing Media: *Noncombustible liquid* whose *vapor* burns in the presence of excess oxygen or a strong ignition source. For small fires, use dry chemical or carbon dioxide (CO_2). For large fires use fog or regular foam. If these materials are unavailable, a water spray may be used but be aware that water reacts slowly with methyl chloroform to release hydrochloric acid.
Unusual Fire or Explosion Hazards: Vapors are heavier than air and may travel to a strong ignition source and flash back. Air/vapor mixtures may explode when heated. Container may explode in heat of fire. Exposure to open flames or arc welding can produce hydrogen chloride and phosgene.
Special Fire-fighting Procedures: Methyl chloroform's burning rate is 2.9 mm/min. Since 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 provides limited protection. Wear clothing specifically recommended by the manufacturer for use in fires involving methyl chloroform. Apply cooling water to container sides until after fire is extinguished. Stay away from ends of tanks. Isolate area for 1/2 mile if fire involves tank, truck, or rail car. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Methyl chloroform is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can occur in contact with aluminum trichloride.
Chemical Incompatibilities: Methyl chloroform is incompatible with sodium hydroxide, nitrogen tetroxide, oxygen (liquid or gas), strong oxidizers, and chemically active metals like aluminum, zinc, and magnesium powders; reacts violently with caustics to form dichloroacetylene; reacts slowly with water to form hydrochloric acid; forms shock sensitive mixtures with potassium; and polymerizes in contact with aluminum trichloride.
Conditions to Avoid: Exposure to moisture, strong ignition sources, and arc-welding units, and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition (temperatures >500 °F, contact with hot metals, or under UV rays) of methyl chloroform can produce carbon dioxide (CO_2) and toxic dichloroacetylene, hydrogen chloride, and phosgene gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC (Class 3, inadequate evidence),[164] NTP,[142] and OSHA[164] do not list methyl chloroform as a carcinogen.
Summary of Risks: Methyl chloroform is considered one of the least toxic of the liquid chlorinated hydrocarbons. It is irritating to eyes, skin, and respiratory tract. Although low in systemic toxicity, methyl chloroform is an anesthetic capable of causing death at high concentrations (>15,000 ppm), generally in poorly ventilated, enclosed areas. Quick and complete recovery is observed after prompt removal of unconscious persons from area of exposure. Like many other solvents, methyl chloroform sensitizes the heart to epinephrine (blood pressure-raising hormone) and may induce cardiac arrhythmias and arrest.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, central nervous (CNS) and cardiovascular (CVS) systems.

Continue on next page

Section 6. Health Hazard Data, *continued*

Primary Entry Routes: Inhalation, skin contact. **Acute Effects:** Methyl chloroform defats the skin causing irritation, redness, dryness, and scaling. Contact with eyes produces irritation and mild conjunctivitis. Vapor inhalation can cause headache, dizziness, equilibrium disturbances, and in high concentrations may lead to CNS depression, unconsciousness, and coma. During a 60-min exposure period these effects are observed: 100 ppm is the observed odor threshold, at 500 ppm there is obvious odor and decreased reaction time, 1000 ppm causes slight equilibrium loss, at 5000 ppm there is definite incoordination, and 20,000 ppm produces surgical strength anesthesia with possible death. Mild liver and kidney dysfunction may occur after CNS depression recovery. Although unlikely, if ingestion occurs, symptoms include nausea, vomiting, diarrhea, and possible esophageal burns. The acute lethal human dose is ~500 to 5000 mg/kg. **Chronic Effects:** None reported.

FIRST AID

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to rub or keep eyes tightly shut. 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. When deciding whether to induce vomiting, carefully consider amount ingested, time since ingestion, and availability of medical help. If large amounts are recently ingested (absorption into the body is not yet likely to have occurred), and medical help or transportation to a medical facility is not readily available, induce vomiting. Otherwise, vomiting is not recommended since aspiration of vomitus can produce chemical pneumonitis. **Note to Physicians:** Do not use adrenaline or sympathomimetic amines in treatment because of the increased cardiac sensitivity involved.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources. If possible without risk, shut off leak. Cleanup personnel should wear fully encapsulating vapor-protective clothing. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material. Using nonsparking tools, place in suitable containers for disposal or reclamation. For large spills, dike far ahead of liquid spill for later disposal or reclamation. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Transport: In water, methyl chloroform's half-life is hours to weeks depending on wind and mixing conditions. It is very persistent in groundwater. On land it volatilizes due to its high vapor pressure and leaches extensively. When released to the atmosphere, methyl chloroform can be transported long distances and returned to earth via rain. It is slowly degraded by reaction with hydroxyl radicals and has a half-life of 6 months to 25 years. The Natural Resources Defenses Council reported recently that methyl chloroform depletes ozone.
Ecotoxicity Values: *Pimephales promelas* (fathead minnow), LC_{50}: 52.8 mg/L/96 hr; *Poecilia reticulata* (guppy), LC_{50}: 133 ppm/7 day.
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): No. U226
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Reportable Quantity (RQ), 1000 lb (454 kg) [* per RCRA, Sec. 3001, CWA, Sec. 307(a), and CAA, Sec. 112]
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 splash-proof, protective chemical safety goggles or faceshields, 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. 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: 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 repeated or prolonged skin contact. Viton and butyl rubber [with breakthrough times (BTs) of >8 hr and 4 to 7.9 hr, respectively] are recommended materials for protective gear. *Do not use* neoprene, polyvinyl chloride (PVC), natural rubber, or polyethylene because these materials have a BT of <1 hr.
Ventilation: Provide general and local exhaust (in some cases, explosion-proof) ventilation 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 the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. 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: Prevent physical damage to containers. Store in cool, dry, well-ventilated (use pressure-vacuum ventilation) area away from ignition sources, arc-welding operations, and incompatibles (Sec. 5). Regularly monitor inhibitor levels. *Do not* store in aluminum containers or use pressure-spraying equipment when methyl chloroform is involved.
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. To prevent static sparks, electrically ground and bond all equipment used in methyl chloroform manufacturing, use, storage, transfer, and shipping.
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers that emphasize CNS, CVS, liver and skin.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: 1,1,1-Trichloroethane
DOT Hazard Class: ORM-A
ID No.: UN2831
DOT Label: None
DOT Packaging Exceptions: 173.505
DOT Packaging Requirements: 173.605

IMO Shipping Name: 1,1,1-Trichloroethane
IMO Hazard Class: 6.1
ID No.: UN2831
IMO Label: St. Andrews Cross
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 148, 153, 159, 162, 163, 164
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

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

Material Safety Data Sheets Collection:

Sheet No. 312
Trichloroethylene

Issued: 7/79 Revision: F, 9/92

Section 1. Material Identification

Trichloroethylene (C_2HCl_3) Description: Derived by treating tetrachloroethane with lime or other alkali in the presence of water, or by thermal decomposition of tetrachloroethane followed by steam distillation. Stabilizers such as epichlorohydrin, isobutanol, carbon tetrachloride, chloroform, benzene, or pentanol-2-triethanolamine are then added. Used as a degreasing solvent in electronics and dry cleaning, a chemical intermediate, a refrigerant and heat-exchange liquid, and a diluent in paint and adhesives; in oil, fat, and wax extraction and in aerospace operations (flushing liquid oxygen). Formerly used as a fumigant (food) and anesthetic (replaced due to its hazardous decomposition in closed-circuit apparatus).

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

NFPA
2
2 0
-

HMIS
H 2†
F 2
R 0
PPE‡
† Chronic Effects
‡ Sec. 8

Other Designations: CAS No. 79-01-6; acetylene trichloride; Algylen; Anamenth; Benzinol; Cecolene; Chlorylen; Dow-Tri; ethylene trichloride; Germalgene; Narcogen; Triasol; trichloroethene; TCE; 1,1,3-trichloroethylene.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: TCE is irritating and toxic to the central nervous system (CNS). Inhalation of high concentrations have lead to death due to ventricular fibrillation. Chronic exposure may lead to heart, liver, and kidney damage. The liquid is absorbed through the skin. Although it has a relatively low flash point, TCE burns with difficulty.

Section 2. Ingredients and Occupational Exposure Limits

Trichloroethylene, < 100% [contains stabilizers (Sec. 1)].

1991 OSHA PELs
8-hr TWA: 50 ppm (270 mg/m³)
15-min STEL: 200 ppm (1080 mg/m³)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
10-hr TWA: 25 ppm (~135 mg/m³)

1992-93 ACGIH TLVs
TWA: 50 ppm (269 mg/m³)
STEL: 200 ppm (1070 mg/m³)

1990 DFG (Germany) MAK
Ceiling: 50 ppm (270 mg/m³)
Category II: Substances with systemic effects
Half-life: 2 hr to shift length
Peak Exposure Limit: 250 ppm, 30 min average value; 2 peaks/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 160 ppm/83 min caused hallucinations and distorted perceptions.
Human, lymphocyte: 5 mL/L caused DNA inhibition.
Rabbit, skin: 500 mg/24 hr caused severe irritation.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.
Mouse, oral, TD_{Lo}: 455 mg/kg administered intermittently for 78 weeks produced liver tumors.

* See NIOSH, *RTECS* (KX4550000), for additional irritation, mutation, reproductive, tumorigenic and toxicity data.

Section 3. Physical Data

Boiling Point: 189 °F (87 °C)
Freezing Point: -121 °F (-85 °C)
Viscosity: 0.0055 Poise at 77 °F (25 °C)
Molecular Weight: 131.38
Density: 1.4649 at 20/4 °C
Refraction Index: 1.477 at 68 °F (20 °C/D)
Odor Threshold: 82 to 108 ppm (*not an effective warning*)

Vapor Pressure: 58 mm Hg at 68 °F (20 °C); 100 mm Hg at 32 °F (0 °C)
Saturated Vapor Density (Air = 0.075 lbs/ft³; 1.2 kg/m³): 0.0956 lbs/ft³; 1.53 kg/m³
Water Solubility: Very slightly soluble; 0.1% at 77 °F (25 °C)
Other Solubilities: Highly soluble in organic solvents (alcohol, acetone, ether, carbon tetrachloride, & chloroform) and lipids.
Surface Tension: 29.3 dyne/cm

Appearance and Odor: Clear, colorless (sometimes dyed blue), mobile liquid with a sweet chloroform odor.

Section 4. Fire and Explosion Data

Flash Point: 90 °F (32 °C) CC | **Autoignition Temperature:** 788 °F (420 °C) | **LEL:** 8% (25 °C); 12.5% (100 °C) | **UEL:** 10% (25 °C); 90% (100 °C)

Extinguishing Media: A Class 1C Flammable Liquid. Although it has a flash point of 90 °F, TCE burns with difficulty. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapor/air mixtures may explode when ignited. Container may explode in heat of fire. **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 firefighters' protective clothing provides only limited protection against TCE. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: TCE slowly decomposes in the presence of light and moisture to form corrosive hydrochloric acid. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include alkalis (sodium hydroxide), chemically active metals (aluminum, beryllium, lithium, magnesium, sodium, potassium, and titanium), epoxides, and oxidants (nitrogen tetroxide, perchloric acid). Contact with 1-chloro-2,3-epoxy propane or the mono and di 2,3-epoxypropyl ethers of 1,4-butanediol + 2,2-bis-4(2',3'-epoxypropoxy)-phenylpropane can, in the presence of catalytic quantities of halide ions, cause dehydrochlorination of TCE to explosive dichloroacetylene. **Conditions to Avoid:** Exposure to light, moisture, ignition sources, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of TCE (above 300 °C) or exposure to ultraviolet light can produce carbon dioxide (CO_2) and toxic dichloro acetylene (explosive), chlorine, hydrogen chloride, and phosgene gas.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies have rated TCE's carcinogenicity: IARC (Class 3, limited animal evidence & insufficient human data), Germany MAK (Class B, justifiably suspected of having carcinogenic potential), & NIOSH (Class X, carcinogen defined with no further categorization). **Summary of Risks:** TCE vapor is irritating to the eyes, nose, and respiratory tract and inhalation of high concentrations can lead to severe CNS effects such as unconsciousness, ventricular arrythmias, and death due to cardiac arrest. Mild liver dysfunction was also seen at levels high enough to produce CNS effects. Contact with the liquid is irritating to the skin and can lead to dermatitis by defatting the skin. Chronic toxicity is observed in the victims increasing intolerance to alcohol characterized by 'degreasers flush', a transient redness of the face, trunk, and arms. The euphoric effect of TCE has led to craving, and habitual sniffing of its vapors.

Continue on next page

Section 6. Health Hazard Data, *Continued*

TCE crosses the placental barrier and thus exposes the fetus (any effects are yet unknown). There are increased reports of menstrual disorders in women workers and decreased libido in males at exposures high enough to cause CNS effects. TCE is eliminated unchanged in expired air and as metabolites (trichloroacetic acid & trichloroethanol) in blood and urine. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the nervous system, skin, heart, liver, and kidney. **Target Organs:** Respiratory, central & peripheral nervous, and cardiovascular (heart) systems, liver, kidney, and skin. **Primary Entry Routes:** Inhalation, skin and eye contact, and ingestion (rarely). **Acute Effects:** Vapor inhalation can cause eye, nose, and throat irritation, nausea, blurred vision, overexcitement, headache, drunkenness, memory loss, irregular heartbeat (resulting in sudden death), unconsciousness, and death due to cardiac failure. Skin contact with the liquid can cause dryness and cracking and prolonged exposure (generally if the victim is unconscious) can cause blistering. Eye contact can cause irritation and watering, with corneal epithelium injury in some cases. Ingestion of the liquid can cause lip, mouth, and gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Effects may persist for several weeks or months after repeated exposure. Symptoms include giddiness, irritability, headache, digestive disturbances, mental confusion, intolerance to alcohol (degreasers flush), altered color perception, loss or impairment of sense of smell, double vision, and peripheral nervous system function impairment including persistent neuritis, temporary loss of sense of touch, and paralysis of the fingers from direct contact with TCE liquid.
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. **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, then induce vomiting. Do not give milk, as its fat content (TCE is lipid soluble) may inhance gastrointestinal absorption of TCE. **Note to Physicians:** TCE elimination seems to be triphasic with half lives at 20 min, 3 hr, and 30 hr. Some success is seen in treating patients with propranolol, atropine, and disulfiram. Monitor urine and blood (lethal level = 3 to 110 µg/mL) metabolites. BEI = 100 mg/g creatinine (trichloroacetic acid) in urine, *sample at end of workweek.* BEI = 4 mg/L (trichloroethanol) in blood, *sample at end of shift at end of the workweek.* These tests are not 100% accurate indicators of exposure; monitor TCE in expired air as a confirmatory test.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container for later disposal. For large spills, flush to containment area where density stratification will form a bottom TCE layer which can be pumped and containerized. Report any release in excess of 1000 lbs. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, LC_{50} = 44,700 µg/L/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 40.7 mg/L/96 hr. **Environmental Degradation:** In air, TCE is photooxidized with a half-life of 5 days and reported to form phosgene, dichloroacetyl chloride, and formyl chloride. In water it evaporates rapidly in minutes to hours. TCE rapidly evaporates and may leach since it does not absorb to sediment. **Soil Absorption/Mobility:** TCE has a Log K_{oc} of 2, indicating high soil mobility. **Disposal:** Waste TCE can be poured on dry sand and allowed to vaporize in isolated location, purified by distillation, or returned to supplier. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) with an acid scrubber to remove halo acids. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33 & 261.31): No. U228 & F002 (*spent solvent*)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001, 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 chemical safety goggles (cup-type or rubber framed, equipped with impact-resistant glass), 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. At any detectable concentration, wear a SCBA with a full facepiece 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 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 from Viton or Neoprene to prevent skin contact. *Do not* use natural rubber or polyvinyl chloride (PVC). **Ventilation:** Provide general and 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] **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 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 steel drums, in a cool, dry, well-ventilated area away from sunlight, heat, ignition sources, and incompatibles (Sec. 5). Store large quantities in galvanized iron, black iron, or steel containers; small amounts in dark (amber) colored glass bottles. **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. Design processes so that the operator is not directly exposed to the solvent or its vapor. Do not use open electric heaters, high-temperature processes, arc-welding or open flames in TCE atmospheres. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, respiratory, cardiac, central and peripheral nervous systems, and liver and kidney function. Employ air and biological monitoring (BEIs). Instruct employees on safe handling of TCE.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Trichloroethylene
DOT Hazard Class: 6.1
ID No.: UN1710
DOT Packing Group: III
DOT Label: Keep Away From Food
DOT Special Provisions (172.102): N36, T1

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 60L
b) Cargo Aircraft Only: 220L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.
Prepared by: M Gerson, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MD

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

Material Safety Data Sheets Collection:
Sheet No. 313
Perchloroethylene
Issued: 11/78 Revision: E, 9/92

Section 1. Material Identification

Perchloroethylene (C_2Cl_4) **Description:** By chlorination of hydrocarbons and pyrolysis of the carbon tetrachloride that is formed, or by catalytic oxidation of 1,1,2,2-tetrachloroethane. Used in dry cleaning and textile processing, metal degreasing, insulating fluid and cooling gas in electrical transformers, production of adhesives, aerosols, paints, and coatings; as a chemical intermediate, a solvent for various applications, extractant for pharmaceuticals, a pesticide intermediate, and an antihelminthic (parasitic worm removal) agent in veterinary medicine.
Other Designations: CAS No. 127-18-4, Ankilostin, carbon dichloride, Didakene, ethylene tetrachloride, Perchlor, Perclene, Perk, Tetracap, tetrachloroethylene.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Perchloroethylene is a central nervous system depressant, causes liver and kidney damage (from acute or chronic exposures), and is considered an IARC Class 2B carcinogen (animal sufficient evidence, human inadequate data).

R 1
I 3
S 2*
K 0
* Skin absorption

NFPA


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

Section 2. Ingredients and Occupational Exposure Limits

Perchloroethylene, < 99%. Impurities include a small amount of amine or phenolic stabilizers.

1991 OSHA PEL
8-hr TWA: 25 ppm (170 mg/m³)

1990 IDLH Level
500 ppm

1990 NIOSH REL
NIOSH-X Carcinogen
Limit of Quantitation: 0.4 ppm

1992-93 ACGIH TLVs
TWA: 50 ppm (339 mg/m³)
STEL: 200 ppm (1357 mg/m³)

1990 DFG (Germany) MAK
TWA: 50 ppm (345 mg/m³)
Category II: substances with systemic effects
Half-life: < 2 hr
Peak Exposure Limit: 100 ppm, 30 min average value, 4/shift

1985-86 Toxicity Data*
Man, inhalation, TC_{Lo}: 280 ppm/2 hr caused conjunctival irritation and anesthesia.
Human, lung: 100 mg/L caused unscheduled DNA synthesis.
Rat, oral, LD_{50}: 3005 mg/kg; caused somnolence, tremor, and ataxia.
Rat, inhalation, TC_{Lo}: 200 ppm/6 hr given intermittently over 2 years produced leukemia and testicular tumors.
Rabbit, eye: 162 mg caused mild irritation.
Rabbit, skin: 810 mg/24 hr caused severe irritation.

* See NIOSH, *RTECS* (KX3850000), for additional irritation, mutation, reproductive, tumorigenic, & toxicity data.

Section 3. Physical Data

Boiling Point: 250 °F (121.2 °C)
Freezing Point: -8 °F (-23.35 °C)
Vapor Pressure: 13 mm Hg at 68 °F (20 °C)
Surface Tension: 31.74 dyne/cm at 68 °F (20 °C)
Viscosity: 0.84 cP at 77 °F (25 °C)
Refraction Index: 1.50534 at 68 °F (20 °C)
Molecular Weight: 165.82

Density: 1.6311 at 59 °F (15/4 °C)
Water Solubility: 0.02% at 77 °F (25 °C)
Other Solubilities: Miscible with alcohol, ether, benzene, chloroform, and oils.
Odor Threshold: 47 to 71 ppm (poor warning properties since olfactory fatigue is probable)
Evaporation Rate: 0.15 gal/ft²/day at 77 °F (25 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.081 lb/ft³ or 1.296 kg/m³

Appearance and Odor: Colorless liquid with an ether-like odor.

Section 4. Fire and Explosion Data

Flash Point: Nonflammable	Autoignition Temperature: Nonflammable	LEL: None reported	UEL: None reported

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2). For large fires, use water spray, fog, or regular foam.
Unusual Fire or Explosion Hazards: Vapors are heavier than air and collect in low-lying areas.
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. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Perchloroethylene is stable up to 932 °F (500 °C) in the absence of catalysts, moisture, and oxygen but deteriorates rapidly in warm, moist climates. It is slowly decomposed by light. Amine or phenolic stabilizers are usually added. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Slowly (faster in presence of water) corrodes aluminum, iron, and zinc. It is incompatible with chemically active metals (i.e., barium, beryllium, and lithium (explodes with lithium shavings), strong oxidizers, sodium hydroxide, caustic soda, potash, and nitric acid. Perchloroethylene forms an explosive mixture with dinitrogen tetraoxide and reacts with activated charcoal at 392 °F (200 °C) to yield hexachloroethane and hexachlorobenzene. **Conditions to Avoid:** Contact with moisture and incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of perchloroethylene can produce carbon dioxide and toxic chlorine, hydrogen chloride, and phosgene gas (also produced by contact with UV light).

Section 6. Health Hazard Data

Carcinogenicity: Perchloroethylene is listed as a carcinogen by The IARC (Group 2B, animal sufficient evidence, human inadequate data),(164) NTP (Class 2, reasonably anticipated as a carcinogen, with limited human evidence and sufficient animal evidence),(169) NIOSH (Class-X, carcinogen defined with no further explanation),(164) and DFG (MAK-B, justifiably suspected of having carcinogenic potential)(164). There is some controversy regarding human carcinogenicity because even though there is an increased number of cancers of the skin, colon, lung, urogenital tract, and lympho-sarcomas; the dry cleaning workers studied were also exposed to other chemicals. **Summary of Risk:** Perchloroethylene is stored in the fatty tissue and slowly metabolized with the loss of chlorine. The half-life of its urinary metabolite (trichloroacetic acid) is 144 hours. Perchloroethylene exerts the majority of its toxicity on the central nervous system causing symptoms ranging from light-headedness and slight 'inebriation' to unconsciousness. Liver damage is possible after severe acute or minor long-term exposure. It has a synergistic effect with toluene.

Continues on next page

Section 6. Health Hazard Data, *continued*

Medical Conditions Aggravated by Long-Term Exposure: Nervous, liver, kidney, or skin disorders. **Target Organs:** Liver, kidney, eyes, upper respiratory tract, skin, and central nervous system. **Primary Entry Routes:** Inhalation and skin and eye contact. **Acute Effects:** Exposure to high levels can cause liver damage which may take several weeks to develop. Vapor exposure can cause slight smarting of the eyes and throat (in high concentrations). In human studies, exposure to 2000 ppm/5 min caused mild CNS depression; 600 ppm/10 min caused numbness around the mouth, dizziness, and incoordination; 100 ppm/7 hr caused mild eye, nose, and throat irritation, flushing of the face and neck, headache, somnolence, and slurred speech. Skin contact may produce dermatitis because of perchloroethylene's defatting action (more common after repeated exposure). Direct eye contact causes tearing and burning but no permanent damage. Ingestion is rare but can cause irritation of the lips, mouth and gastrointestinal tract, irregular heartbeat, nausea & vomiting, diarrhea (possibly blood stained), drowsiness, unconsciousness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Prolonged exposure can cause impaired memory, extremity (hands, feet) weakness, peripheral neuropathies, impaired vision, muscle cramps, liver damage (fatty degeneration, necrosis, yellow jaundice, and dark urine) and kidney damage (oliguric uremia, congestion and granular swelling).

FIRST AID ***Rescuers must not enter areas with potentially high perchloroethylene levels without a self-contained breathing apparatus.*** **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. ***Never administer adrenalin!*** **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, then induce vomiting. Be sure victim's head is positioned to avoid aspiration of vomitus into the lungs. **Note to Physicians:** Monitor level of consciousness, EEG (abnormalaties may indicate chronic toxicity), blood enzyme levels (for 2 to 3 wk after exposure), EKG, adequacy of respirations & oxygenation, and liver and kidney function. ***BEIs:*** C_2Cl_4 in expired air (10 ppm), sample prior to last shift of work week; C_2Cl_4 in blood (1 mg/L), sample prior to last shift of work week; trichloroacetic acid in urine (7 mg/L), sample at end of workweek.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources (although noncombustible, it forms toxic vapors from thermal decomposition). 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 spill and await reclamation or disposal. Report any release in excess of 1 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, perchloroethylene evaporates and some leaches to groundwater. It may absorb slightly to soils with heavy organic matter. Biodegradation may be important in anaerobic soils. In water, it is subject to rapid volatilization with an estimated half-life from <1 day to several weeks. In air, it exists mainly in the vapor-phase and is subject to photooxidation with a half-life of 30 minutes to 2 months. **Ecotoxicity Values:** Guppy (*Poecilia reticulata*), LC_{50} = 18 ppm/7 days; fathead minnow (*Pimephales promelas*), LC_{50} = 18.4 mg/L/96 hr, flow through bioassay. **Disposal:** Consider recovery by distillation. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) or 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 261.33): No. U210
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per CWA Sec. 307 (a)]
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 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 a faceshield (8 inch minimum) 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 any detectable concentration, use a supplied-air respirator or SCBA with a full facepiece 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 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 butyl rubber, Neoprene, or Viton to prevent skin contact. **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: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from sunlight, and incompatibles. Do not store sludge from vapor degreasers in tightly-sealed containers and keep outside until disposal is arranged. **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. Check stabilizer levels frequently and ventilation equipment (air velocity, static pressure, air valve) at least every 3 months. Install an air dryer in ventlines to storage tanks to prevent moisture from rusting and weakening the tank and contaminating or discoloring its contents. Purge all tanks before entering for repairs or cleanup. Build a dike around storage tanks capable of containing all the liquid. Ground tanks to prevent static electricity. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize liver, kidney, and nervous system function, and the skin. Alcoholism may be a predisposing factor.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Tetrachloroethylene
DOT Hazard Class: 6.1
ID No.: UN1897
DOT Packing Group: III
DOT Label: Keep away from food
Special Provisions (172.102): N36, T1

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 60 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

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)

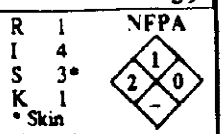
Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

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



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/m³
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m³

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m³)
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/m³)
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/m³
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m³

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m³
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m³

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloracne 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^{-5} 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.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[144] and NTP[109] 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