

Pico Power Project

***Appendix 8.14-C
Phase II Environmental Site Assessment
Work Plan—City of Santa Clara Property
at 850 Duane Avenue***

October 2002

Final
**PHASE II ENVIRONMENTAL SITE ASSESSMENT
WORK PLAN,
DUANE AVENUE AT LAFAYETTE STREET,
SANTA CLARA, CALIFORNIA**

Prepared for:

Silicon Valley Power
1500 Warburton Avenue
Santa Clara, CA 95050
September 3, 2002



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Reviewed by:



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September 3, 2002

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ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
DPT	direct-push technology
DOT	Department of Transportation
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
Foster Wheeler	Foster Wheeler Environmental Corporation
IDW	investigation-derived waste
PCB	polychlorinated biphenyl
PG&E	Pacific Gas and Electric
PID	photoionization detector
PVC	polyvinyl chloride
SVP	Silicon Valley Power
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons as diesel
TPH-g	total petroleum hydrocarbons as gasoline
TRPH	total recoverable petroleum hydrocarbons
VOC	volatile organic compound

1.0 INTRODUCTION

This limited Phase II Environmental Site Assessment (ESA) Work Plan was prepared by Foster Wheeler Environmental Corporation (Foster Wheeler) for Silicon Valley Power (SVP), for the purpose of assessing potential environmental issues at the proposed Pico Power Plant site on Duane Avenue at Lafayette Street in Santa Clara, California. The site location is shown on Figures 1-1 and 1-2. A Phase I ESA was performed for SVP by SCS Engineers for the Duane Avenue site and was submitted to SVP on June 3, 2002.

The scope of work for Phase II ESA activities described in this Work Plan was developed based on the findings of the June 3, 2002, Phase I ESA (SCS Engineers, 2002). Soil samples will be collected and analyzed at a total of seven locations, and one groundwater sample will be collected and sampled from one location at the site.

A Site-Specific Health and Safety Plan is included as Attachment 1, describing health and safety procedures to be followed for implementation of this Phase II ESA Work Plan.

2.0 SCOPE OF WORK

This section describes the scope of the proposed field activities, documentation, and reporting requirements for the proposed Phase II ESA.

2.1 SITE CLEARANCE

Underground Services Alert will be notified and a geophysical survey will be conducted of proposed soil boring locations prior to subsurface sampling.

2.2 PROPOSED SAMPLE LOCATIONS AND ANALYTICAL PROTOCOLS

The following is a description of the general sample locations and analytical protocols proposed. Exact sample locations will be determined in the field by experienced personnel, who will select and document final sample locations based on visual inspection of the site and knowledge of the concerns described in the Phase I ESA. All sample locations and key site reference points will be recorded using either a global positioning system receiver with an approximate position accuracy of 10 feet or measurements from identifiable points.

2.2.1 South Property Area

Two locations will be sampled in the vicinity of the south property boundary near the Silicon Valley Power substation fence where reported oil staining and open containers reportedly containing oily liquids were described. Each of these two locations will be cored using a hand auger, with samples collected from 0 to 1 foot and 2 to 3 feet below ground surface (bgs). Each soil sample will be analyzed for total recoverable petroleum hydrocarbons (TRPH) by Environmental Protection Agency (EPA) Method 1664 and for polychlorinated biphenyls (PCBs) by EPA Method 8082. If contamination is suspected below 2 to 3 feet bgs based on visual and photoionization detector (PID) screening, that location will be cored as deep as practical (maximum of 6 feet bgs) until no contamination is suspected, with one additional sample collected for analysis from the deepest depth.

2.2.2 West Property Area

Two locations will be sampled in the vicinity of the trailers and equipment storage area along the west side of the site. This area reportedly contained portable fuel containers, 5-gallon containers of hydraulic fluid, and a small number of unlabeled 55-gallon drums that may or may not have been empty. Each of these two locations will be cored using a hand auger, with samples collected from 0 to 1 foot and 2 to 3 feet bgs. As described above, if visual or PID evidence of contamination is observed, each location would be cored and sampled to a maximum depth of 6 feet bgs. Each sample will be analyzed for TRPH, total petroleum hydrocarbons (TPH) as

gasoline (TPH-g) (EPA Method 8015B-purgeable), and TPH as diesel (TPH-d) (EPA Method 8015B-extractable).

2.2.3 East Property Area

Three locations in the eastern area of the site will also be sampled. One location will be in the vicinity of the street-sweeper wash station, where runoff has been observed from the equipment washing area. This location will be sampled from 0 to 1 feet and 2 to 3 feet bgs, with deeper sampling only being performed if visual or PID evidence warrants (as described above). The 0 to 1-foot sample will be analyzed for TRPH, TPH-d, and total metals (EPA Method 6010). The deeper, 2 to 3-foot, sample will be analyzed for TRPH and TPH-d. One location, at the location of the historical "ponding" area, identified in the Phase I ESA from aerial photographs, will be cored and sampled from 0 to 1 feet bgs and 2 to 3 feet bgs (and potentially to 6 feet bgs, if warranted, as described above). The 0 to 1-foot sample will be analyzed for TRPH, PCBs, and total metals and the 2 to 3-foot sample will be analyzed for TRPH and PCBs. One location in the northeast portion of the site, near the vault described in the Phase I ESA, which potentially had a PCB-containing transformer, will be investigated by coring with a hand auger near the vault to a depth at least 1 foot below the bottom of the vault, assuming this can be accomplished using a hand auger. If no evidence indicates deeper contamination, one soil sample will be collected and analyzed from the depth equal to the base of the vault (to 1 foot below), and analyzed for PCBs.

2.2.4 Groundwater Sampling

One groundwater sample will be collected at the site by installing and sampling from a temporary well. The boring will take place near the proposed power plant oil-water separator vault location, which will require the deepest excavation during construction. Drilling will be performed using a direct-push technology (DPT) drill rig (such as a GeoProbe[®]) operated by a California-licensed driller. A 2-inch-diameter-borehole will be continuously cored from the surface to 25 feet bgs using a DPT rig. A 1-inch-diameter polyvinyl chloride (PVC) temporary well with 15 feet of well screen will be installed in the borehole. One groundwater sample will be collected for analysis using a new disposable bailer and sent to a state of California-certified analytical laboratory. The groundwater sample will be analyzed for TRPH, TPH-d, TPH-g and volatile organic compounds (VOCs). The temporary well will then be removed from the borehole and backfilled with bentonite grout to the surface. A surface patch of dirt or asphalt will be placed to match existing grade and surface conditions.

2.3 REGULATORY REQUIREMENTS

As there is no regulatory oversight for potential environmental contamination issues at this site. No regulatory agency review or approval is required prior to conducting this investigation. No drilling permits or notifications are required in Santa Clara County for environmental drilling extending to less than 45 feet bgs.

2.4 WASTE MANAGEMENT

All soil cuttings and decontamination water generated during this investigation will be contained in Department of Transportation (DOT) rated 55-gallon drums. Investigation-derived waste (IDW) will be characterized for disposal based on analytical results from the soil and groundwater analyses. It is anticipated that IDW generated will be characterized as non-hazardous waste. If all the analytical results are “non-detect”, then the soil cuttings and decontamination water will be placed back on site. Foster Wheeler Environmental will supervise waste profiling, the selection of a qualified waste transporter, and an appropriate treatment, storage, and disposal facility. Upon completion of waste profiling and manifesting, Foster Wheeler Environmental will arrange for transportation and disposal of IDW off site.

3.0 DELIVERABLES

FWENC will prepare a Phase II ESA Report documenting the results of this investigation. This report will document the results of the Phase II ESA sampling effort and will include site maps, data summary tables, analytical laboratory data, and waste manifests for any IDW disposed off site.

4.0 REFERENCES

SCS Engineers. 2002. *Phase I Environmental Assessment Report, Duane Avenue at Lafayette Street, Santa Clara, California, 95050*. June.

ATTACHMENT 1
SITE-SPECIFIC HEALTH AND SAFETY PLAN
(SHSP)

FIGURE 1

VICINITY MAP

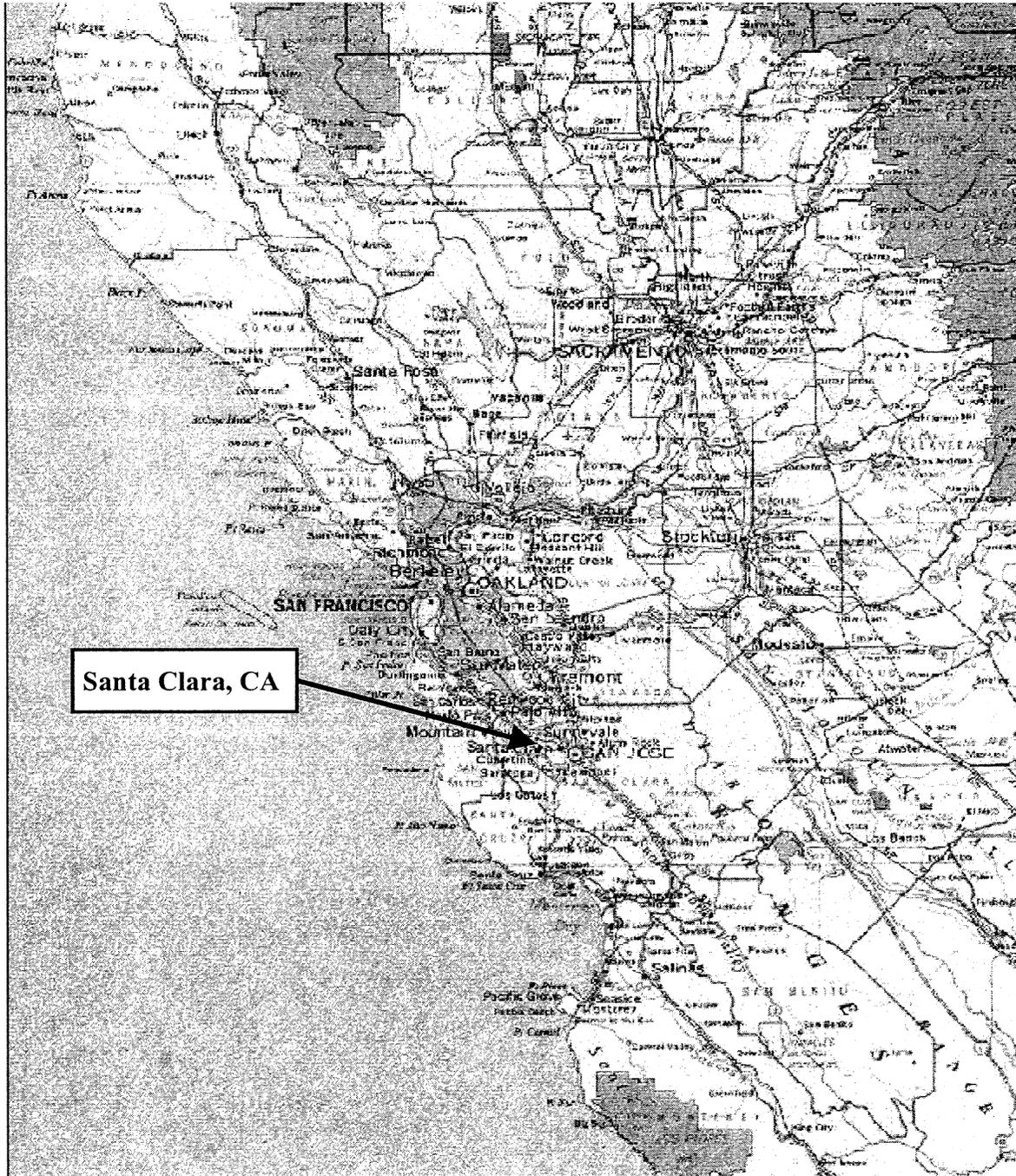
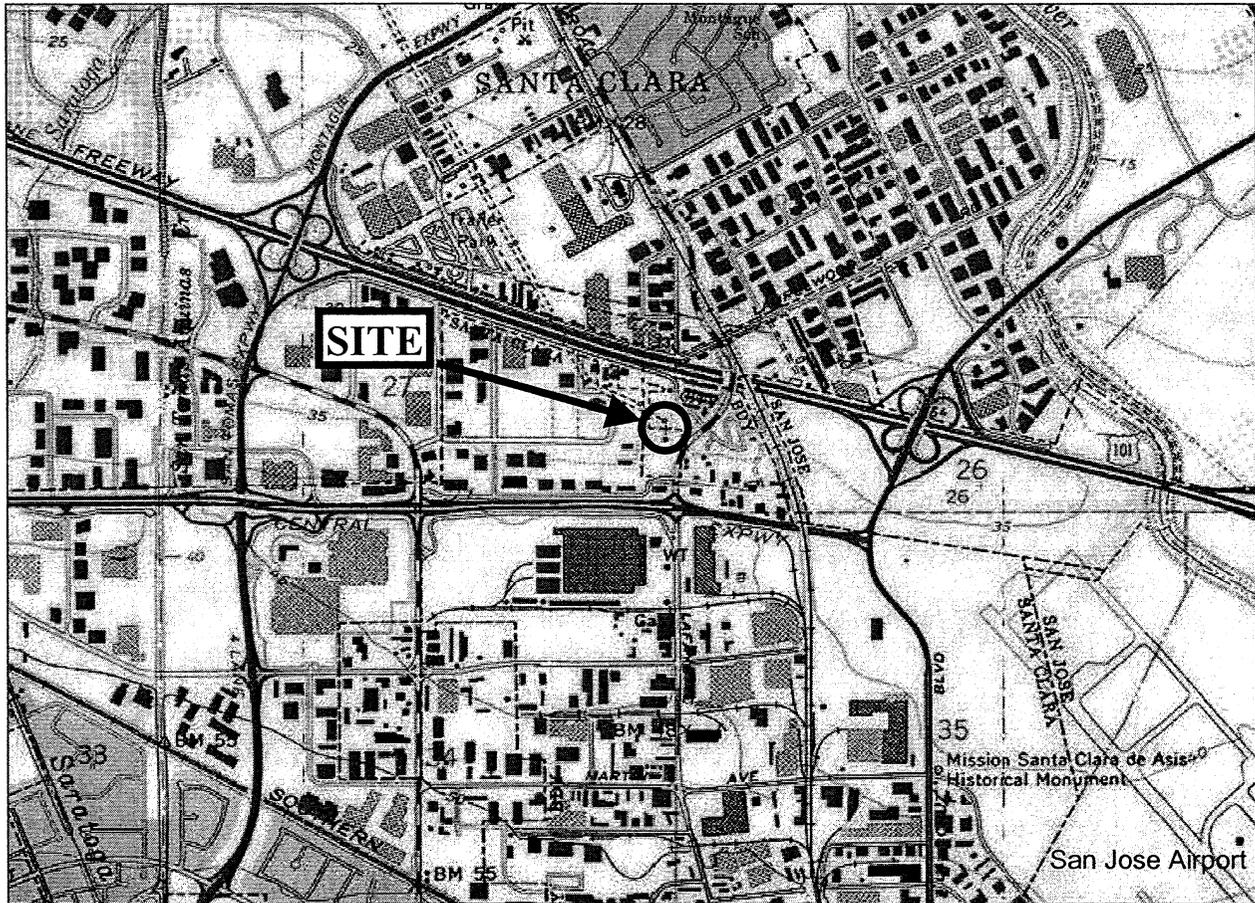


FIGURE 2

SITE LOCATION MAP



TN * MN
15°

0 5 1 MILE
0 1000 FEET 0 500 1000 METERS

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

SITE-SPECIFIC ENVIRONMENTAL HEALTH AND SAFETY PLAN

SITE NAME: Duane Ave. at Lafayette Street, Proposed Pico Power Plant Location

LOCATION: Street No.: Duane Ave. at Lafayette Street
City: Santa Clara
State: California

DATE PREPARED: 8-21-02

REVISION / DATE: _____

PROJECT NUMBER: 2663.1000.0021

PROJECT DESCRIPTION: Phase II Environmental Site Assessment (ESA), Soil and Groundwater
Collect seven soil samples via hand auger (6 feet below ground surface
(bgs) maximum) and 1 groundwater sample via temporary well
installed using a direct-push technology drill rig. Contaminants of
potential concern include total recoverable petroleum hydrocarbons
(TRPH), total petroleum hydrocarbons as gasoline (TPH-g), TPH as
diesel (TPH-d), polychlorinated biphenyls (PCBs), and trichloroethene
(TCE). No contaminants have been documented historical at the site.
Contaminants of potential concern are based on inferences made from a
Phase I ESA in June 2002. Site is currently used infrequently as a
wash-off yard for City of Santa Clara street sweepers. Evidence of
minor vehicle maintenance activities was observed during the Phase I
ESA. Adjacent site is a PG&E electrical substation, built circa 1970
(potential source of PCBs). Possible groundwater contamination from
large regional groundwater contamination plume originating off site,
primary groundwater contaminant of concern is TCE. Shallow aquifer
depth estimated at 10 to 20 feet bgs.

WASTE TYPES PRESENT

Possibly TRPH, TPH-g, TPH-d, VOCs (TCE), PCBs.

(Attach applicable MSDSs in Attachment 1):

UNUSUAL SITE FEATURES: None.

STATUS (Active, Inactive, or Unknown): Minimal site activities, minor, infrequent vehicle maintenance

LOCATION CLASS:

Industrial Commercial Urban/Residential
 Rural Other (specify): _____

BACKGROUND REVIEW: Complete Preliminary

DOCUMENTS USED AS REFERENCES FOR THIS PLAN:

See Phase II ESA Work Plan

This SHSP is an attachment to the Phase II ESA Work Plan

Additional site background information is contained in the Phase I ESA (SCS Engineers, 2002)

PROJECT ORGANIZATION:

Client Contact: Don McArthur
Project Manager: Doug Urry
Field Operations Lead: Jeff Oslick or Dave Dirkin
Project Environmental and Safety Manager (PESM): Roger Margotto
Site Environmental and Safety Supervisor (ESS): Jeff Oslick or Dave Dirkin
Other (specify title/position): Mike LoStracco (field assistant, also ESS-qualified)

**PROJECT TASKS, POTENTIAL HAZARDS, AND CONTROL MEASURES:
SEE ATTACHED ACTIVITY HAZARD ANALYSES**

TASKS	POTENTIAL SAFETY, HEALTH, AND ENVIRONMENTAL HAZARDS	CONTROL MEASURES
Site reconnaissance inspection	See attached AHA	
Hand Augering, soil sample collection	See attached AHA	
Drilling – direct-push drilling (e.g. GeoProbe®) groundwater sample collection	See attached AHA	
Waste drum handling		
Off-road driving (flat terrain)	Dry brush may be ignitable.	Do not park vehicles on or near dry brush.
	Uneven terrain, bumps and dips, dust.	Drive slowly, be certain of ground that vehicle is going to drive upon.

PHYSICAL SAFETY HAZARDS TO PERSONNEL:

- Hot Work Line Breaking Boating Drill Rigs Excavation
- Heat Cold Precipitation Confined Space Terrain
- Walking/Working Surfaces Fire and Explosion Oxygen Deficiency
- Underground Utilities Overhead Utilities Heavy Equipment
- Unknowns in Drums, Tanks, Containers Ponds, Lagoons, Impoundments
- Rivers, Streams Pressurized Containers, Systems Noise
- Illumination Nonionizing Radiation Ionizing Radiation

BIOLOGICAL HAZARDS TO PERSONNEL:

- Infectious/Medical/Hospital Waste Non-domesticated Animals
- Insects Poisonous Plants/Vegetation Raw Sewage

TRAINING REQUIREMENTS:

- 40-Hour General Site Worker Course with three days supervised experience
- 24-Hour Course for limited, specific tasks with one day supervised experience
- 24-Hour Course for Level D Site with one day supervised experience
- 8-Hour Annual Refresher Health and Safety Training
- 8-Hour Management/Supervisor Training in addition to basic training course
- Site-Specific Safety, Health and Environmental Training (Includes EMS Goals and P2)
- Pre-entry training for emergency response skilled support personnel
- 4-Hour DOT Training
- 4-Hour Waste Management Training
- Other (specify): First Aid and Adult CPR

MEDICAL SURVEILLANCE REQUIREMENTS:

- Baseline initial physical examination with physician certification for hazwaste and respirator use
- Annual medical examination with physician certification for hazwaste and respirator use
- Site-specific medical monitoring protocol (Radiation, Pesticide, PCB, Metals)
Specify: _____
- Asbestos Worker medical protocol
- Exempt from medical surveillance (specify): _____
- Examination required in event of chemical exposure or trauma

CHEMICAL DATA:

COMPOUND	CONTAM. CONC./ MEDIA	CAS #	ACGIH TLV	OSHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	FIRST AID	APPLICABLE PHYSICAL DATA
Benzene		71-43-2	0.5 ppm	1.0 ppm	Inhalation, contact, ingestion	Irritated skin, eyes, nose, respiratory system giddiness, headache, nausea, staggered gait, fatigue, Anorexia, weakness, dermatitis, bone marrow depression. Benzene is a carcinogen.	Resp. system, skin, eyes, CNS, bone marrow	Eyes: irrigate immed., skin: prompt soap wash, Breath.: resp. support, Ing.: immed. med. attention	Sol.: 0.07% VP: 75mm IP: 9.24 ev Flash Pt: 12°F UEL: 7.8% LEL: 1.2% Sp. Gr.: 0.88
Methyl tert-butyl ether		1634-04-4	50 ppm (proposed)	None	Inhalation, absorption, contact, ingestion	Irritation of skin or eyes, nausea, vomiting, anesthetic effect on central nervous system, nasal and tracheal inflammation, dermatitis	CNS, upper respiratory tract	Eyes: irrigate immed., skin: prompt soap wash, Breath.: resp. support, Ing.: immed. med. attention	Sol.: 4.8% VP: 245mm Flash Pt: -18°F UEL: 8.4% LEL: 1.6% Sp. Gr.: 0.74
Trichloroethene		79-01-6	25 ppm	50 ppm	Inhalation, contact, ingestion	Headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, irr. eyes, dermatitis, cardiac arrhythmia, paresthesia.	Eyes, skin, respiratory system, heart, liver, CNS	Eyes: irrigate immed., skin: prompt soap wash, Breath.: resp. support, Ing.: immed. med. attention	Sol.: 0.1% VP: 58mm IP: 9.45 ev Flash Pt: 90°F UEL: 10.5% LEL: 8% Sp. Gr.: 1.46

ABBREVIATIONS: BP = Boiling Point
 CNS = Central Nervous System
 FP = Flash Point
 IP = Ionization Potential
 PPB = parts per billion
 PPM = parts per million

PERSONAL PROTECTIVE EQUIPMENT¹:

TASK	TYPE OF CHEMICAL PROTECTIVE COVERALL	INNER GLOVE	OUTER GLOVE	HEAD	EYE/FACE	FOOT	RESPIRATOR TYPE	APR CARTRIDGE AND CHANGE SCHEDULE
1	Mobilization/site set-up	None	Cut resistant, if working with sharp edges, otherwise standard work gloves	Hard hat	Safety glasses	Leather work boots w/ steel-toeds	Not applicable	Not applicable
2	Drilling Operations, Modified Level D	Nitrile	Leather work gloves, cut resistant, if working with sharp edges	Hard hat	Safety glasses	Leather work boots w/steel-toed; overboots as needed	None with monitoring (action levels not exceeded)	Not applicable
3	Drilling Operations, Level C	Nitrile	Leather work gloves, cut resistant, if working with sharp edges	Hard hat	Safety glasses	Steel-toed rubber boots or leather boots w/ overboots	Full-face respirator	Organic vapor/acid gas At end of shift, if wet or breakthrough; every 4 hrs if humidity >85%
4	Soil/Groundwater Sampling and sample handling	Nitrile	Nitrile	Hard hat	Safety glasses	Leather work boots w/steel-toed; overboots as needed	None w/ monitoring (action levels not exceeded) Full-face resp. (if action level) exceeded	If needed, organic vapor/acid gas At end of shift, if wet or breakthrough; every 4 hrs if humidity >85%
6	Decontamination	Nitrile	Nitrile	Hard hat	Safety glasses and plastic face shield	Steel-toed rubber boots or leather	None w/ monitoring (action levels not exceeded)	If needed, organic vapor/acid gas w/ particulate filter At end of shift, if

¹ Include any special PPE not covered here in Hazard Analysis table on page 3.

7	Demobilization and Site Restoration	None, Standard work coveralls	None	Cut resistant, if working with sharp edges, otherwise standard work gloves	Hard hat	Safety glasses	Leather work boots w/ steel-toeds	Full-face resp. (if action level) exceeded	wet or breakthrough; every 4 hrs if humidity >85%
									Not applicable

AIR MONITORING:

TASK	INSTRUMENT	FREQUENCY	ACTION LEVEL	ACTION
1 Drilling, hand augering, well sampling	<input checked="" type="checkbox"/> CGI/O ₂	As needed every 15 min or when odors are present.	10% LEL 20.8% O ₂ 10 ppm	Stop work Stop work contact PESM
	<input checked="" type="checkbox"/> PID Lamp probe 10.2 or 10.6 eV			
	<input type="checkbox"/> FID			
	<input type="checkbox"/> Aerosol monitor			
	<input type="checkbox"/> Detector tube(s) Type: _____			
	<input type="checkbox"/> Radiation meter			
2	<input type="checkbox"/> CGI/O ₂			
	<input type="checkbox"/> PID Probe: _____ eV			
	<input type="checkbox"/> FID			
	<input type="checkbox"/> Aerosol monitor			
	<input type="checkbox"/> Detector tube(s) Type: _____			
	<input type="checkbox"/> Radiation meter			
3	<input type="checkbox"/> CGI/O ₂			
	<input type="checkbox"/> PID Probe: _____ eV			
	<input type="checkbox"/> FID			
	<input type="checkbox"/> Aerosol monitor			
	<input type="checkbox"/> Detector tube(s) Type: _____			
	<input type="checkbox"/> Radiation meter			

CALIBRATION: ALL INSTRUMENTS WILL BE CALIBRATED ACCORDING TO MANUFACTURERS INSTRUCTIONS BEFORE AND AFTER USE (DAILY). THE RESULTS WILL BE DOCUMENTED IN THE ESS LOGBOOK OR CALIBRATION SHEETS.

**HAZARDOUS WASTE SITE
AND ENVIRONMENTAL SAMPLING/MONITORING ACTIVITIES:**

Off-site: Yes No

On-site: Yes No

Description of types of sampling and methods used to obtain samples:

Hand-driven soil core samplers, direct-push drilling for temporary well installation. Groundwater sampling using bailer.

DECONTAMINATION:

Dry Decon: For personnel and vehicles

Wet Decon: For sampling equipment. Wet decon will consist of a three stage process where the first stage is non-phosphate detergent and potable water mixture, the second stage a potable water rinse, and the final stage a de-ionized water rinse.

DESCRIPTION OF SITE-SPECIFIC DECONTAMINATION PROCEDURE:

PPE will be properly disposed as described in the Work Plan. Drill rig and other sampling equipment in direct contact with contaminants will be decontaminated either using the procedures described above or using a dedicated decontamination trailer (for drilling rods).

ADEQUACY OF DECONTAMINATION DETERMINED BY:

Visual inspection, no visible contamination. Proper washing/rinsing procedures.

SITE WORK ZONES:

See Work Plan.

WASTE MANAGEMENT PLAN:

WASTE TYPE	CONTAINER TYPE	ANALYSIS AVAIL?	WASTE CLASSIFICATION	STORAGE AREA REQUIREMENTS	EPA/DOT/TSCA LABEL REQUIREMENTS	DISPOSITION
(e.g., Soil, Groundwater, PPE, Decon Fluids, C&D Debris, ACM, Used Oil, Spent Carbon)	(e.g., 55-gal. Open Head Steel Drum, 30-gal. Open Head Poly Drum)	Y/N Reference	(e.g., RCRA Hazardous, Non-hazardous, TSCA-regulated [PCBs]) To be determined.	(e.g., TSCA-PCB, <90-day RCRA Hazardous, Satellite Accumulation) Secure fenced area.	(e.g., Hazardous Waste, DOT Flammable, PCBs, Asbestos) DOT Haz or non-haz waste; interim labels with IDW-Pending analysis	(Off-Site/ On-Site) Off-Site
Investigation-derived soil cuttings, decon and well purge water, PPE	55 gallon drum	Preliminary from past data – additional to be collected.				

Additional information (specify waste stream):

DIRECTIONS TO HOSPITAL:

Route verified by: Roger Margotto Date: / /

Sunnyvale Urgent Care: Start on **Lafayette St.** (0.2 mi.); turn right on **Central Expwy** (2.7 mi.); bear right towards **Lawrence Expwy South** (0.0 mi.); continue on **San Vicnete Way** (0.0 mi.); bear right on **Miraloma Way** (0.1 mi.); continue on **Ramp** (0.1 mi.); continue on **Lawrence Expwy** (1.0 mi.); turn right on **Reed Ave** (1.0 mil.); continue on **Old San Francisco Rd** (1.0 mi.).

Santa Clara Valley Medical Ctr.: Start on **Lafayette St** (2.4 mi.); continue on **Washington St** (0.4 mi.); continue on **N. Bascom Ave.** (1.1 mi.); continue on **S. Bascom Ave** (0.7 mi.)

ADDITIONAL EMERGENCY PHONE CONTACTS:

CONTACT	PHONE NUMBER
Project/Delivery Order Manager Doug Urry	(916) 928-4823
PESM Roger Margotto, CIH	(619) 471-3503 pager (714) 810-3742
Mike McSherry (Director, Health and Safety Programs)	(215) 702-4021 H (215) 538-0471
Craig O'Rourke, Environmental Compliance Manager	(949) 756-7511
Chemtrec	(800) 424-9300
ATSDR	(404) 639-0615
ATF (explosives information)	(800) 424-9555
National Response Center	(800) 424-8802
National Poison Control Center	(800) 942-5969
Medical Consultant (Dr. Greaney)	(800) 455-6155
Client Contact	(408) 261-5365

MAJOR SPILL CONTAINMENT PROCEDURES

MATERIAL	CONTAINERS	DESCRIBE CONTAINMENT FACILITIES AND PROCEDURES
Samples	Drums or additional sample jars.	Scoop up contaminated soil and the sample and place in another container.
Drill cuttings	Drums	See Waste Management Plan.

NOTE: THE NATURE OF THE WORK ASSIGNMENT MAY REQUIRE THE USE OF THE FOLLOWING PROCEDURES/PROGRAMS WHICH WILL BE INCLUDED AS ATTACHMENTS TO THIS PLAN AS APPLICABLE:

CHECK IF APPLICABLE:

- HEALTH AND SAFETY**
- Activity Hazard Analyses
 - Boating
 - Chemical Hygiene Plan
 - Confined Space Entry
 - Demolition Safety
 - Drill Rig Safety
 - Drum and Container Handling
 - Excavation and Trenching
 - Fall Protection
 - Hazard Communication Program
 - Lockout/Tagout
 - Temperature Extremes
 - UXO Operations
 - Welding/Hot Work
 -
 -

OSHA STANDARD	FOSTER WHEELER PROGRAM	OTHER
	EHS 3-5	
	EHS 6-6	
1910.1450		
1910.146	EHS 6-1	
1926, Subpart T		
	EHS 6-2	
	EHS 6-7	
1926.651	EHS 6-3	
1926, Subpart M	EHS 3-8	
1910.1200	EHS 4-2	
1910.147	EHS 6-4	
1910.120	EHS 4-6	
	HS 7-1 to 7-5	
1910.252	EHS 6-5	

- ENVIRONMENTAL COMPLIANCE**
- Transportation of Hazardous Mat.
 - Signing Waste Documentation
 - Permit Exceedance Reporting
 - Reporting Spills and Releases
 -
 -

	EHS 3-7	
	EHS 1-8	
	EHS 1-7	
	EHS 1-7	

PLAN APPROVAL:

By their signature, the undersigned hereby certify that this plan has been reviewed and approved for use at the Pico Power Plant Project site.

<u>Doug Urry</u> Project Manager	<u>8/22/02</u> Date
<u>Dave Dirkin</u> Field Operations Lead	<u>8/23/02</u> Date
<u><i>Roger N. Mangotto, CIH</i></u> Project Environmental and Safety Manager	<u>8/21/02</u> Date

THIS PLAN WAS PREPARED FOR WORK TO BE CONDUCTED BY FOSTER WHEELER ENVIRONMENTAL CORPORATION. USE OF THIS PLAN BY FOSTER WHEELER AND ITS SUBCONTRACTORS IS INTENDED TO FULFILL THE OSHA REQUIREMENTS FOUND IN 29 CFR 1910.120 and Cal-OSHA 8CCR5192.

FOSTER WHEELER ENVIRONMENTAL CORPORATION, FOSTER WHEELER SUBCONTRACTORS, AND FOSTER WHEELER'S CLIENT DO NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THIS SITE. DUE TO THE NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE, AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS WHICH MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE ENVIRONMENTAL HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH AND EVALUATION BY TRAINED HEALTH AND SAFETY SPECIALISTS.

ATTACHMENT 1

Material Safety Data Sheets



Section 1. Material Identification

Polychlorinated Biphenyls [C₁₂H_{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

HMS
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 chloroacne won't occur.
† See NIOSH, RTECS (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19 °C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10⁻⁶ to 10⁻³ mm at 20 °C
Molecular Weight: 188.7 to 398.5

Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 °F (141-196 °C) OC* | **Autoignition Temperature:** 464 °F (240 °C) | **LEL:** None reported | **UEL:** None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO₂), 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,⁽¹⁶⁴⁾ and NTP⁽¹⁶⁹⁾ list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through unbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID **Eyes:** Do not allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLM: 0.278 ppm/96 hr. Mallard Duck, LD₅₀: 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

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Sheet No. 467
Automotive Gasoline, Lead-free

Issued: 10/81 Revision: A, 9/91

Section 1. Material Identification

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Automotive Gasoline, Lead-free, Description: A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

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



HMS
H 2
F 3
R 1
PPG†
† Sec. 8

Other Designations: CAS No. 8006-61-9, benzin, gasoline, gasolene, motor spirits, natural gasoline, petrol.

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

Cautions: Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

1990 OSHA PELs
8-hr TWA: 300 ppm, 900 mg/m³
15-min STEL: 500 ppm, 1500 mg/m³

1990-91 ACGIH TLVs
TWA: 300 ppm, 890 mg/m³
STEL: 500 ppm, 1480 mg/m³

1990 NIOSH REL
None established

1985-86 Toxicity Data*
Man. inhalation, TC_{Lo}: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)
Human eye: 140 ppm/8 hr; toxic effects include mild irritation
Rat. inhalation, LC₅₀: 300 g/m³/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.

† See NIOSH, RTECS (LX3300000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)

Vapor Density (air = 1): 3.0 to 4.0

Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)

Water Solubility: Insoluble

Appearance and Odor: A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

Section 4. Fire and Explosion Data

Flash Point: -45 °F (-43 °C)

Autoignition Temperature: 536 to 853 °F (280 to 456 °C)

LEL: 1.3% v/v

UEL: 6.0% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.

Unusual Fire or Explosion Hazards: Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

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

Chemical Incompatibilities: Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).

Summary of Risks: Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Skin, eye, respiratory and central nervous systems.

Primary Entry Routes: Inhalation, ingestion, skin contact.

Acute Effects: Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas; fatty degeneration of the liver and kidneys, and passive congestion of spleen.

Chronic Effects: Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.

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

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).

Aquatic Toxicity: Bluegill, freshwater, LC₅₀: 8 ppm/96 hr.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

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). Since contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. **Note:** Resistance of specific materials can vary from product to product.

Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.⁽¹⁰³⁾

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.

Engineering Controls: Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Gasoline (including casing-head and natural)

DOT Hazard Class: Flammable liquid

ID No.: UN1203

DOT Label: Flammable liquid

DOT Packaging Exceptions: 173.118

DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline

IMO Hazard Class: 3.1

ID No.: UN1203

IMO Label: Flammable liquid

IMDG Packaging Group: II

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159

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Sheet No. 470
Diesel Fuel Oil No. 2-D

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification

33

Diesel Fuel Oil No. 2-D Description: Diesel fuel is obtained from the middle distillate in petroleum separation; a distillate oil of low sulfur content. It is composed chiefly of unbranched paraffins. Diesel fuel is available in various grades, one of which is synonymous with fuel oil No. 2-D. This diesel fuel oil requires a minimum Cetane No. (efficiency rating for diesel fuel comparable to octane number ratings for gasoline) of 40 (ASTM D613). Used as a fuel for trucks, ships, and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.

Other Designations: CAS No. 68334-30-5, diesel fuel.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*⁷³ for a suppliers list.

Cautions: Diesel fuel oil No. 2-D is a skin irritant and central nervous depressant with high mist concentrations. It is an environmental hazard and moderate fire risk.

R	1	
I	-	
S	2	
K	2	
NFPA		
HMS		
H	0	
F	2	
R	0	
PPG*		
* Sec. 8		

Section 2. Ingredients and Occupational Exposure Limits

Diesel fuel oil No. 2-D*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data†
None established	Mineral Oil Mist TWA: 5 mg/m ³ † STEL: 10 mg/m ³	None established	Rat. oral. LD ₅₀ : 9 g/kg produces gastrointestinal (hypermotility, diarrhea) effects

* Diesel fuel No. 2-D tends to be low in aromatics and high in paraffinics. This fuel oil is complex mixture of: 1) >95% paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, 2) sulfur (<0.5%), and 3) benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)]. Although low in the fuel itself, benzene concentrations are likely to be much higher in processing areas.

† As sampled by nonvapor-collecting method.

‡ Monitor NIOSH, RTECS (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 340 to 675 °F (171 to 358 °C)	Specific Gravity: <0.86
Viscosity: 1.9 to 4.1 centistoke at 104 °F (40 °C)	Water Solubility: Insoluble

Appearance and Odor: Brown, slightly viscous liquid.

Section 4. Fire and Explosion Data

Flash Point: 125 °F (52 °C) min.	Autoignition Temperature: >500 °F (932 °C)	LEL: 0.6% v/v	UEL: 7.5% v/v
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Extinguishing Media: Use dry chemical, carbon dioxide, or foam to fight fire. Use a water spray to cool fire exposed containers. Do not use a forced water spray directly on burning oil since this will scatter the fire. Use a smothering technique for extinguishing fire.

Unusual Fire or Explosion Hazards: Diesel fuel oil No. 2-D is a OSHA Class II combustible liquid. Its volatility is similar to that of gas oil. Vapors may travel to a source of ignition and flash back.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to pollution and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Diesel fuel oil No. 2-D is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: It is incompatible with strong oxidizing agents; heating greatly increases the fire hazard.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of diesel fuel oil No. 2-D can produce various hydrocarbons and hydrocarbon derivatives, and other partial oxidation products such as carbon dioxide, carbon monoxide, and sulfur dioxide.

Section 6. Health Hazard Data

Carcinogenicity: Although the IARC has not assigned an overall evaluation to diesel fuels as a group, it has evaluated occupational exposures in petroleum refining as an IARC probable human carcinogen (Group 2A). It has evaluated distillate (light) diesel oils as not classifiable as human carcinogens (Group 3).

Summary of Risks: Although diesel fuel's toxicologic effects should resemble kerosine's, they are somewhat more pronounced due to additives such as sulfurized esters. Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, vomiting, and loss of coordination, depending on concentration and exposure time. When removed from exposure area, affected persons usually recover completely. If vomiting occurs after ingestion and if oil is aspirated into the lungs, hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result. A comparative ratio of oral to aspirated lethal doses may be 1 pt vs. 5 ml. Aspiration may also result in transient CNS depression or excitement. Secondary effects may include hypoxia (insufficient oxygen in body cells), infection, pneumatocele formation, and chronic lung dysfunction. Inhalation may result in euphoria, cardiac dysrhythmias, respiratory arrest, and CNS toxicity. Prolonged or repeated skin contact may irritate hair follicles and block sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Central nervous system, skin, and mucous membranes.

Primary Entry Routes: Inhalation, ingestion.

Acute Effects: Systemic effects from ingestion include gastrointestinal irritation, vomiting, diarrhea, and in severe cases central nervous system depression, progressing to coma or death. Inhalation of aerosols or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish discoloration of the skin and mucous membranes caused by deficient blood oxygenation).

Chronic Effects: Repeated contact with the skin causes dermatitis.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body have been exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, do not induce vomiting due to aspiration hazard.

Contact a physician immediately. Position to avoid aspiration.

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

Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Diesel fuel oil No. 2-D spills may be environmental hazards. Report large spills.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with a mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.⁽¹⁰³⁾

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area; soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for a OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in storage or use areas.

Engineering Controls: Avoid vapor or mist inhalation and prolonged skin contact. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist concentration may occur. Additional suitable protective clothing may be required depending on working conditions. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. At least weekly laundering of work clothes is recommended. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Fuel oil

DOT Hazard Class: Combustible liquid

ID No.: NA1993

DOT Label: None

DOT Packaging Exceptions: 173.118a

DOT Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 101, 103, 126, 127, 132, 133, 136, 143, 146

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD; **Edited by:** JR Stuart, MS

**Section 1. Material Identification**

Benzene (C₆H₆) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.

Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*⁷³ for a suppliers list.

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



HMIS
H 3
F 3
R 0
PPG†
† Sec 8

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

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)

8-hr TWA: 1 ppm, 3 mg/m³

15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)

8-hr TWA: 10 ppm

Acceptable Ceiling Concentration: 25 ppm

Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH

TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs

TWA: 0.1 ppm, 0.3 mg/m³

Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡

Man. oral, LD₅₀: 50 mg/kg; no toxic effect noted

Man. inhalation, TC₅₀: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)

Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.

† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.

‡ See NIOSH, *RTECS* (CY 1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)

Melting Point: 42 °F (5.5 °C)

Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)

Vapor Density (Air = 1): 2.7

Evaporation Rate (Ether = 1): 2.8

Molecular Weight: 78.11

Specific Gravity (15 °C/4 °C): 0.8787

Water Solubility: Slightly (0.180 g/100 g of H₂O at 25 °C)

% Volatile by Volume: 100

Viscosity: 0.6468 mPa at 20 °C

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

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC

Autoignition Temperature: 928 °F (498 °C)

LEL: 1.3% v/v

UEL: 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.

Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

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

Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a suspected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).

Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.

Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS. **Target Organs:** Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.

Primary Entry Routes: Inhalation, skin contact.

Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).

Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.

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

Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Listed as SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.¹⁰³

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area; soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.

Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."

Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)

DOT Hazard Class: Flammable liquid

ID No.: UN1114

DOT Label: Flammable liquid

DOT Packaging Exceptions: 173.118

DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene

IMO Hazard Class: 3.2

ID No.: UN1114

IMO Label: Flammable liquid

IMDG Packaging Group: II

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

MSDS Collection References: 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143

Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

**Section 1. Material Identification**

Ethylbenzene (C₈H₈) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α -methylbenzol alcohol. Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393. Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*⁷³ for a suppliers list.

R 1	NFPA
I 3	
S 2*	
K 4	
* Skin absorption	HMIS
	H 2†
	F 3
	R 0
	PPE - Sec. 8
	† Chronic effects

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

Section 2. Ingredients and Occupational Exposure Limits

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

1991 OSHA PELs

8-hr TWA: 100 ppm (435 mg/m³)
15-min STEL: 125 ppm (545 mg/m³)
Action Level: 50 ppm (217 mg/m³)

1990 IDLH Level

2000 ppm

1990 NIOSH REL

TWA: 100 ppm (435 mg/m³)
STEL: 125 ppm (545 mg/m³)

1992-93 ACGIH TLVs

TWA: 100 ppm (434 mg/m³)
STEL: 125 ppm (545 mg/m³)

1990 DFG (Germany) MAK

TWA: 100 ppm (440 mg/m³)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*

Human, inhalation, TC₁₀: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 nmol/L induced sister chromatid exchange.
Rat, oral, LD₅₀: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC₁₀: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.¹⁷⁰

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

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)

Melting Point: -139 °F (-95 °C)

Surface Tension: 31.5 dyne/cm

Ionization Potential: 8.76 eV

Viscosity: 0.64 cP at 77 °F (25 °C)

Refraction Index: 1.4959 at 68 °F (20 °C)

Relative Evaporation Rate (ether = 1): 0.0106

Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)

Critical Temperature: 651 °F (343.9 °C)

Critical Pressure: 35.6 atm

Molecular Weight: 106.16

Density: 0.863 at 77 °F (25 °C)

Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)

Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia

Odor Threshold: 2.3 ppm

Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg at 165.38 °F (74.1 °C)

Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0768 lb/ft³ or 1.2298 kg/m³

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

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC

Autoignition Temperature: 810 °F (432 °C)

LEL: 1.0% v/v

UEL: 6.7% v/v

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

Section 5. Reactivity Data

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

Chemical Incompatibilities: Reacts vigorously with oxidizers.

Conditions to Avoid: Exposure to heat and oxidizers.

Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,¹⁶⁴ NTP,¹⁶⁹ and OSHA¹⁶⁴ do not list EB as a carcinogen. Summary of Risks: Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD₅₀, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive pulmonary disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was tolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm²/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 µg/cm²/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

IRST AID

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

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

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

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release > 1000 lb. Follow applicable SHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 yrs. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** shrimp (*Mysidopsis bahia*) LC₅₀ = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC₅₀ = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC₅₀ = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (50 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

RA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001

Listed as a SARA Toxic Chemical (40 CFR 372.65)

ARA Extremely Hazardous Substance (40 CFR 355). TPQ: Not listed

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations

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

Section 8. Special Protection Data

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

Section 9. Special Precautions and Comments

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

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene

DOT Hazard Class: 3

UN No.: UN1175

DOT Packing Group: II

DOT Label: Flammable liquid

Special Provisions (172.102): T1

Packaging Authorizations

a) Exceptions: 173.150

b) Non-bulk Packaging: 173.202

c) Bulk Packaging: 173.242

Quantity Limitations

a) Passenger Aircraft or Railcar: 5L

b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements

a) Vessel Stowage: B

b) Other: —

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 318
Xylene (Mixed Isomers)

Issued: 11/80 Revision: E. 9/92 Errata: 12/94

Section 1. Material Identification

Xylene (Mixed Isomers) (C₈H₁₀) Description: The commercial product is a blend of the three isomers [*ortho*-(*o*-), *meta*-(*m*-), *para*-(*p*-)] with the largest proportion being *m*-xylene. Xylene is obtained from coal tar, toluene by transalkylation, and pseudocumene. Used in the manufacture of dyes, resins, paints, varnishes, and other organics; as a general solvent for adhesives, a cleaning agent in microscope technique; as a solvent for Canada balsam microscopy; as a fuel component; in aviation gasoline, protective coatings, sterilizing catgut, hydrogen peroxide, perfumes, insect repellants, pharmaceuticals, and the leather industry; in the production of phthalic anhydride, isophthalic, and terephthalic acids and their dimethyl esters which are used in the manufacture of polyester fibers; and as an indirect food additive as a component of adhesives. Around the home, xylene is found as vehicles in paints, paint removers, degreasing cleaners, lacquers, glues and cements and as solvent/vehicles for pesticides.

Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

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

Cautions: Xylene is an eye, skin, and mucous membrane irritant and may be narcotic in high concentrations. It is a dangerous fire hazard.

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NFPA

 HMIS
 H 2+
 F 3
 R 0
 PPE ‡
 ‡ Chronic Effects
 ‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Xylene (mixed isomers): the commercial product generally contains ~ 40% *m*-xylene; 20% each of *o*-xylene, *p*-xylene, and ethylbenzene; and small quantities of toluene. Unpurified xylene may contain pseudocumene.

1991 OSHA PELs 8-hr TWA: 100 ppm (435 mg/m ³) 15-min STEL: 150 ppm (655 mg/m ³)	1992-93 ACGIH TLVs TWA: 100 ppm (434 mg/m ³) STEL: 150 ppm (651 mg/m ³) BEI (Biological Exposure Index): Methylhippuric acids in urine at end of shift: 1.5 g/g creatinine	1985-86 Toxicity Data* Human, inhalation, TC _{Lo} : 200 ppm produced olfaction effects, conjunctiva irritation, and other changes involving the lungs, thorax, or respiration. Man, inhalation, LC _{Lo} : 10000 ppm/6 hr; toxic effects not yet reviewed. Human, oral, LD _{Lo} : 50 mg/kg; no toxic effect noted. Rat, oral, LD ₅₀ : 4300 mg/kg; toxic effect not yet reviewed. Rat, inhalation, LC ₅₀ : 5000 ppm/4 hr; toxic effects not yet reviewed.
1990 IDLH Level 1000 ppm	1990 DFG (Germany) MAK TWA: 100 ppm (440 mg/m ³) Category II: Substances with systemic effects Half-life: < 2 hr Peak Exposure: 200 ppm, 30 min, average value, 4 peaks per shift	
1990 NIOSH RELs TWA: 100 ppm (435 mg/m ³) STEL: 150 ppm (655 mg/m ³)		

* See NIOSH, RTECS (XE2100000), for additional toxicity data.

Section 3. Physical Data

Boiling Point Range: 279 to 284 °F (137 to 140 °C)* Boiling Point: <i>ortho</i> : 291 °F (144 °C); <i>meta</i> : 281.8 °F (138.8 °C); <i>para</i> : 281.3 °F (138.5 °C) Freezing Point/Melting Point: <i>ortho</i> : -13 °F (-25 °C); <i>meta</i> : -53.3 °F (-47.4 °C); <i>para</i> : 55 to 57 °F (13 to 14 °C) Vapor Pressure: 6.72 mm Hg at 70 °F (21 °C) Saturated Vapor Density (Air = 1.2 kg/m ³): 1.23 kg/m ³ , 0.077 lbs/ft ³ Appearance and Odor: Clear, sweet-smelling liquid. * Materials with wider and narrower boiling ranges are commercially available.	Molecular Weight: 106.16 Specific Gravity: 0.864 at 20 °C/4 °C Water Solubility: Practically insoluble Other Solubilities: Miscible with absolute alcohol, ether, and many other organic liquids. Octanol/Water Partition Coefficient: logKow = 3.12-3.20 Odor Threshold: 1 ppm Viscosity: <32.6 SUS
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Section 4. Fire and Explosion Data

Flash Point: 63 to 77 °F (17 to 25 °C) CC | Autoignition Temperature: 982 °F (527 °C) (*m*-) | LEL: 1.1 (*m*-, *p*-); 0.9 (*o*-) | UEL: 7.0 (*m*-, *p*-); 6.7 (*o*-)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO₂), water spray or regular foam. For large fires, use water spray, fog or regular foam. Water may be ineffective. Use water spray to cool fire-exposed containers. Unusual Fire or Explosion Hazards: Xylene vapors or liquid (which floats on water) may travel to an ignition source and flash back. The heat of fire may cause containers to explode and/or produce irritating or poisonous decomposition products. Xylene may present a vapor explosion hazard indoors, outdoors, or in sewers. Accumulated static electricity may occur from vapor or liquid flow sufficient to cause ignition. Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after fire is extinguished. Stay clear of tank ends. Use unmanned hose holder or monitor nozzles for massive cargo fires. If impossible, withdraw from area and let fire burn. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Xylene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Xylene is easily chlorinated, sulfonated, or nitrated. Chemical Incompatibilities: Incompatibilities include strong acids and oxidizers and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin). Xylene attacks some forms of plastics, rubber, and coatings. Conditions to Avoid: Avoid heat and ignition sources and incompatibles. Hazardous Products of Decomposition: Thermal oxidative decomposition of xylene can produce carbon dioxide, carbon monoxide, and various hydrocarbon products.

Section 6. Health Hazard Data

Carcinogenicity: The IARC⁽¹⁶⁴⁾ NTP⁽¹⁶⁹⁾ and OSHA⁽¹⁶⁴⁾ do not list xylene as a carcinogen. Summary of Risks: Xylene is an eye, mucous membrane, and respiratory tract irritant. Irritation starts at 200 ppm; severe breathing difficulties which may be delayed in onset can occur at high concentrations. It is a central nervous system (CNS) depressant and at high concentrations can cause coma. Kidney and liver damage can occur with xylene exposure. With prolonged or repeated cutaneous exposure, xylene produces a defatting dermatitis. Chronic toxicity is not well defined, but it is less toxic than benzene. Prior to the 1950s, benzene was often found as a contaminant of xylene and the effects attributed to xylene such as blood dyscrasias are questionable. Since the late 1950s, xylenes have been virtually benzene-free and blood dyscrasias have not been associated with xylenes. Chronic exposure to high concentrations of xylene in animal studies have demonstrated mild reversible decrease in red and white cell counts as well as increases in platelet counts.

Section 6. Health Hazard Data, continued

menstrual irregularity was reported in association with workplace exposure to xylene perhaps due to effects on liver metabolism. Xylene crosses the placenta, but does not appear to be teratogenic under conditions tested to date. **Medical Conditions Aggravated by Long-Term Exposure:** CNS, respiratory, eye, skin, gastrointestinal (GI), liver and kidney disorders. **Target Organs:** CNS, eyes, GI tract, liver, kidneys, and skin. **Primary Entry Routes:** Inhalation, skin absorption (slight), eye contact, ingestion. **Acute Effects:** Inhalation of high xylene concentrations may cause dizziness, nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid lung); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensation in the oropharynx and stomach and transient CNS depression. **Chronic Effects:** Repeated or prolonged skin contact may cause drying and flaking of the skin leading to dermatitis. Repeated eye exposure to high vapor concentrations may cause reversible eye damage, peripheral and central neuropathy, and liver damage. Other symptoms of chronic exposure include headache, fatigue, irritability, chronic bronchitis, and GI disturbances such as nausea, loss of appetite, and gas.

RST AID Emergency personnel should protect against exposure. 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. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Move exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, do not induce vomiting! If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). **Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage. Note to Physicians:** Hippuric acid or the ether glucuronide of ortho-toluic acid may be useful in diagnosis of meta-, para- and ortho-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate spill area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without undue risk, stop leak. Use appropriate foam to blanket release and suppress vapors. Water spray may reduce vapor, but does not prevent ignition in closed spaces. For small spills, absorb on paper and evaporate in appropriate exhaust hood or absorb with sand or some non-combustible absorbent and place in containers for later disposal. For large spills dike far ahead of liquid to contain. Do not allow xylene to enter a confined space such as sewers or drains. On land, dike to contain or divert to impermeable holding area. Apply water spray to control flammable vapor and remove material with pumps or vacuum equipment. On water, contain material with natural barriers, booms, or weirs; apply universal gelling agent; and use suction hoses to remove spilled material. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** Little bioconcentration is expected. Biological oxygen demand 5 (after 5 days at 20 °C): 0.64 (no stated isomer). **Ecotoxicity values:** LD₅₀ Goldfish, 13 mg/L/24 hr. Conditions of bioassay not specified, no specific isomer. **Environmental Degradation:** In the atmosphere, xylenes degrade by reacting with photochemically produced hydroxyl radicals with a half-life ranging from 1-1.7 hr. in the summer to 10-18 hr in winter or a typical loss of 67-86% per day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, they volatilize and leach into groundwater. **Disposal:** As a hydrocarbon, xylene is a good candidate for controlled incineration. Contact your supplier or licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

A Designations

ARA 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): No. U239, F003 (spent solvent)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4); per RCRA, Sec. 3001]

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; or any applied-air respirator; or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. **Warning!** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.⁽¹⁰³⁾ **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. 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 clearly labelled, tightly closed, containers in a cool, well-ventilated place, away from strong oxidizing materials and heat and ignition sources. During transferring operations, electrically ground and bond metal containers. **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. Use hermetically sealed equipment, transfer xylene in enclosed systems, avoid processes associated with open evaporating surfaces, and provide sources of gas release with enclosures and local exhaust ventilation. Use Class I, Group D electrical equipment. **Administrative Controls:** Establish air and biological monitoring programs and evaluate regularly. Consider preplacement and periodic medical examinations including a complete blood count, a routine urinalysis, and liver function tests. Consider hematologic studies if there is any significant contamination of the solvent with benzene. If feasible, consider the replacement of xylene by less toxic solvents such as petrol (motor fuel) or white spirit. Before carrying out maintenance and repair work, steam and flush all equipment to remove any xylene residues.

Transportation Data (49 CFR 172.101)

Shipping Name: Xylenes	Packaging Authorizations	Quantity Limitations	Vessel Stowage Requirements
DOT Hazard Class: 3	a) Exceptions: 173.150	a) Passenger, Aircraft, or Railcar: 5L	a) Vessel Stowage: B
DOT No.: UN1307	b) Nonbulk Packaging: 173.202	b) Cargo Aircraft Only: 60L	b) Other: -
DOT Packing Group: II	c) Bulk Packaging: 173.242		
DOT Label: Flammable Liquid			
Special Provisions (172.102): T1			

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.

Prepared by: MJ Wurth, BS, Industrial Hygiene Review; PA Roy, MPH, CIH, Medical Review; W Silverman, MD

**Section 1. Material Identification**

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Toluene (C₆H₅CH₃) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.

Other Designations: CAS No. 108-88-3. Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*⁷³ for a suppliers list.

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

R	1	NFPA
I	3	
S	2*	
K	3	
* Skin absorption		
HMIS		
H	2	Chronic effects
F	3	
R	0	
PPE-See 8		

Section 2. Ingredients and Occupational Exposure Limits

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

1991 OSHA PELs8-hr TWA: 100 ppm (375 mg/m³)15-min STEL: 150 ppm (560 mg/m³)**1990 IDLH Level**

2000 ppm

1990 NIOSH RELsTWA: 100 ppm (375 mg/m³)STEL: 150 ppm (560 mg/m³)**1992-93 ACGIH TLV (Skin)**TWA: 50 ppm (188 mg/m³)**1990 DFG (Germany) MAK***TWA: 100 ppm (380 mg/m³)

Half-life: 2 hr to end of shift

Category II: Substances with systemic effects

Peak Exposure Limit: 500 ppm, 30 min

average value, 2/shift

1985-86 Toxicity Data†

Man. inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.

Human, oral, LD₅₀: 50 mg/kg; toxic effects not yet reviewed

Human, eye: 300 ppm caused irritation.

Rat. oral, LD₅₀: 5000 mg/kg

Rat. liver: 30 μmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.

† See NIOSH, RTECS (XSS250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)

Melting Point: -139 °F (-95 °C)

Molecular Weight: 92.15

Density: 0.866 at 68 °F (20/4 °C)

Surface Tension: 29 dyne/cm at 68 °F (20 °C)

Viscosity: 0.59 cP at 68 °F (20 °C)

Refraction Index: 1.4967 at 20 °C/D

Water Solubility: Very slightly soluble. 0.6 mg/L at 68 °F (20 °C)

Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.

Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)

Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0797 lb/ft³ or 1.2755 kg/m³

Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC

Autoignition Temperature: 896 °F (480 °C)

LEL: 1.27% v/v

UEL: 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluene's burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidinone. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,⁽¹⁶⁴⁾ NTP,⁽¹⁶⁵⁾ and OSHA⁽¹⁶⁴⁾ do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm²/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, dizziness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesia, and vertigo progressing to narcotic coma. May result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, transient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and alcohol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and amyotrophic lateral sclerosis (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend. **RST AID** **Eyes:** Do not allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that conscious and alert person drink 1 to 2 glasses of water to dilute. Do not induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: Urinary p-cresol in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and sorbent carbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Studies:** Blue gill, LC₅₀ = 17 mg/L/24 hr; shrimp (*Crangonfrax coroon*), LC₅₀ = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC₅₀ = 36.2 g/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **Disposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon sorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

RCRA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220

Listed as an Extremely Hazardous Substance (40 CFR 355): TPO: Not listed

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)

* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)

Listed as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 2000 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning stills, reactor vessels, or storage tanks), wear an SCBA. **Warning!** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.¹⁰³ **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric and thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Toluene

DOT Hazard Class: 3

DOT No.: UN1294

DOT Packing Group: II

DOT Label: Flammable Liquid

Special Provisions (172.102): T1

Packaging Authorizations

a) Exceptions: 150

b) Non-bulk Packaging: 202

c) Bulk Packaging: 242

Quantity Limitations

a) Passenger Aircraft or Railcar: 5L

b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements

Vessel Stowage: B

Other: --

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

ATTACHMENT 2

Site Work Zones

See Phase II ESA Work Plan

ATTACHMENT 3

Emergency Response Procedures

EMERGENCY	PROCEDURES
Injury	Administer first aid/CPR (trained personnel only) if needed and appropriate, contact hospital or emergency services. First aid only injuries or non-life threatening injuries. drive injured worker to hospital or clinic, if injuries are more than a simple band-aid.
Chemical Exposure	
Inhalation	Move to fresh air. Decontaminate and transport to hospital or local medical provider.
Skin contact	Use copious amounts of soap and water. Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Skin should also be rinsed for 15 minutes if contact with caustics, acids or hydrogen peroxide occurs.
Eye Contact	Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination.
Fire	In the event of a fire or explosion, procedures will include immediately evacuating the work area (the air horn will sound for a single continuous blast), and notification of fire department and police. No field team personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).
Vapor/Gas Release	<ol style="list-style-type: none"> 1. Evacuate the release area to an up wind location to a safe location; 2. Notify appropriate response teams and authorities; 3. If a flammable gas or vapor is involved, remove all ignition sources
Major Spill	<p>The following eight steps should be taken by the Emergency Coordinator:</p> <ol style="list-style-type: none"> 4. Determine the nature, identity and amounts of major spill components; 5. Make sure all unnecessary persons are removed from the spill area; 6. Notify appropriate response teams and authorities; 7. Use proper PPE in consultation with the ESS; 8. If a flammable liquid, gas or vapor is involved, remove all ignition sources and use nonsparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.); 9. If possible, try to stop the leak with appropriate material; and, 10. Remove all surrounding materials that can react or compound with the spill. 11. Notify client, the PESM, and the EHS Services Manager..
Off-site Emergency (e.g. Client or neighbor facility emergency)	Dial 911. Explain the nature of the emergency, your location, your name, phone number. Remember that 911 contacts the State Highway Patrol dispatcher if a cell phone is used.,
Other (Describe):	

ATTACHMENT 4

Foster Wheeler Environmental Corporation

MEDICAL DATA SHEET

The brief medical data sheet shall be completed by all on-site personnel and will be kept in the Support Zone by the HSO as a project record during the conduct of site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project: _____

Name: _____ Home Telephone: _____

Address: _____

Age: _____ Height: _____ Weight: _____ Blood Type: _____

Name and Telephone Number of Emergency Contact: _____

Drug or Other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

Provide A Check List Of Previous Illnesses: _____

What Medications Are You Presently Using? _____

Do You Have Any Medical Restrictions? _____

Name, Address, And Phone Number Of Personal Physician: _____

HAZARD ANALYSIS #1

Activity: Mobilization and Site Setup Analyzed By/Date: Roger Margotto 6/12/02 Reviewed By: Roger Margotto, CIH

Principal Steps	Potential Hazards	Recommended Controls
Set up work areas	<p>Potential exposure to chemical hazards</p> <p>Noise exposure</p> <p>Slip, trip, and fall hazards</p> <p>Sharp objects/punctures</p>	<p>Delineate exclusion zones and use PPE specified in HASP.</p> <p>Ambient air monitoring and visual observation shall be used to verify selection of PPE.</p> <p>Identify all chemical hazards and receive training (MSDS) regarding safe handling of chemicals. The ESS will file copies of all MSDSs at the site.</p> <p>Hearing protection is required when sound levels exceed 84 dBA continuously. Areas where hearing protection is required shall display warning signs requiring hearing protection.</p> <p>Work areas shall be visually inspected, and slip, trip, and fall hazards shall be marked, barricaded, or eliminated, if feasible.</p> <p>Maintain proper illumination in all work areas.</p> <p>Refer to EHS Procedure 3-8, Fall Protection.</p> <p>Wear cut-resistant work gloves when sharp edges or other objects may cause the possibility of lacerations or other injury. When possible, sharp edges will be blunted.</p> <p>Workers should not stand or walk on debris.</p>
	Strains from manually moving materials and equipment	<p>Personnel shall be directed to use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment.</p> <p>Use of hand truck shall be encouraged.</p> <p>Employees will not lift more than 50 pounds.</p> <p>Refer to EHS Procedure 3-1, Ergonomics.</p>

HAZARD ANALYSIS #1

Activity: Mobilization and Site Setup Analyzed By/Date: Roger Margotto 6/12/02 Reviewed By: Roger Margotto, CIH

Principal Steps	Potential Hazards	Recommended Controls
	<p>Exposure to extreme temperatures</p> <p>Eye hazards</p> <p>Struck by or against heavy equipment</p>	<p>Monitor for heat stress in accordance with EHS Procedure 4-6, Temperature Extremes.</p> <p>Provide fluids and rest breaks during warm weather and while wearing impermeable protective clothing.</p> <p>Safety glasses are the minimum required eye protection for all work areas.</p> <p>Wear high visibility reflective vests when exposed to vehicle traffic.</p> <p>Make eye contact with operators before approaching equipment.</p> <p>Understand and review posted hand signals.</p> <p>Traffic barricades, signs, flags, and backup spotters will be used during field activities.</p>
<p>Install barricades and other support structures</p>	<p>Power and hand tools</p> <p>Material handling</p>	<p>Inspect all tools before each use.</p> <p>Personnel will be trained in the proper use of hand tools.</p> <p>Identify and avoid pinch points.</p> <p>Maintain communication with others involved in material handling.</p> <p>Use appropriate PPE.</p>
	<p>Strains from handling materials</p>	<p>Personnel shall be directed to use proper lifting techniques such as keeping back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment.</p> <p>Use of hand trucks shall be encouraged.</p> <p>Personnel shall work at a steady pace.</p> <p>Refer to EHS Procedure 3-1, Ergonomics.</p>

HAZARD ANALYSIS #1

Activity: Mobilization and Site Setup

Analyzed By/Date: Roger Margotto 6/12/02

Reviewed By: Roger Margotto, CIH

Equipment to be Used	Inspection Requirements	Training Requirements
Heavy equipment and hand tools	Daily and before use	Only trained equipment operators may operate heavy equipment; only DMV-licensed personnel will operate trucks. Specific training for power tools, hand tools, and electrical safety.

Notes:

- dBA - decibel, A-scale
- DMV - Department of Motor Vehicles
- EHS - Environmental Health and Safety
- GFCI - ground fault circuit interrupter
- MSDS - Material Safety Data Sheet
- PPE - personal protective equipment
- ESS - Environmental Safety Supervisor

HAZARD ANALYSIS #2

Activity: Drilling Analyzed By/Date: Roger Margotto 6/12/02 Reviewed By: Roger Margotto, CIH

Principal Steps	Potential Hazards	Recommended Controls
Survey site	Slips, trips, and falls from various agents	<p>Work areas shall be visually inspected and pre-existing slip, trip, and fall hazards shall be marked, barricaded, or eliminated if feasible.</p> <p>Work areas shall be kept in an orderly state of housekeeping.</p> <p>Proper illumination shall be maintained in work areas.</p>
Drilling operations	<p>Damage to existing utilities</p> <p>Noise</p> <p>Atmospheric and contact hazards from chemical agents</p>	<p>Personnel shall contact the service facilities engineer before working on utilities.</p> <p>Contact a utility clearance service..</p> <p>Review site drawings and as-builts.</p> <p>Permit shall be obtained through the Base Civil Engineer prior to any drilling.</p> <p>Earplugs shall be worn whenever the drill rig is in operation.</p> <p>PPE shall be used.</p> <p>Ambient air monitoring and visual monitoring shall be used to verify selection of PPE.</p> <p>Proper decontamination of drilling implements shall be performed after use.</p> <p>All soil cuttings shall be properly drummed and labeled.</p> <p>All PPE shall be placed in a separate, properly labeled container.</p>

HAZARD ANALYSIS #2

Activity: Drilling Analyzed By/Date: Roger Margotto 6/12/02 Reviewed By: Roger Margotto, CIH

Principal Steps	Potential Hazards	Recommended Controls
	<p>Injury from use of drilling equipment</p>	<p>Drilling equipment shall be inspected before each use. Personnel shall have been trained in the use of drilling equipment. Underground utilities and utility companies must be notified prior to drilling. Boom must not come closer than 15 feet from overhead facilities. Personnel shall maintain appropriate work/rest cycles to minimize fatigue. Loose protective clothing shall be restrained with duct tape to prevent entanglement in moving parts. Hands shall not be put in areas where parts are moving except as required for drill operation. Drill rig shall be moved with the boom down. Refer to EHS 6-2.</p>
	<p>Strains from manually moving materials, equipment, and drums</p>	<p>Personnel shall be directed to use proper lifting techniques such as keeping back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Mechanical equipment shall be used as much as possible.</p>

HAZARD ANALYSIS #2

Activity: Drilling Analyzed By/Date: Roger Margotto 6/12/02 Reviewed By: Roger Margotto, CIH

Equipment to be Used	Inspection Requirements	Training Requirements
Drilling rig, hand tools, and power tools	Daily or before use	Only trained equipment operators may operate heavy equipment; only DMV-licensed personnel will operate trucks.

Notes:

DMV – Department of Motor Vehicles
 PPE – personal protective equipment

Principal Steps	Potential Hazards	Recommended Controls
Collecting soil and groundwater samples	<p>Back strains</p> <p>Exposure to chemical contaminants</p> <p>Slips, trips, and falls</p> <p>Strains from use of tools such as shovels, extension poles, and hand augers</p>	<p>Follow EHS Procedure 3-1, Ergonomics.</p> <p>Avoid prolonged repetitive motion. Rotate job tasks with other workers when shoveling or using hand augers.</p> <p>Use pivot and shift technique when shoveling soil into containers.</p> <p>Get help or use mechanical lifting devices for heavy loads.</p> <p>Wear required PPE and respiratory protection as specified in the SHSP.</p> <p>Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection.</p> <p>Remove PPE properly and wash hands.</p> <p>Maintain good housekeeping as per EHS Procedure 3-8, Fall Protection.</p> <p>Mark or remove all identified trip and slip hazards.</p> <p>Maintain proper illumination in work areas.</p> <p>Inspect all tools for damage before use.</p> <p>Do not use damaged tools. Tag damaged tools as "out of service".</p> <p>Maintain steady pace, and follow the rest periods given on the job.</p> <p>Rotate job tasks among personnel so that no one person is performing the same task for an extended period of time.</p> <p>Use appropriate tools for the task, and maintain in good condition.</p>

Principal Steps	Potential Hazards	Recommended Controls
Sample handling	Atmospheric and contact hazards from contaminated soil or water	Wear required PPE and respiratory protection. Selection of PPE and respiratory protection will be determined by visual inspection and ambient air monitoring. Decontaminate exteriors of sample containers. Avoid spills. Ensure spill cleanup supplies are available.

Equipment to be Used	Inspection Requirements	Training Requirements
Hand tools	Daily and before use	Specific training for hand tools

Notes:

- EHS - Environmental Health and Safety
- PPE - personal protective equipment
- SHSP - Site-Specific Health and Safety Plan